LATVIA'S

NATIONAL INVENTORY REPORT

Submitted under United Nations Convention on Climate Change

Common Reporting Formats (CRF)
1990 – 2005

2007

Data sheet

Title: Latvia's National Inventory Report for 1990-2005 – submitted under the United Nations Convention on Climate Change

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ABBREVIATIONS

CRF – Common Reporting Format
CSB – Central Statistical Bureau of Latvia
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
FEWE – Polish Foundation for Energy Efficiency
GHG – Greenhouse Gases
IPCC – Intergovernmental Panel on Climate Change
IPCC 1996 – Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories (1997)
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 (2003)
LEGMA – Latvian Environment, Geology and Meteorology Agency
LSIAE – Latvian State Institute of Agrarian Economics
LULUCF – Land Use, Land Use Change and Forestry
MoA - Ministry of Agriculture
MoE - Ministry of Environment
MoT - Ministry of Transport
NCV – Net calorific value
NIR – National inventory report
OECD - Organisation for Economic Co-operation and Development
REB – Regional Environment Boards
RTSD – Road Traffic Safety Department
SFRS – State Fire fighting & Rescue Service
SFS – State Forest Service
UN – United Nations
UNFCCC – United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

ES.1 Background Information

Latvia takes part in the global climate change mitigation process and together with many other countries, of the world signed the United Nations (UN) Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro the UN Conference on Environment and Development held in 1992. It entered into force on 21 March 1994. The Parliament of the Republic of Latvia (Saeima) ratified the UNFCCC on 23 February 1995 [21].

As a party to the UNFCCC Latvia is required to produce and regularly update national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by Montreal Protocol.

Latvia is a member of Europe Union since May, 2004 and Latvia's climate change policy is based on Europe Union climate policy therefore according to Commission decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing Kyoto Protocol article 3 (1) Member States shall report information regarding their anthropogenic GHG emissions.

Latvian GHG inventory contains updated information on anthropogenic emissions by sources and removals by sinks for the direct CO_2, CH_4, N_2O, HFCs and SF_6 and indirect CO, NO_x, SO_2, NMVOC greenhouse gases. Greenhouse gas inventory covers the years 1990-2005. For the preparation of the 2007 inventory CRF Reporter v.3.1 software has been used. The NIR includes a description of the methodologies and data sources used for estimating emissions by sources and removals by sinks, and description of their trends.

The GHG inventory is prepared according to the UNFCCC "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (following incorporation of the provisions of decision 13/CP.9) "(FCCC/SBSTA/2004/8).

Greenhouse gas inventory is compiled due to the methodologies recommended by the Intergovernmental Panel on Climate Change (IPCC).

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 (NO_x, CO, NMVOC) emissions, as well as emissions of SO_2. Greenhouse gas inventory covers the years 1990-2005. Estimated GHG emissions for 1990, 1995 and 2000 – 2005 is presented in Table 1, which shows GHG emissions by sectors, expressed in CO_2 equivalent.

Table 1 Aggregated GHG emissions (1990, 1995, 2000 - 2005)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2001	2002	2003	2004	2005
	CO$_2$ equivalent (Gg)							
CO_2 emissions including net CO_2 from LULUCF	-1 555.12	-8 614.66	-7 150.76	-6 729.03	-5 746.96	-6 113.69	-6 439.38	-6 895.97
CO_2 emissions excluding net CO_2 from LULUCF	19 135.93	9 073.63	7 021.10	7 496.36	7 422.12	7 562.42	7 502.32	7 573.79
CH_4 emissions including CH4 from LULUCF	3 511.77	2 069.76	1 811.47	1 882.74	1 897.42	1 802.46	1 791.84	1 834.45
CH_4 emissions excluding CH_4 from LULUCF	3 492.94	2 034.66	1 755.28	1 848.07	1 859.28	1 765.55	1 758.42	1 799.81
N_2O emissions including N_2O from LULUCF	3 815.47	1 378.55	1 269.87	1 389.59	1 383.86	1 458.81	1 436.71	1 482.97
N_2O emissions excluding N_2O from LULUCF	3 813.56	1 374.96	1 264.04	1 385.81	1 379.35	1 454.28	1 432.95	1 479.73
HFCs	IE,NA,NE,NO	0.29	8.59	9.81	11.83	12.95	16.24	19.12
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
SF_6	NA,NE,NO	0.25	1.28	1.98	3.38	4.41	5.37	7.53
Total (including LULUCF)	**5 772.12**	**-5 165.81**	**-4 059.56**	**-3 444.92**	**-2 450.48**	**-2 835.07**	**-3 189.23**	**-3 551.90**
Total (excluding LULUCF)	**26 442.42**	**12 483.80**	**10 050.28**	**10 742.02**	**10 675.96**	**10 799.62**	**10 715.30**	**10 880.00**

1. Energy	19 239.67	9 495.53	7 328.38	7 808.49	7 733.11	7 834.36	7 801.36	7 869.07
2. Industrial Processes	525.29	167.86	201.54	220.54	236.79	246.58	255.40	276.74
3. Solvent and Other Product Use	55.70	46.17	49.11	55.16	53.41	54.07	55.32	54.23
4. Agriculture	5 939.00	2 129.28	1 728.06	1 868.80	1 864.65	1 906.87	1 857.79	1 921.02
5. Land Use, Land-Use Change and Forestry	-20 670.30	-17 649.61	-14 109.84	-14 186.94	-13 126.44	-13 634.68	-13 904.53	-14 431.89
6. Waste	682.76	644.97	743.19	789.03	788.00	757.73	745.43	758.94
Total (including LULUCF)	**5 772.12**	**-5 165.81**	**-4 059.56**	**-3 444.92**	**-2 450.48**	**-2 835.07**	**-3 189.23**	**-3 551.90**

Between 1990 and 2000 GHG emissions decreased significantly as reason of crisis in Latvian national economy in the beginning of 1990-ties.

In 2005, Latvia's total GHG emissions without LULUCF showed a decrease of 59 % from the base. Emissions have risen by about 1.5 % compared to the total GHG emissions in 2004.

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.

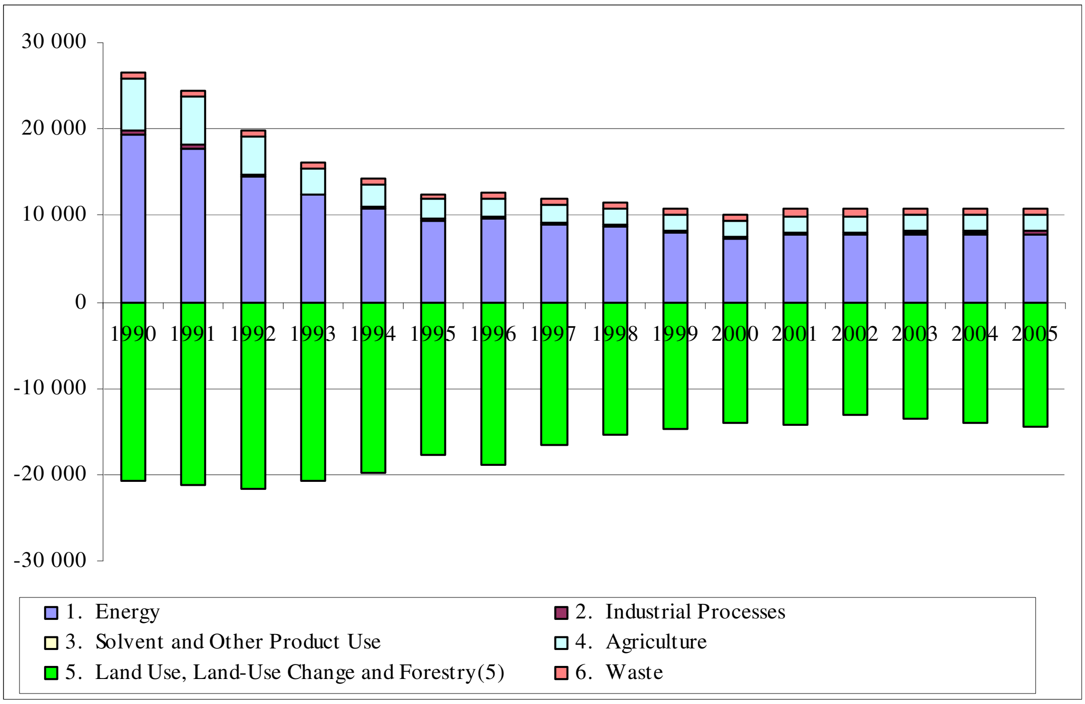


Figure 1 Latvia's greenhouse gas emission trends by sector (Gg CO_2 eqv.)

The **Energy sector** is the most significant source of GHG emissions with over 72.3% share of the total emissions in the 2005. 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 is 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 27.5% of total CO_2 equivalent emissions and 37.9% of total CO_2 equivalent Energy sector emissions. Emissions from this sub-sector rose by 3.2% 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 18% 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 68% 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. Since year 2000, CO_2 equivalent emissions from Industrial Processes sector has a slightly increasing tendency. It is 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.

GHG emissions from **Waste sector** have been increased since 1990. In 2005, emissions were 11.15% higher than in 1990. In 2005, emissions from the Waste sector were 758.94 Gg CO_2 equivalents; it contributes about 6.98% of total GHG emissions (excluding LULUCF). Emissions from Solid Waste Disposal (SWD) and Wastewater Handling (WWH) in 1990 do not have big difference. In 1993, methane collection from wastewaters was started and emissions from wastewaters decreased. Every year emissions from waste disposal on land increased equable, because First Order Decay (Tier 2) method for calculations is used and methane collection and recovery in landfills is not yet well developed.

Land use, Land use change and forestry (LULUCF) is a net sink in Latvia. In 2005, CO_2 removals were 14431.89 Gg CO_2 compared to 20670.3 Gg CO_2 in the base year, that is, 30.2% lower than in 1990.
In 2005, the main sink is Forest land with net removals of 14140.85 Gg CO_2.

ES.4 Overview of emission estimates and trends of indirect GHG and SO_2

Emission estimates of indirect GHG and SO_2 are presented in Table 2.

Table 2 Emissions of indirect GHG and SO_2, Gg

	NOx	CO	NMVOC	SO2
1990	66.55	382.21	94.34	99.69
1991	60.96	328.72	65.84	82.25
1992	51.30	307.59	60.18	70.15
1993	44.92	316.44	58.48	66.61
1994	42.26	315.39	59.25	66.07
1995	39.96	320.81	59.53	47.82
1996	40.17	331.77	61.60	53.94
1997	39.80	322.05	62.71	38.67
1998	40.04	319.75	62.13	35.24
1999	39.23	321.23	62.93	28.75
2000	37.64	320.43	57.92	9.66
2001	38.24	326.53	56.85	7.80
2002	38.52	327.19	59.43	6.22
2003	39.76	324.34	59.69	4.81
2004	40.33	337.54	61.09	3.85
2005	41.14	336.43	62.99	3.58

In the period from 1990 to 2000 indirect emissions have decreased, but starting from 2001 NO_x, NMVOC and CO started to grow as a reason of increasing wood fuel consumption in Residential sector as well as fuel consumption in Transport sector. SO_2 emissions have decreased significantly as reason of fuel switch and approved legislation.

1. INTRODUCTION

1.1 Background Information on Climate Change Policy and Greenhouse Gas Inventories

Latvia is a country by the Baltic Sea with total area of 64 589 square kilometres and there are 2 306 600 (2005) inhabitants. Baltic coastline is approximately 496 km. 45.2% of Latvia's territory is covered by forest, 38.1% of territory is used for agriculture, but 16.8% includes other land, roads, courtyards, bogs, and bushes (data on 01.01.2006). Latvia lies in a temperate climate zone where active cyclone determines rapid changes in weather conditions (190-200 days per year). Annual mean precipitation is 600-700 mm. Main minerals in Latvia are clay, dolomite, sand, gravel, limestone and gypsum [21].

Since restoration of independence in 1991 economy of Latvia had experienced very significant changes. From 1990-ties Latvia starts up a transition from a centrally planned economy to market based economy. It arises in decreasing of economical activities in all branches. Over that time period GDP decreased approximately by 50%. In 1994, increase of GDP was noticed, but in 1995 it decreased due to the crisis of bank sector. Since 1996, economy of Latvia started to grow [25].

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 in 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".

Latvia is a member of EU since May, 2004 and Latvia's climate change policy is based on Europe Union climate policy. Ministry of Environment, Climate and Renewable Energy Department coordinate policy related to climate change and renewable energy in Latvia.

As a party of the UNFCCC and European Union Latvia is required to produce and regularly update 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 and submit to the UNFCCC Conference of the Parties, European Commission and European Environment Agency.

"Climate change mitigation programme for 2005-2010" is approved by the Cabinet of Ministers of the Republic of Latvia (Ordinance No 220, 06.04.2005). The goal of programme is to ensure that starting from 2008 the total GHG emission will not exceed 92% from level of 1990.

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.

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.

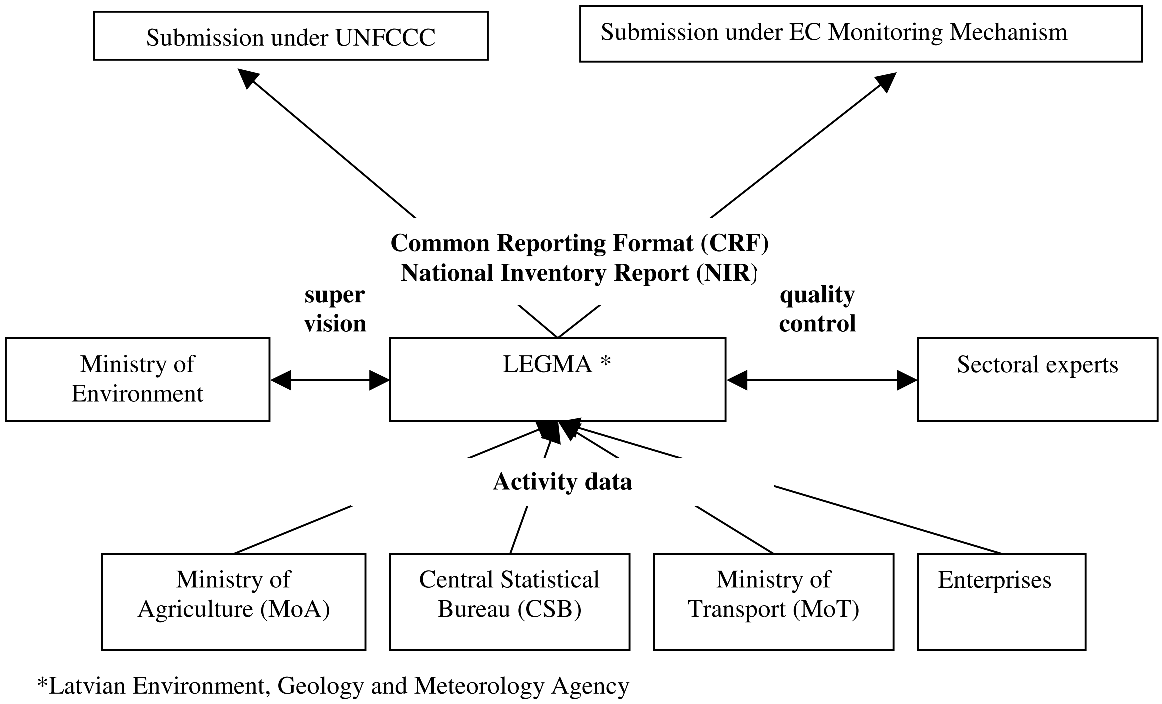


Figure 1.1 National Inventory system of Latvia

The single entity responsible for the establishment of the yearly GHG inventory and it's submission to European Commission and UNFCCC is the Ministry of Environment (MoE), Climate and Renewable Energy Department.

LEGMA is a governmental institution under the supervision of the MoE and is responsible for preparing GHG inventory, including compilation of results, data management and archiving and QA/QC procedures.

Activity data is mainly collected from other institutions and is used by LEGMA to calculate emissions. This is done at the Division Environmental Pollution of LEGMA. Before GHG inventory are reported to European Commission and UNFCCC secretariat it is forwarded to the MoE for final approval.

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 and removal 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 institutions
Table 1.A(a) - Fuel Combustion Activities (Sectoral Approach)	Activity data	CSB, MoT
	Calculations	LEGMA
Table 1.A(b) – CO_2 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	CSB; MoA
	Calculations	MoA; LEGMA
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. Final data regarding fuel consumption was received until 30 of November when CSB prepared Energybalances for EUROSTAT according to additional agreement.

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

1.3 General description of methodologies and data sources

Latvia's GHG emissions inventories are based on the Revised 1996 Guidelines for National

Greenhouse Gas Inventories (1997), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) and Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003) and EMEP/CORINAIR Emission Inventory Guidebook – 3rd editions (2002) according to the UNFCCC recommendations for inventories.

The main sources for emission factors are:

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

The updated CRF Reporter version 3.10 is used for data compiling. 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 were used.

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.

A Tier 2 method was 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 to 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 2003 was used to estimate emissions from LULUCF sector.

IPCC GPG 2000 was 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 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; Research of experts	LEGMA
Industry	National production and sale statistics; Direct information from enterprises operating with pollutants; Chemicals Register; 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; LEGMA
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 (2005) and the trend of emissions (change between 1990 and 2005) or both. Level Assessment identify source category whose level has a significant effect on total national emissions. Trend Assessment identifies sources that are key because of their contribution to the total trend of national emissions.

It is important to identify key source categories so that the resources available for inventory preparation may be prioritised and the best possible estimates prepared for the most significant source categories.

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 identification is divided in two parts, key sources excluding LULUCF and key sources including LULUCF source categories. The starting point for the choice of source categories without LULUCF is the list 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 base year for CO_2, CH_4, and N2O greenhouse gas emissions was 1990, but for some categories base year is taken the year when this source category is estimated or observed for the first time. For Other mineral products (CO_2) and Grassland (CH_4, N_2O) the base year is 1993, for Solvent and Other Product Use (N_2O), Electrical equipment (SF6) and Consumption of HFCs (HFCs) base year is 1995, from Waste incineration (CO_2) – 1999, Soda Ash production and use (CO_2) – 2000 and from Compost production (CH_4, N_2O) the base year is 2003.

Key source categories are those which, when summed together GHG emissions calculated in CO_2 equivalent units in descending order of their magnitude, add up to over 95% of the total emissions estimates in the inventory for each year.

12 key sources of Level Assessment without LULUCF were identified in 1990 and 11 with LULUCF, but in 2005 without LULUCF – 14 and with – 12. The key sources identified according to trend assessment without LULUCF was 14, but with LULUCF – 13.

The key sources for 2005 with 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 2005 with LULUCF

IPCC Source Categories	Direct GHG	2005, CO_2 eqv. Gg	Level Assessment, %	Cumulative, %
Removals from Forest Land	CO_2	-14140.85	0.56	0.56
Emissions from Stationary Combustion-gas	CO_2	3156.48	0.12	0.68
Mobile Combustion: Road Vehicles	CO_2	2585.52	0.10	0.78
Emissions from Stationary Combustion-oil	CO_2	913.97	0.04	0.82
Emissions from Agricultural Soils	Direct-N_2O	721.15	0.03	0.85
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	577.51	0.02	0.87
Emissions from Solid Waste Disposal Sites	CH_4	496.88	0.02	0.89
Removals from Grassland	CO_2	-387.07	0.02	0.91
Emissions from Stationary Combustion-coal	CO_2	298.39	0.01	0.92
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	283.23	0.01	0.93
Emissions from Stationary Combustion-biomass	CH_4	260.29	0.01	0.94
Mobile Combustion: Railways	CO_2	255.04	0.01	0.95

Table 1.4 Key sources -Trend assessment in 2005 with LULUCF

IPCC Source Categories	Direct GHG	Base year, CO_2 eqv. Gg	2005, CO_2 eqv. Gg	Level Assessment %	Trend Assessment	Contribution to trend, %	Cumulative, %
Removals from Forest Land	CO_2	-20666.28	-14140.85	0.56	0.22	0.27	0.27
Emissions from Stationary Combustion-oil	CO_2	7300.20	913.97	0.04	0.22	0.27	0.53
Mobile Combustion: Road Vehicles	CO_2	2396.66	2585.52	0.10	0.09	0.11	0.65
Emissions from Stationary Combustion-coal	CO_2	2826.08	298.39	0.01	0.09	0.11	0.76
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057.23	577.51	0.02	0.04	0.05	0.80
Emissions from Solid Waste Disposal Sites	CH_4	278.79	496.88	0.02	0.03	0.03	0.83
Removals from Grassland	CO_2	-192.99	-387.07	0.02	0.02	0.03	0.86
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	1033.87	283.23	0.01	0.02	0.02	0.88
Emissions from Stationary Combustion-gas	CO_2	5488.89	3156.48	0.12	0.01	0.02	0.90
Emissions from Agricultural Soils	Direct-N_2O	1658.35	721.15	0.03	0.01	0.02	0.92
Emissions from Stationary Combustion-biomass	CH_4	167.29	260.29	0.01	0.01	0.02	0.93
Emissions from Manure Management	N_2O	551.63	153.43	0.01	0.01	0.01	0.95
Emissions from Manure Management	CH_4	279.52	83.39	0.00	0.00	0.01	0.951

1.5 Uncertainties

Uncertainty estimates are an essential element of a complete emissions inventory. Uncertainty information is not intended to dispute the validity of the inventory estimates, but to help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice.

The uncertainty estimate of the inventory 2007 has been done 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, because there is a lack of the information about background data to make actual calculations. 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, e.g. CO_2, CH_4, N_2O and F-gases only.

The overall uncertainty is calculated to be approximately 5.1% and the trend uncertainty is 2.1%. The Tables 1; 2; 3 in the Annex 2 show the uncertainties separate for each direct GHG. The overall uncertainty for CO_2 is 3.4%, for CH_4 – 16% and for N_2O – 28%. The trend uncertainty is calculated for CO_2 – 1.3%, for CH_4 – 8% and for N_2O – 13%. 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 2008.

1.6 Quality Assurance and Quality Control

The implementation of Quality Assurance and Quality Control (QA/QC) procedures in the development of national GHG inventory is required by IPCC GPG 2000.

LEGMA is responsible for coordination of the process of annual greenhouse gas inventory, and also for development and implementation of the QA/QC plan.

QC activities were carried out at the various stages of the inventory compilation process:

- processing,
- handling,
- documenting,
- cross-checking,
- recalculations.

These activities are implemented by sector experts and inventory compiler.

QA/QC program is developed and will be approved by Director of LEGMA. The QA/QC program consists of aims related GHG inventory, QA/QC plan and defined responsibilities. The plan includes Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000.

QC system includes various activities aimed to ensuring transparent data flow through all inventory process. The general QC checks include:

- Assumptions and criteria for the selection of activity data and emission factors are documented;
- Transcription errors in data input and reference;
- Correctness of calculations of emissions;
- Correctness of emission parameters, units, conversion factors;
- Integrity of database files;
- Consistency in data between source categories.

Every annual inventory is archived.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process.

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.

The Table 1.5 shows the Latvia's data submission completeness. For submission 2007 completeness was assessed by taking into account sub-sectors. In Energy the completeness compared to last submission has is the same, in Industrial Processes it has grown by 2%, in Solvents is the same, in Waste sector by 9%, in LULUCF decreased by 4% and in Agriculture there are now changes regarding completeness. The overall inventory completeness has improved by 4%. Detailed information about changes in inventory is explained in each sector's description.

Table 1.5 Completeness in submission 2007

Sector	Submission 2006 2004		Submission 2007 2005	
	NE	Completeness	NE	Completeness
Energy	23	89%	23	89%
Industrial Processes	17	89%	14	91%
Solvents	4	67%	4	67%
Agriculture	28	66%	28	66%
LULUCF	50	23%	58	19%
Waste	19	57%	15	66%
Total	**141**	**71%**	**142**	**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).

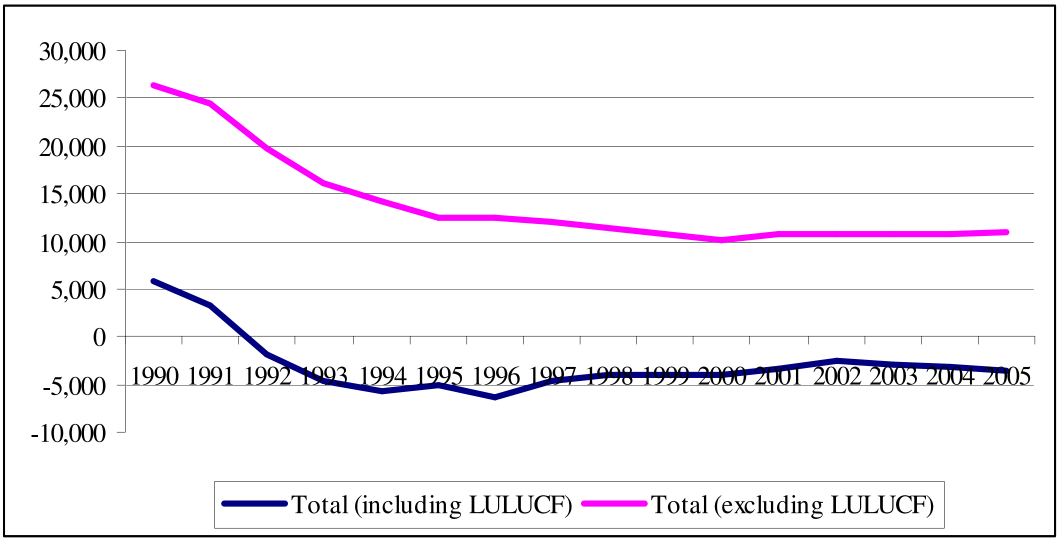


Figure 2.1 Latvia's aggregated greenhouse gas emissions in 1990-2005 (Gg CO_2 eqv.)

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 2005, Latvia's total greenhouse gas emissions were 10880 Gg in CO_2 equivalents. This was about 59 % 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 level. Figure 2.2 shows the trend in CO_2 equivalent emissions compared to the emission target of the Kyoto Protocol.

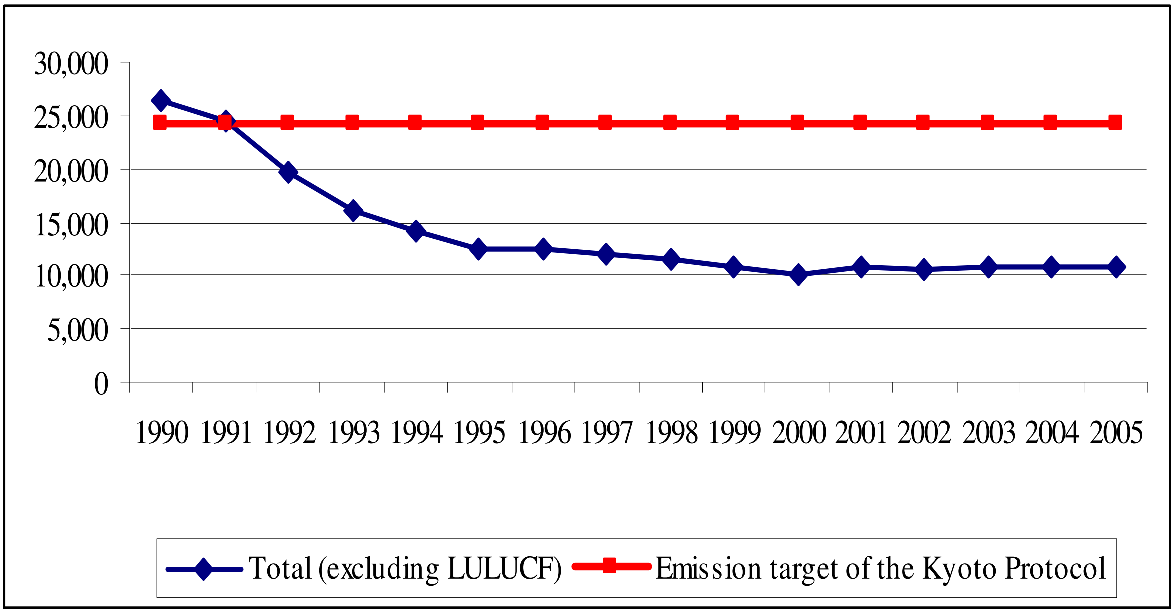


Figure 2.2 Trends in Gg CO_2 eqv. emissions and emission target of the Kyoto Protocol

2.2 Description of emission trends by gas and source

In the Annex 3, Tables 1; 2; 3; and 4 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 2005, CO_2 emissions contribute 69.6% of Latvia's total greenhouse gas emissions. In 2005, total CO_2 emissions had decreased by approximately 60.4% since 1990.

The most important source of CO_2 emissions (Gg) in 2005 was fossil fuel combustion – 96.02%, including Energy Industries – 27.3%; Manufacturing Industries and Construction – 14.99%; Transport – 38.1%, Other sectors (Agriculture, Forestry, etc.) – 15.6%.

Other anthropogenic emission sources of CO_2 are Industrial Processes – 3.3%, Solvent and Other Product Use approximately 0.68% and tilling and liming of agricultural lands – 0.77%. CO_2 removals take place by green plants absorbing CO_2 in the process of photosynthesis. In 2005 forests in Latvia removed 14 527.9 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 2005 contribute approximately 16.9% of total GHG emissions. The methane emissions (Gg) decreased by 48.5% in 2005 since 1990.

Agricultural soils are the main source of N_2O emission in Latvia generating 74.8% of all N_2O emissions (Gg) in 2005. 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. Since 1990, total N_2O emissions had decreased by 61.2% in 2005, mainly due the decrease in the emissions from agriculture.

Emissions from HFCs and sulphur hexafluoride (SF_6) consumption are reported for the period 1995-2005. Total HFCs emissions (Gg CO_2 eqv.) increased by 15.1% in 2005 compared with 2004. The biggest emission source is HFC-134a from Mobile air-conditioning and contributes 89.1% from total HFCs emissions. SF_6 emissions only from electrical equipment are reported and contribute 7.53 Gg CO_2 eqv. in 2005. 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.

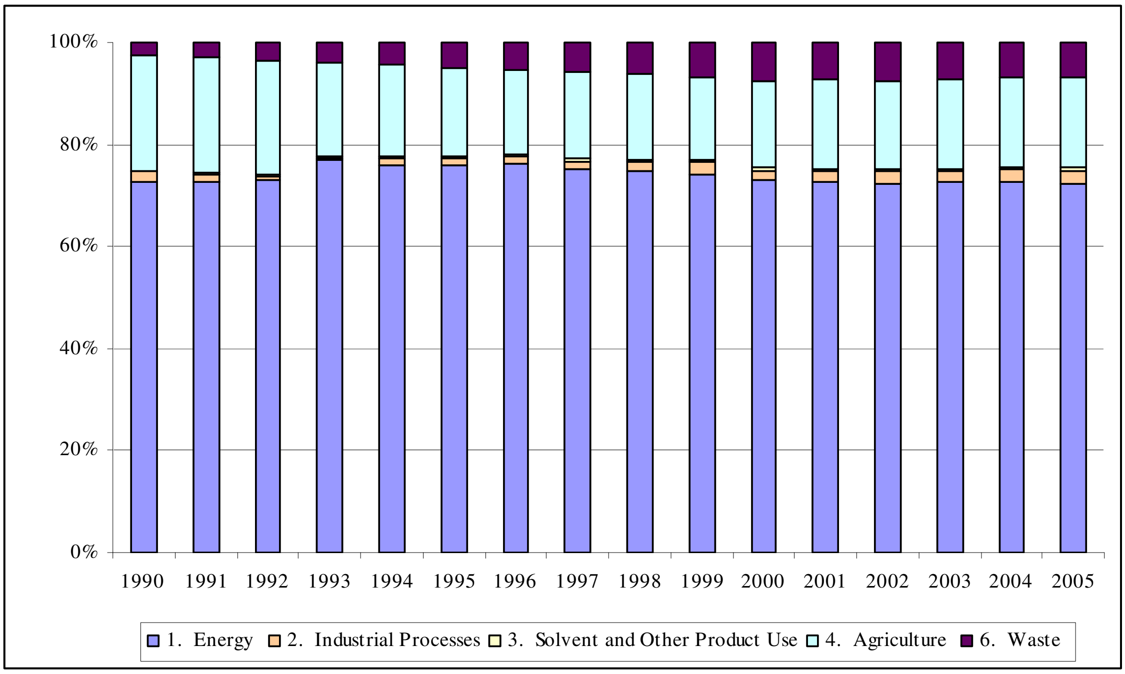


Figure 2.3 Latvia's greenhouse gas emissions by source 1990–2005 excluding LULUCF

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.

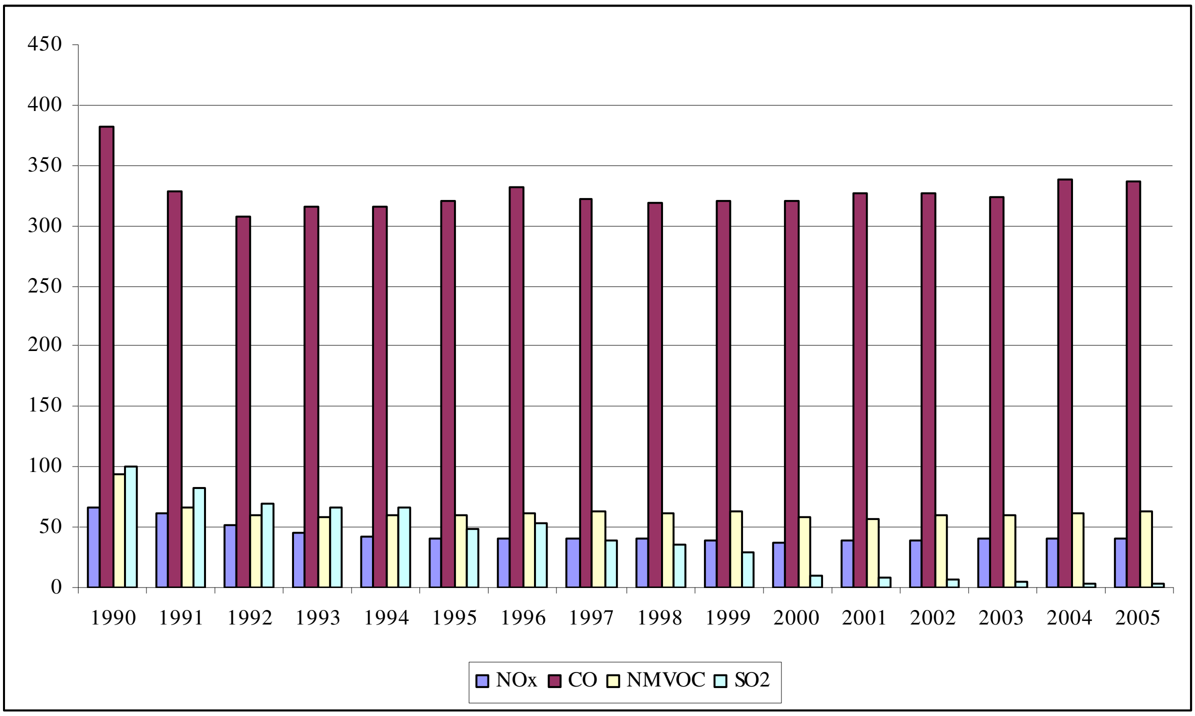


Figure 2.4 Total indirect greenhouse gas emissions trend 1990-2005 (Gg)

In 2005, the sulphur **dioxide emissions** were 3.6 Gg from which 94.5% originated in the Energy sector, where Energy Industries generated 31.5%, but Other sectors 36.9% of total SO_2 emissions.

Nitrogen oxides were generated generally in the Energy sector 91.2% and 7.7% in the Industrial Processes. In 2005, the total emissions were 41.1 Gg. The Transport sector was responsible for 52.5% of the total emissions. Energy Industries, Manufacturing Industries and Construction as well as Other sectors generated 15.6%, 10.2% and 12.8% of the total emissions, respectively.

In 2005, **Carbon monoxide** emissions were 336.4 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 63.7% and Transport 21.5%.

In 2005, total emissions of **non-methane volatile organic compounds** were 62.99 Gg from which Energy sector generated 55% (Other sectors contribute 72.7%, but Transport 23.1% emissions from total energy emissions), Solvent and Other Product Use approximately 26.1%, but Industrial Processes 18.9%.

3. ENERGY (CRF 1)

3.1 Overview of sector (CRF 1)

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 [16].

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

Consumption of Energy Resources	1990	1995	2000	2004	2005
Energy consumption – total	**327.3**	**187.1**	**164.4**	**189.3**	**194.4**
of which:					
Natural gas	99.5	41.3	45.1	55.3	56.8
Light fuel products and other oil products	84.0	39.6	42.4	53.9	54.5
Heavy oil, shale oil	61.1	36.1	11.9	3.9	3.3
Coal	26.0	7.2	2.8	2.6	3.1
Peat, coke and other types of solid fuel	4.4	4.5	2.7	0.6	0.5
Firewood and other wood products	27.5	44.2	46.5	57.4	59.4
Electrical power (HPPs, wind generators)	24.8	14.1	13.0	15.7	16.9

* Source: CSB and Ministry of Economics

The use of natural gas as a primary energy resource has grown increasingly since middle of the 90ties. The largest consumers of natural gas are combined heat and power plant (CHP) and heat generation enterprises as well as industrial enterprises.

Oil products have an important place in the Latvian energy resource market; their market share is about 29.7%, including heavy fuel with about 1.7%. The biggest consumers of heavy oil are public heat and electricity supply (65.4%) and industry (14%). Its' consumption is basically concentrated in the biggest cities. 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 (countries of former Union of Soviet Socialist Republics) 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, enterprises reported these data in quite small amount. Use of peat is decreasing. Total share of solid fuels in national market is quite low – approximately 1.9%.

Biomass fuels are firewood, wood remains and biogas. In the total fuel consumption the share of firewood and other wood products is quite substantial and has reached to 30.6% in 2005 by the side of 1990 when firewood consumption was only about 8.8% from total energy consumption. The biggest users of firewood are households – 48.9%, industry (including autoproducers and mainly wood processing companies) – 18.9%, other consumers – 15.8% and public heat and electricity supply companies – 13.1%.

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		2004		2005	
	Electricity	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**
Production	23933	99439	14324	46112	14890	31867	16880	31093	17658	31144
Own use and losses	6883	15171	6372	8215	5202	7160	4975	6512	4766	6124
Import	25700	NO	9529	NO	7589	NO	9839	NO	10278	NO
Export	12798	NO	1408	NO	1159	NO	2290	NO	2545	NO
Final consumption										
CRF 1.A.2.	13842	32929	6689	1969	6538	659	7355	608	7506	684
CRF 1 A.3.	918	NO	677	NO	547	NO	500	NO	533	NO
CRF 1.A.4.	17806	51339	10501	35928	10663	24048	13388	23973	14342	24336
TOTAL	**32566**	**84268**	**17867**	**37897**	**17748**	**24707**	**21244**	**24581**	**22381**	**25020**

Emissions from fuel combustion comprise all in-country 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 2005 (Figure 3.1.1).

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 is explained with increasing number of vehicles in Latvia and wherewithal CO_2 emissions from Transport sector as well as GHG emissions from industry have increased due to development of industrial production. Transport is the most important Energy sub–sector with 37.96% of total CO_2 eqv energy emissions and 39.7% of total CO_2 Gg energy emissions. GHG emissions from Transport sector rose by 3% compared to last year.

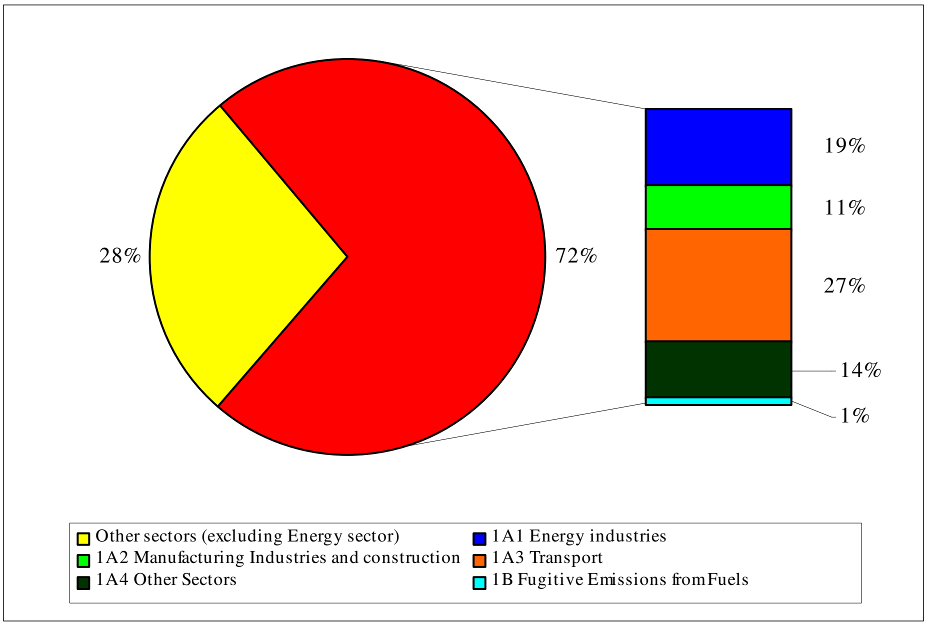


Figure 3.1.1 Emissions from the Energy sector in 2005

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 – 2005 by subcategories and gases (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
A Fuel combustion																
CO_2,	18 555.0	17 089.4	13 785.1	11 687.7	10 140.1	8 864.7	8 934.4	8 382.4	8 001.4	7 361.5	6 782.4	7 238.6	7 152.8	7 284.8	7 219.0	7 272.2
CH_4	12.2	13.6	12.3	13.0	12.9	13.7	14.1	13.4	13.0	12.9	12.1	13.2	13.1	12.9	13.7	13.5
N_2O	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
B Fugitive emissions from fuels																
CH_4	13.1	12.6	11.5	11.0	10.7	10.4	10.1	9.4	9.0	8.6	7.9	7.7	8.0	6.3	6.2	6.9

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

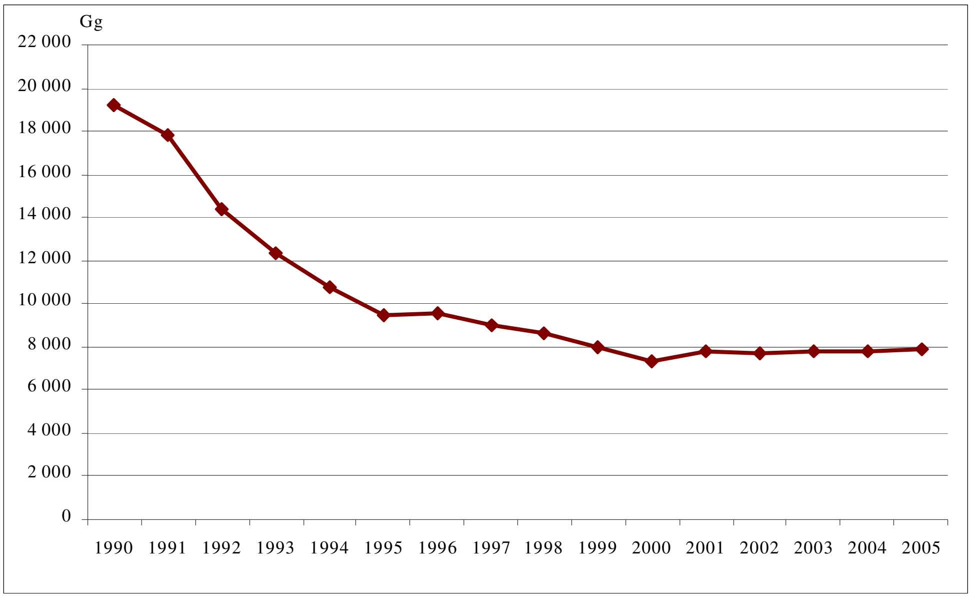


Figure 3.1.2 GHG emissions from Energy sector 1990 – 2005 (Gg CO_2 eqv)

It is seen that emissions expressed in CO_2 equivalents in 1.A Energy sector decreased year by year till 2000. Decrease of emissions dependent from economical and social situation in the 1990-ties. Since 2000, fuel consumption as well as emissions from fuel combustion has increased due to development of national economy.

CO_2 emissions from fuel combustion were 7 272.2 Gg (including Transport sector) and accounted 96% of the total emissions in 2005.

CH_4 emissions from fuel combustion were 13.5 Gg (including Transport sector). The biggest part of CH_4 emissions contributes Other sectors - 12.2 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 it was noticed by 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 0.5 Gg (including Transport sector) and accounted 11.3% of the total N_2O emissions in 2005.

Emissions from fuel combustion are presented in the Figure 3.1.3.

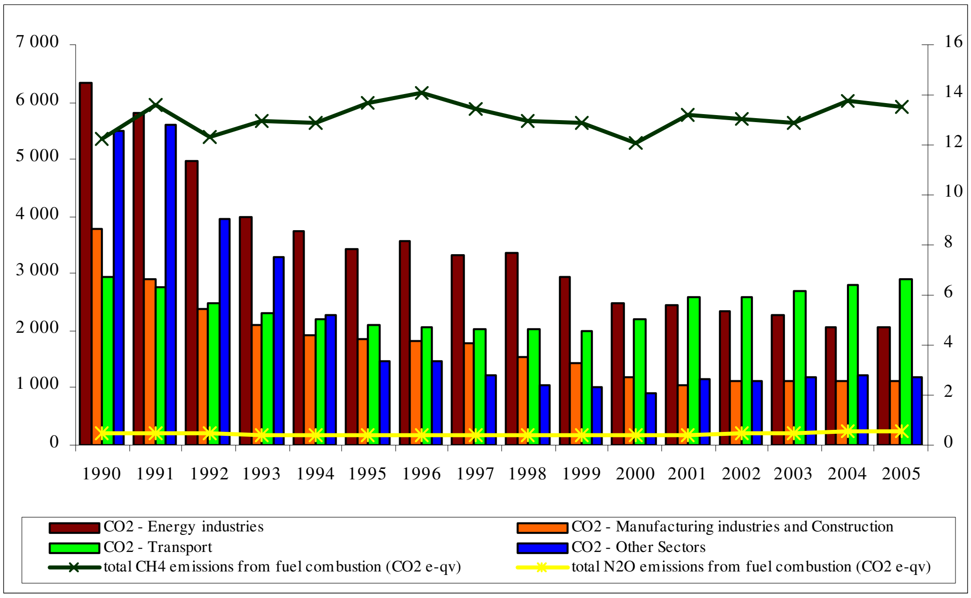


Figure 3.1.3 Total direct GHG emissions from fuel combustion in 1990 – 2005 (Gg)

The following indirect greenhouse gases NO_x, CO, NMVOC, SO_2 are calculated. Total emissions from Energy sectors for 1990 – 2005 are presented in Figure 3.1.4.

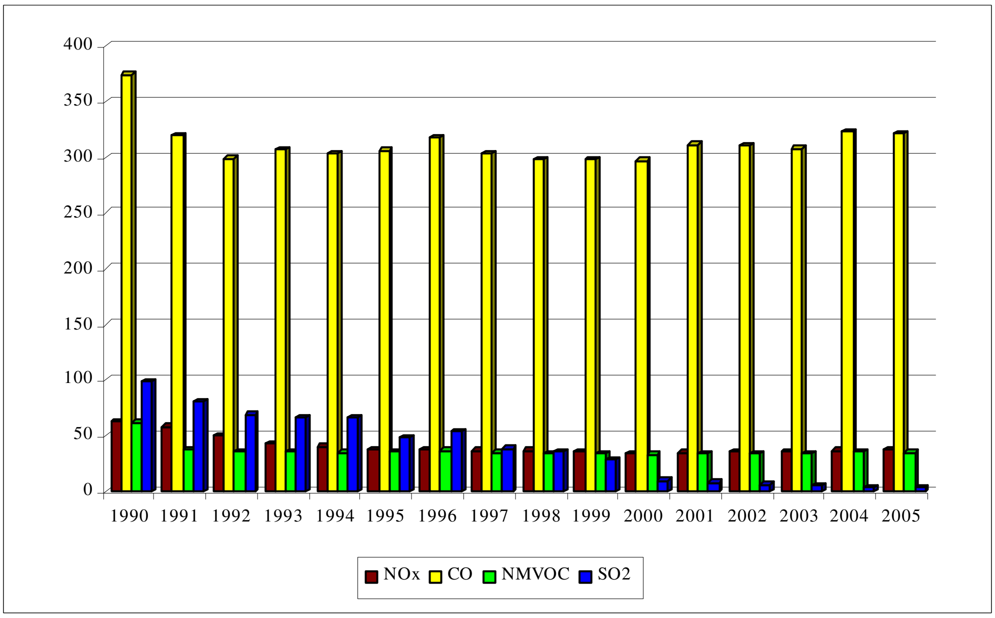


Figure 3.1.4 Total indirect GHG emissions from fuel combustion in 1990 – 2005 (Gg)

In 2005, the largest part of indirect emissions contributes CO, but then NO_x and NMVOC emissions. Most CO and NMVOC emissions come from wood combustion in the Residential sector. The biggest decrease is observed in SO_2 emissions where emissions decreased from almost 100 Gg in 1990 to 3.38 Gg emissions in 2005. It is explained by changes in type of fuels combusted in Energy sector as well as with rules of national legislations for sulphur content in liquid fuels used for transport.

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)

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

3.2.1 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. There are 4 key source categories of stationary fuel combustion with respect to Level assessment – CO_2 emissions from natural gas – 12%; liquid fuels – 4%; and solid fuels combustion – 1%; as well as CH_4 emissions from biomass – 1% combustion. With respect to Trend Assessment there are 5 key source categories in stationary fuel combustion sector – CO_2 emissions from liquid fuels – 47.3%; natural gas – 20.2%; solid fuels – 19.6; as well as CH_4 and N_2O emissions from biomass – 4.3% and 1.3% respectively.

The emissions from 1.A.1 and 1.A.2 sectors by relevant subcategories and gases in time period 1990 – 2005 are presented in Table 3.2.1.

Table 3.2.1 Emissions from Energy industries and Manufacturing Industries and Construction sub-sectors in 1990 – 2005 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1.A.1 Energy industries																
CO_2,	6332.41	5806.01	4955.43	3993.68	3749.17	3442.41	3566.67	3327.76	3368.53	2944.29	2490.47	2442.76	2335.33	2269.90	2077.51	2068.24
CH_4	0.27	0.26	0.25	0.24	0.24	0.24	0.27	0.32	0.34	0.29	0.29	0.27	0.30	0.32	0.30	0.31
N_2O	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
1.A.2 Manufacturing industries and construction																
CO_2,	3781.19	2905.24	2378.32	2106.67	1909.16	1869.93	1827.84	1772.91	1554.17	1421.88	1184.07	1066.80	1125.91	1107.76	1121.41	1135.36
CH_4	0.26	0.20	0.17	0.18	0.17	0.18	0.23	0.22	0.24	0.23	0.22	0.25	0.25	0.27	0.33	0.43
N_2O	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05

Emissions from these two sectors are decreasing year by year (Figure 3.2.1). In the beginning of 1990-ties it is explained with economical crisis caused by political and social situation in the country. In the middle of 1990-ties curve of direct GHG emissions fluctuated. At the end of 1990-ties it started to decrease again and continued till 2005. Decreasing in the end of 1990-ties is explained with economical crisis in Russian Federation with whom Latvia has close economical collaboration. Lasting decrease of emissions is explained with high standards of physical characterization of fuels and fuel switching to the kind of fuels with lower costs and emissions level.

Since 2000, emissions from Manufacturing Industries and Construction have increased due to development of nation economy and industry as well as increase of demand of industrial production and improvement of well-being of population.

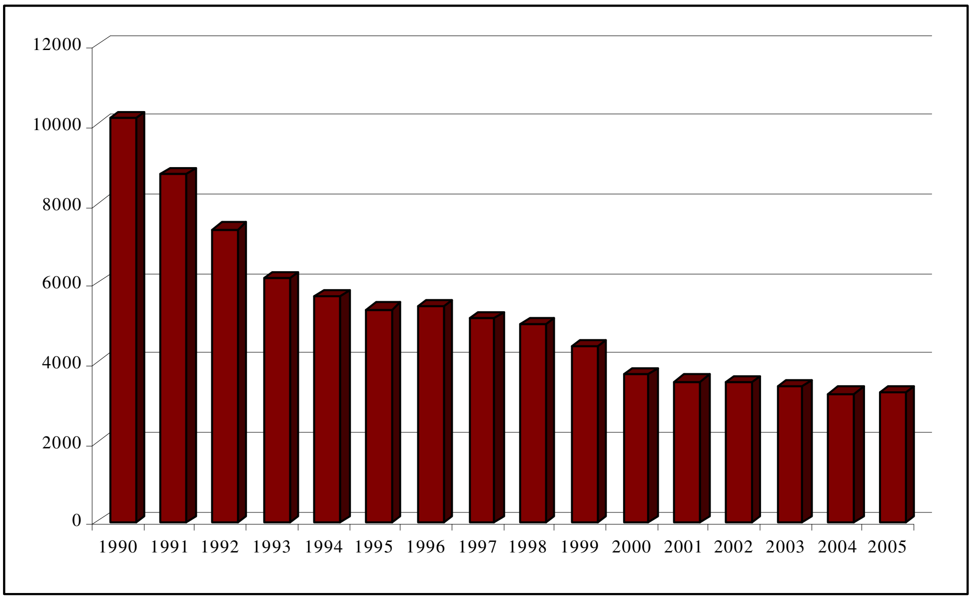


Figure 3.2.1 Total direct GHG emissions of Energy Industries and Manufacturing industries and construction in 1990 – 2005 (Gg CO_2 eqv)

Also indirect GHG emissions from Energy Industries and Manufacturing industries and Construction sub-sectors were estimated (Figure 3.2.2). As it is seen from Figure 3.2.2 SO_2 had biggest decrease in time period 1990 – 2005. It is explained with fuel switching to natural gas and biomass where sulphur dioxide emissions did not occurred.

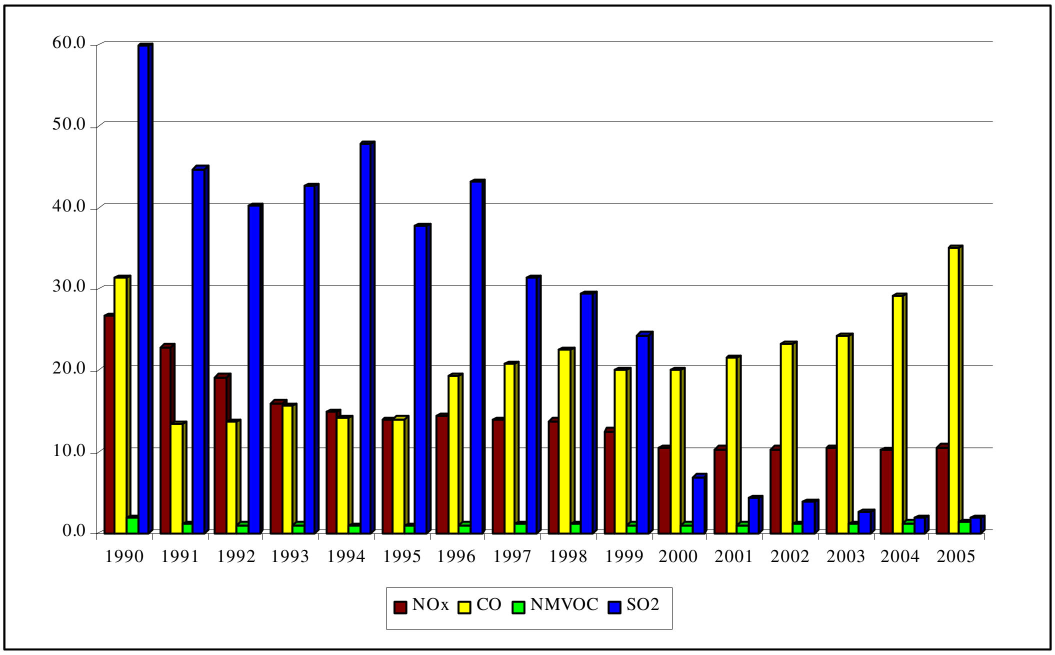


Figure 3.2.2 Total indirect GHG emissions of Energy industries and Manufacturing industries and construction in 1990 – 2005 (Gg)

3.2.2 Methodological issues

IPCC 1996 Tier 1 Sectoral approach and Reference approach for the comparison of CO_2 emissions as well as EMEP/CORINAIRS Guidebook 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.

CO_2 emissions for all types of fuels (except biomass) are key source categories for stationary fuel combustion with respect to Level assessment, so emissions have to be calculated with higher level according to IPCC Good Practice Guidance. Also CH_4 emissions from biomass stationary combustion are key source category with respect to Level assessment. Still these emissions are estimated with Tier 1 method.

Although in CO_2 emissions country specific emission factors are used according to IPCC 1996 it is Tier 1 method. According to 2006 IPCC Guidelines it is Tier 2 approach if country specific emission factors and fuel consumption in specific source category are used in emission estimations.

CH_4 emissions from biomass stationary combustion are estimated with Tier 1 method using activity data of specific source category and default emission factors from IPCC 1996. For now it was not possible to use higher emission estimation level due to lack of national researches to estimated country specific emissions factors.

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:

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

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;
- IPCC 1996;
- EMEP/CORINAIR Guidebook.

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

In 2004, research by local expert was made regarding CO_2 emission factors for Latvia in concern with IPCC Guidelines and used fuel type of physical characteristics [11].

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 3.2.2).

For calculating CO_2 emission factors following equation was used [11]:

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

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 to IPCC.

Table 3.2.2 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 (EF 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:

$$2 \times \left(\frac{s}{100}\right) \times \frac{1}{Q} \times 10^6 \times \left(\frac{100 - r}{100}\right) \times \left(\frac{100 - n}{100}\right)$$

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, NO_x, CO, NMVOC emission factors used in estimation of emission were taken from IPCC Guidelines (Table 3.2.3).

Table 3.2.3 CH_4, N_2O, NO_x, CO, NMVOC emission factors

	IMPLIED EMISSION FACTORS					
	CO_2 (Gg/PJ)	CH_4 (Gg/PJ)	N_2O (Gg/PJ)	NO_x (Gg/PJ)	CO (Gg/PJ)	NMVOC (Gg/PJ)
1.A.1 Energy Industries						
Gasoline	68.6	0.05	0.002	0.21	27.0	1.0
Diesel oil	74.0	0.003	0.0006	0.2	0.015	0.005
RFO	76.59	0.003	0.0006	0.2	0.015	0.005
LPG	62.44	0.003	0.0006	0.2	0.015	0.005
Jet fuel	70.86	0.003	0.0006	0.2	0.015	0.005
Other kerosene	71.52	0.003	0.0006	0.2	0.015	0.005
Other liquid	72.6	0.003	0.0006	0.2	0.015	0.005
Shale oil	75.43	0.003	0.0006	0.2	0.015	0.005
Coal	92.2	0.001	0.0014	0.3	0.02	0.005
Coke	86.98	0.01	0.0014	0.3	0.15	0.02
Peat briquettes	95.06	0.03	0.004	0.1	1.0	0.05
Peat	103.87	0.03	0.004	0.1	1.0	0.05
Natural gas	55.82	0.001	0.0001	0.15	0.02	0.005
Wood	107.78	0.03	0.004	0.1	1.0	0.05
Biogas	55.82	0.001	0.0001	0.15	0.02	0.005
1.A.2 Manufacturing Industries and Construction						
Gasoline	68.6	0.05	0.002	0.21	27.0	1.0
Diesel oil	74.0	0.002	0.0006	0.2	0.01	0.005
RFO	76.59	0.002	0.0006	0.2	0.01	0.005
LPG	62.44	0.002	0.0006	0.2	0.01	0.005
Jet fuel	70.86	0.002	0.0006	0.2	0.01	0.005
Other kerosene	71.52	0.002	0.0006	0.2	0.01	0.005
Other liquid	72.6	0.002	0.0006	0.2	0.01	0.005
Shale oil	75.43	0.002	0.0006	0.2	0.01	0.005
Coal	92.2	0.01	0.0014	0.3	0.15	0.02
Coke	86.98	0.01	0.0014	0.3	0.15	0.02
Peat briquettes	95.06	0.03	0.004	0.1	1.0	0.05
Peat	103.87	0.03	0.004	0.1	1.0	0.05
Natural gas	55.82	0.005	0.0001	0.15	0.03	0.005
Wood	107.78	0.03	0.004	0.1	2.0	0.05
Biogas	55.82	0.005	0.0001	0.15	0.03	0.005

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 – 2005 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 resources"(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 2007 submission, official data for 1992 – 1993 are available therefore there are no gap in time series 1990 – 2005.

Table 3.2.4 Fuel consumption in Energy industries (CRF 1.A.1) and Manufacturing Industries and Construction (CRF 1.A.2) in 1990 – 2005 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1.A.1 Energy industries																
Liquid fuels	40.481	33.255	28.442	27.174	30.863	20.521	27.339	17.442	20.664	17.494	7.903	5.280	5.078	3.619	3.170	2.405
Solid fuels	5.262	4.748	5.510	5.612	4.519	5.227	4.155	3.967	2.784	1.766	2.752	1.645	1.291	0.873	0.279	0.243
Gaseous fuels	49.029	50.290	40.182	24.415	16.770	24.114	18.833	28.451	27.076	25.721	28.861	33.572	32.549	34.136	32.413	33.353
Biomass	0.436	0.590	0.673	0.831	1.300	1.414	2.144	4.669	5.870	5.742	5.433	6.238	7.409	8.609	8.625	8.839
1.A.2 Manufacturing industries and construction																
Liquid fuels	29.006	19.664	16.094	16.641	16.106	16.425	16.051	15.771	12.794	11.485	7.991	5.060	4.845	4.729	4.700	3.796
Solid fuels	1.439	0.902	0.978	1.616	1.520	0.681	0.609	0.477	0.422	0.439	0.254	0.254	0.254	0.263	0.220	0.917
Gaseous fuels	26.101	23.919	19.167	12.510	9.755	9.996	9.888	9.551	9.786	9.145	9.856	11.597	12.848	12.747	13.092	13.549
Biomass	0.617	0.603	0.616	1.779	2.289	3.054	4.373	4.478	5.261	5.216	4.897	5.770	5.828	6.257	8.424	11.263
Other Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.037	0.131	0.245	0.332	0.291	0.314	0.184

The biggest decrease in time period 1990 – 2005 was for liquid fuel consumption (Table 3.2.4, Figure 3.2.3). It is 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 – 2005. These are types of fuels with lower cost to whom liquid and solid fuels were switched. Consumption of used tires in Mineral production reported as Other Fuels is increasing till 2004 but for the last year in time series consumption of used tires has decreased due to fuel and technology switch in cement production enterprise.

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

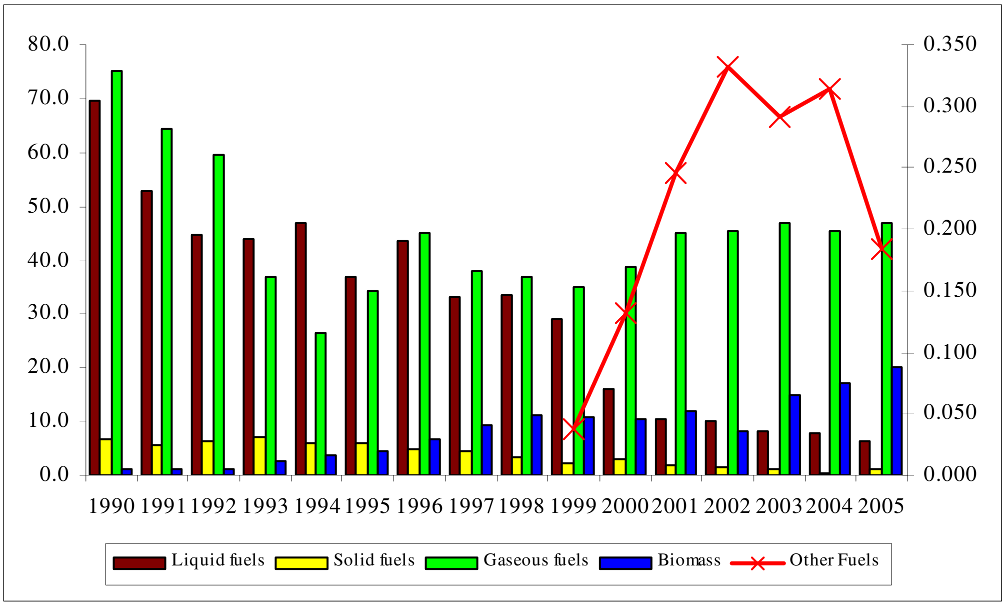


Figure 3.2.3 Total fuel consumption in Energy industries and Manufacture industries and Construction (PJ)

3.2.3 Uncertainties

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.1; CRF 1.A.2 is ±2% in 2005. 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. Uncertainty biogas combusted in enterprises covered by 1.A.1 Energy Industries sector was assumed rather low – 5% because biogas is combusted together with other types of fossil fuel and uncertainty of 2% (as for all statistical data) couldn't be assumed. So it gives average uncertainty 10% for activity data.

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. As well as CO_2 emissions from biogas consumption was assigned as 10% because emission factor was equated to natural gas emission factor due to lack of methodology or country specific emission factor.

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 GPG 2000.

3.2.4 Recalculations

Overall activity data changes in all sub-sectors of 1.A.1 Energy Industries and 1.A.2 Manufacturing Industries and Construction for all years from time period 1990 – 2004. Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

CSB finished their work with historical data reconstruction therefore all fuel consumption data for all years in time series 1990 – 2005 is available.

CSB finished work on data of fuel consumption improvement and data of fuel consumption for autoproducers are separated from 1.A.1 Energy Industries sector and included in other sub-sectors of Energy sector – all sub-sectors of 1A2 Manufacturing Industries and Construction, as well as1.A.4.a Commercial / Institutional and 1.A.4.c Agriculture / Forestry / Fishery sectors, where primary fuel was combusted for all years in time series 1990 – 2005. Fuel consumption for on-site use in Energy industries as well as fuel consumption in peat briquettes and charcoal production are excluded from total 1.A.1 Energy Industries sector fuel consumption and included in 1A1c Manufacture of Solid Fuels and Other Energy Industries sector for all year in time series 1990 – 2005.

For submission 2007, consumption of biogas were included in total consumption of biomass according to IPCC Guidelines where it is assumed that biogas are CO_2 neutral so CO_2 emissions from biogas have to be excluded from CO_2 emissions. Previously consumption of biogas in 1A1 and 1A4a sectors was included in total consumption as Other Fuels. For 2007 submission, only consumption of used tires in 1.A.2 Manufacturing Industries and Construction sector is reported.

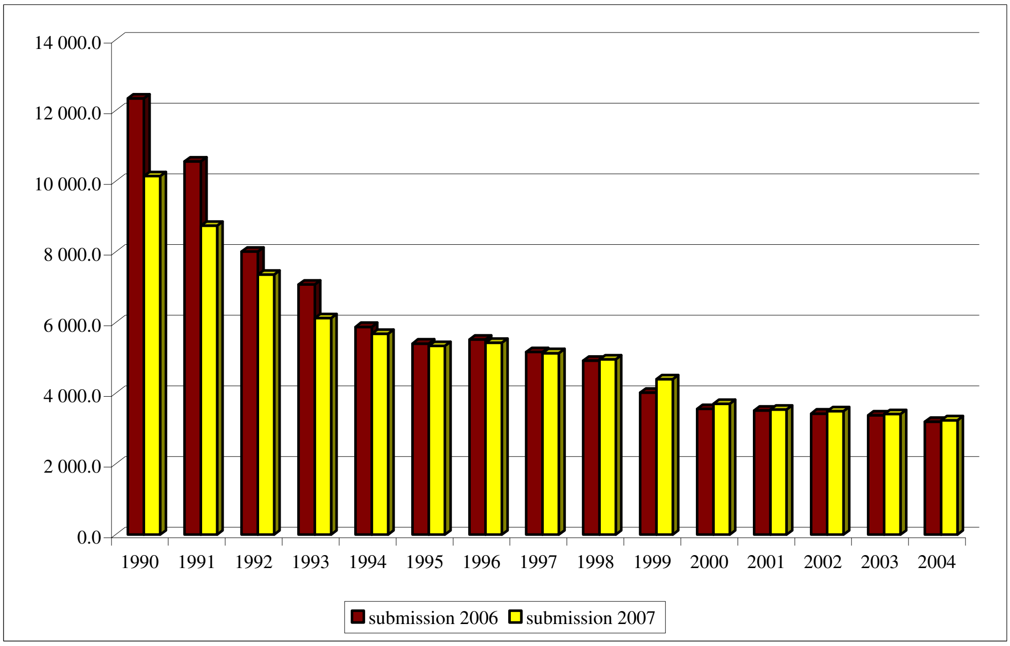


Figure 3.2.4 Direct GHG emissions difference in Energy Industries and Manufacture Industries and Construction sectors for submission 2006 and 2007 (CO_2 eqv. Gg)

Difference for submission 2006 and submissions 2007 in reported direct GHG emissions is significant for early 1990-ties, but since 2000, difference is very small due to accuracy and completeness of statistical data acquisition system (Figure 3.2.4). Difference is explained with reallocation of activity data and emissions due to data reallocation of autoproducers, changes of statistical information and correction of some previously made data mistakes.

3.2.5 Planned Improvements

CH_4 emissions from biomass stationary combustion are key source category so it is important to use Tier 2 method from IPCC Guidelines in emission estimations. Therefore country specific emission factors are needed. The summarized necessary improvements are:

- 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.

3.3 TRANSPORT (CRF 1.A 3)

3.3.1 Source category description

The Transport sector is the fastest growing sector in Latvia and amount of the emissions is increased compared to 1990. Emissions from Transport sector include following sectors: Road Transport, Railway, Civil Aviation and Domestic Navigation (Table 3.3.1). The most important reason of this growing tendency is that the economical situation and the welfare of population are developing. It is also the reason that the number of vehicles and private boats are growing and the number of flights is growing too.

Table 3.3.1 Emissions from Transport sector in 1990-2005 by sub-categories (Gg CO_2 eqv.)

	1990	1995	2000	2001	2002	2003	2004	2005
Road Transport	2422.17	1835.51	1985.53	2371.68	2362.84	2456.54	2553.93	2648.15
Civil Aviation	0.07	0.47	1.65	1.88	2.09	2.24	2.35	2.49
Domestic Navigation	19.49	51.12	54.24	54.32	52.49	51.86	49.48	50.49
Railway	589.94	265.31	226.90	233.87	244.36	279.25	286.22	286.34
Total Transport	**3031.66**	**2152.40**	**2268.32**	**2661.75**	**2661.78**	**2789.89**	**2891.98**	**2987.48**

In 2005, Transport sector contributed 27.5% from total CO_2 equivalent emissions, excluding LULUCF, and 38% CO_2 equivalent from the total Energy sector. The biggest part of Transport emissions take up Road Transport (88.6%), then Railways (9.6%), Domestic Navigation (1.7%) and Civil Aviation, which contribute a very small part of transport emissions (0.1%). Road transport and Railway in all years were key sources by Level Assessment including and also excluding LULUCF sector, CO_2 emissions from Road Transport are key source reporting Trend Assessment in 2005 including and excluding LULUCF, but N_2O emissions from Road Transport are key source reporting Trend Assessment in 2005 just without LULUCF (Table 3.3.2).

Table 3.3.2 Key sources from Transport sector

		Without LULUCF			With LULUCF		
		LA*		TA**	LA		TA
		1990	2005	2005	1990	2005	2005
Road Vehicles	**CO_2**	9%	24%	22%	5%	10%	11%
	N_2O	-	-	1%	-	-	-
Railway	**CO_2**	2%	2%	-	1%	1%	-

*LA –Level Assessment
**TA – Trend Assessment

Emissions from Road Transport increase yearly (Figure 3.3.1) and the reason of it is the growing number of vehicles (Table 3.3.7). Emissions from Railway became stable for the last time (Figure 3.3.1). Since 1990, emissions from Domestic Aviation are increasing because the numbers of flights are increased, and emissions from Domestic Navigation also are more or less stable, significant fluctuations are not observed in last years.

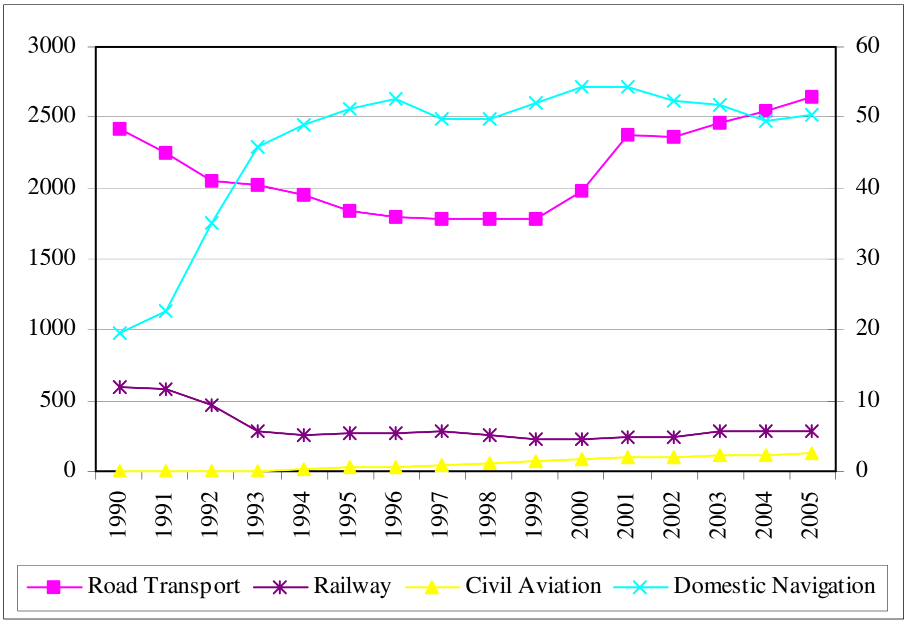


Figure 3.3.1 Emissions from the Transport sector in 1990-2005 by sub sectors (Gg CO_2 eqv.)
(Civil aviation and Domestic navigation – secondary axis)

Road Transport includes all transportation types of vehicles on roads: passenger cars, light duty vehicles, buses, heavy-duty vehicles and motorcycles and also mopeds are now included. 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 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 Transport sector is Road transport. The most significant emissions that releases Transport sector are NO_x emissions, especially Road transport. NO_x emissions contribute 52% from national total NO_x emissions. Although the specific NO_x emissions (amount of NO_x emissions per vehicle unit, kg/y) are decreased (1996 – 42 kg/y, 2005 – 36 kg/y) due to increased number of new vehicles with catalysts, the total NO_x emissions from Road transport are increased, because the number of vehicles is growing last years (Table 3.3.7). Emissions from CO and NMVOC are decreasing because of CO exhaust gas limitation from vehicles in Latvian legislation and also due to number of new vehicles. SO_2 emissions from Transport sector are inessential, because of sulphur limitation in fuels. Sulphur limitation in fuels is well presented in Figure 3.3.2; first limitation was in 1999 and next in 2005. Figure 3.3.2 presents indirect GHG emissions from Transport sector.

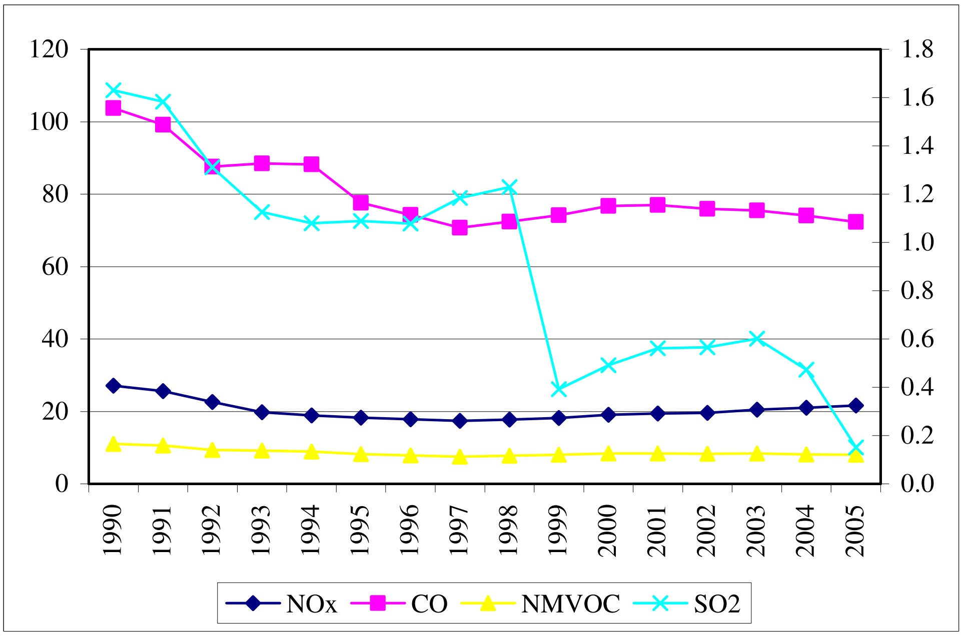


Figure 3.3.2 Indirect GHG emissions from Transport sector (Gg)
(SO_2 – secondary axis)

3.3.2 Methodological issues

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 of average mileage of vehicles and the fixed emission factors. Road traffic vehicles use four different fuels - gasoline, diesel oil, liquid petroleum gases (LPG) and in 2005 also biodiesel. Emissions are calculated for gasoline and diesel vehicles separately. Emissions from LPG and Biodiesel are calculated using Tier 1 method from IPCC 1996, because biofuel is not included in COPERT III version, but LPG is calculated with Tier1, due to problems concerned to inconsistency in statistical data and also COPERT III is not fully available for emissions calculation from LPG, this problem is described in section activity data about road transport. The mileage (km/a) or used fuel (for CO_2 emission calculation) 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, cold start-ups and also urban, rural and highway driving. Finally all emissions are summed up.

To calculate emissions from **Railway, Civil Aviation and Domestic Navigation** are used the Tier 1 method from IPCC 1996. 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** (Table3.3.3) are taken from IPCC 1996 and are presented in Table 3.3.3. The SO_2 emissions factors are used consistent with sulphur content in diesel oil (Table 3.3.4).

Table 3.3.3 Emission factors used in the calculation of emissions from Railway

	CO_2	CH_4	N_2O	NO_x	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 3.3.4 SO_2 Emission factors for Diesel oil 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
2004-2005	0,035	42,49	0,0165

Default emission factors for **civil aviation and domestic navigation** are taken from IPCC 1996 and are presented in Table 3.3.5 and Table 3.3.6.

Table 3.3.5 Emission factors used in the calculation of emissions from Civil Aviation

	CO_2	CH_4	N_2O	NO_x	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 3.3.6 Emission factors used in the calculation of emissions from Domestic Navigation

	CO_2	CH_4	N_2O	NO_x	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 transport

From 1998 the number of registered vehicles is increased by 52%, but number of vehicles that are in technical order is increased by 45.5%. Number of passenger cars is increased more quickly, number of registered passenger cars is increased by 58%, and number of passenger cars that are in technical order by 51%.

But still it is not so much compared to other EU countries and the projection is that next years the number of vehicles will grow. In 2005, there were 323 passenger cars per 1000 populations, but in other EU countries this number is about 500 passenger cars per 1000 populations.

In the time period 1998 – 2005, the number of vehicles registered in the RTSD has grown by an average 6% per year (Table 3.3.7).

Table 3.3.7 Total number of vehicles (without sidecars) in 1998-2005*

	1998	1999	2000	2001	2002	2003	2004	2005
Registered	567 420	635 712	662 441	700 611	737 225	770 975	806 560	863 909
In technical order	321 197	345 469	348 865	365 286	378 619	402 326	430 507	467 493
In technical order, %	*56.6*	*54.3*	*52.7*	*52.1*	*51.4*	*52.2*	*53.4*	*54.1*

*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 fueled ones. A modern register of road vehicles was created in 1993, and registration process was begun. Unfortunately reliable data are only available since 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, especially for historical data.

Year by year the RDSD improve the vehicle statistics and from 2001 there are available the distribution per vehicle ages, but still there is not available the distribution per legislation classes, therefore is used instead 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 3.3.3 and 3.3.4 present the distributed data which Latvia use to calculate emissions from passenger cars. In 2005, the EURO I gasoline passenger cars (26.5%) dominated what correspond to vehicle production year from 1992 to 1996 (Figure 3.3.3).

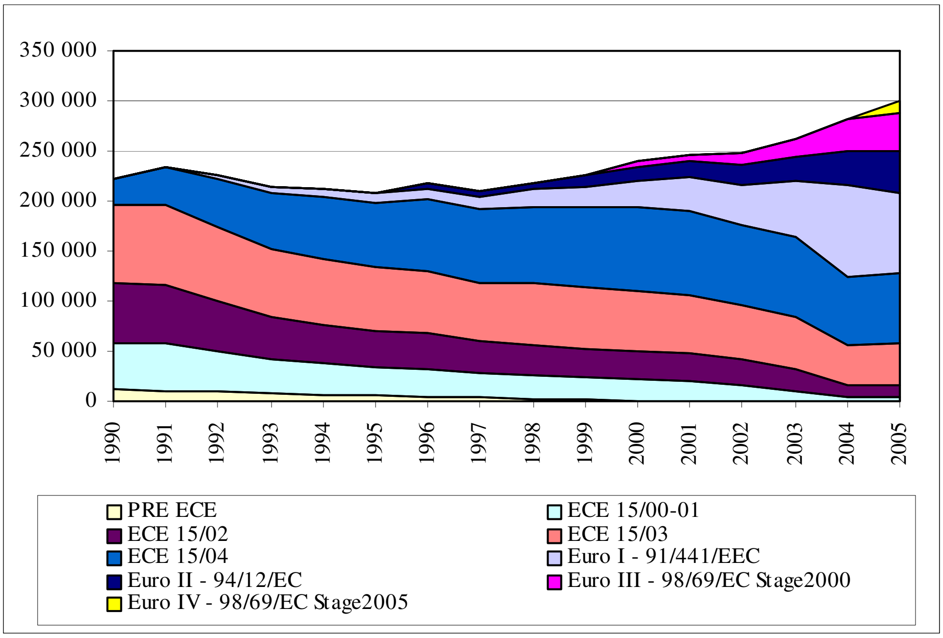


Figure 3.3.3 The number of gasoline passenger cars

The most part of diesel passenger cars are Conventional, which corresponds to cars without catalytic converter (Figure 3.3.4). And the average age of diesel passenger cars is also likewise gasoline passenger cars about 12 years. Last years are growing the number of new cars.

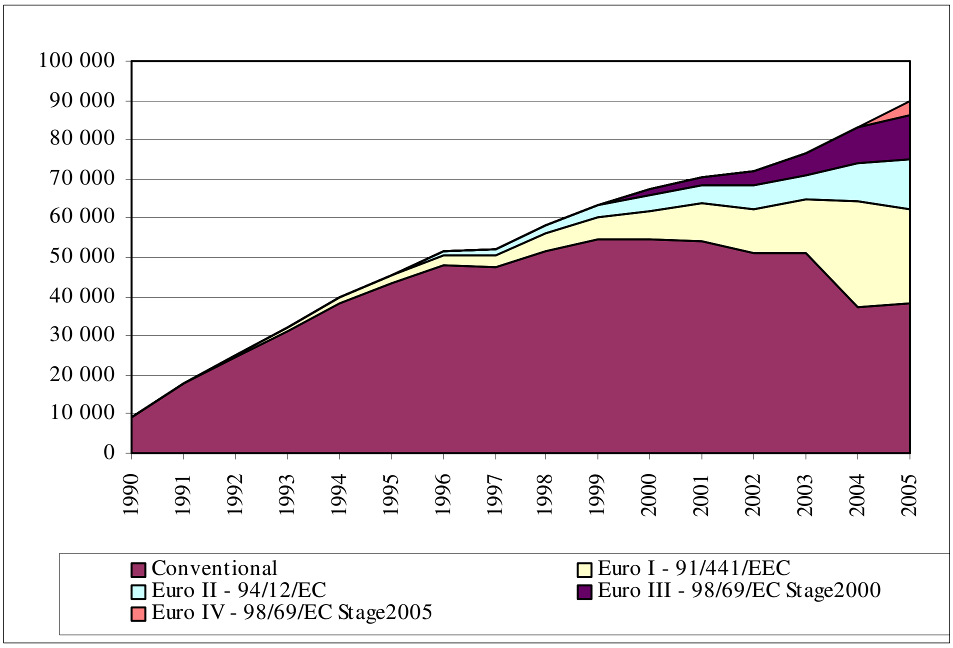


Figure 3.3.4 The number of diesel passenger cars

The statistics about LPG passenger cars is not so precise as statistics about diesel and gasoline cars. It is so because the 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 (Figure 3.3.5) and this figure is not in line with registered number of LPG passenger cars. It is clear that the number of LPG passenger cars is growing, but the plausible time series is not available.

Fuel consumption in road transport in 2005 was about 29% from total energy consumption. In last years the consumption of gasoline in road transport becomes stable, while the consumption of diesel oil since 1999 is increased more then half (Figure 3.3.5). In 2005, for the first time in energy balance was included Biodiesel. Biodiesel contributes very small part from total fuel used in road transport, just 0.3%, but amount of biofuel will grow in next years, because it is an environmental friendly fuel. According to national legislation in 2010 the amount of biofuel will contribute 5.75% from fuel used in Transport sector.

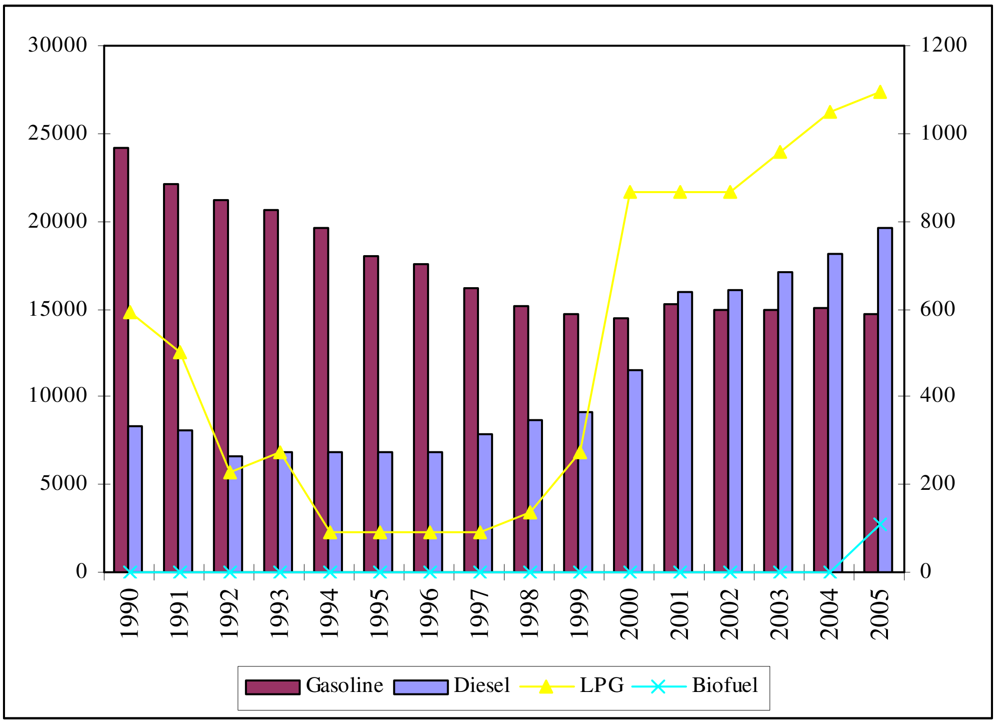


Figure 3.3.5 Fuel consumption in road transport (Gg)
(Biofuel and LPG - secondary axes)

Till 2000 the main fuel used by Road transport in Latvia was gasoline (Figure 3.3.5). 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.

Railways

Emissions are calculated using fuel consumption form Energy balance prepared by CSB of Latvia (Table 3.3.8).

Table 3.3.8 Fuel consumption in railway transport (TJ)*

	1990	1995	2000	2001	2002	2003	2004	2005
Diesel oil	**7180.81**	**3229.24**	**2761.85**	**2846.83**	**2974.30**	**3399.20**	**3484.18**	**3484.20**

*Data from Central Statistical bureau of Latvia, 2006

Passenger carriage in 2005 continued to grow for 2000, before this growth of passenger carriage had steadily decreased since the beginning of 1990s. The number of passengers carried by rail amounted to 25.9 million and has increased by 8.4% in comparison with 2004. Cargo traffic by rail also is increasing from 1994. The amount of cargo carried by rail in 2005 reach to 60068 thousand tonnes and has increased by 7% in comparison with 2004.

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.

End of 2005 there was made a research "Research about fuel consumption in domestic navigation and aviation 1990-2004" [10]. This research came by good results for 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 the 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. Data for 2005 was calculated based on this research, but the assumption is that domestic aviation in 2005 is grown taken into account the last year tendencies. The fuel consumption and emissions from domestic aviation is still insignificant just 0.1% from total Transport fuel consumption (Table 3.3.9).

Table 3.3.9 Fuel consumption in civil aviation (TJ)*

	1990	1995	2000	2001	2002	2003	2004	2005
Aviation Gasoline	0.16	1.14	3.99	4.56	5.13	5.42	5.70	6.04
Jet Kerosene	0.76	5.35	18.76	21.44	23.73	25.46	26.80	28.41

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

Domestic Navigation

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

End of 2005 there was made a research "Research about fuel consumption in domestic navigation and aviation 1990-2004" [10]. The research was dealt into 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 for 2004 and expert judgment was used to divide power of engines for rowboats with engine, motorboats, launches and water craft. 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 2004; the consumption for other years was extrapolated (Table 3.3.10). Data for 2005 was calculated based on this research, but the assumption is that domestic navigation in 2005 is grown taken into account the last year tendencies.

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. 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 3.3.10). Data for 2005 was calculated based on this research, but the assumption is that domestic navigation in 2005 is grown taken into account the last year tendencies. Fuel consumption from domestic navigation is insignificant, just 1.7% from total Transport fuel consumption.

Table 3.3.10 Fuel consumption in domestic navigation, TJ*

	1990	1995	2000	2001	2002	2003	2004	2005
Diesel oil	212.5	588.3	621.7	621.7	598.9	590.0	560.8	572.0
Gasoline	24.9	29.0	33.8	34.8	35.9	37.0	38.2	39.3

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

3.3.3. 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 emission factors presented by IPCC GPG 2000.

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 GPG 2000.

Very precise activity data in 2004 was obtained from research in **Civil Aviation**, therefore in last submission 2006 the uncertainty was very small, just 2%, but in this submissions data for 2005 are calculated based on made assumption, therefore the uncertainty for activity data is 20%. The default uncertainties are used for emission 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.

3.3.4. Recalculations

Remarkable recalculations have been made for **Road transport**. The total number of vehicles is the same, but changes have been made in division per vehicle classes and also average mileage has been improved. Changes has been made also in diesel oil consumption, in previous submission 2006, diesel fueled cars was started just for 1994, but in this Submission 2007 diesel fueled cars started from 1990, because CSB present the time series for diesel oil from 1990.

Table 3.3.11 CO_2 eqv emission differences between Submission 2006 and 2007

	Submission 2006	Submission 2007	Difference	Submission 2006	Submission 2007	Difference	Submission 2006	Submission 2007	Difference	Submission 2006	Submission 2007	Difference
	1990, CO_2 eqv.		%	**1995, CO_2 eqv.**		%	**2000, CO_2 eqv.**		%	**2004, CO_2 eqv.**		%
Road transport	**1975.40**	**2422.17**	**22.62**	**1642.17**	**1835.51**	**11.77**	**1993.59**	**1983.61**	**-0.50**	**2558.63**	**2553.93**	**-0.18**
Gasoline	1767.93	1756.89	-0.62	1317.10	1309.40	-0.58	1069.29	875.65	-18.11	1122.59	1122.04	-0.05
Diesel oil	168.73	626.55	271.33	319.11	520.15	63.00	867.70	1051.35	21.17	1367.52	1363.37	-0.30
LPG	38.73	38.73	-0.01	5.96	5.96	-0.06	56.60	56.60	0.01	68.52	68.52	0.00

CSB has finished work on times series of **Railway** fuel consumption. In last submission 2006 for 1991-1993 the fuel consumption data was interpolated, but now all activity data are taken from CSB energy balance. CO_2 eqv emission differences between Submission 2006 and 2007 are presented in Figure 3.3.6.

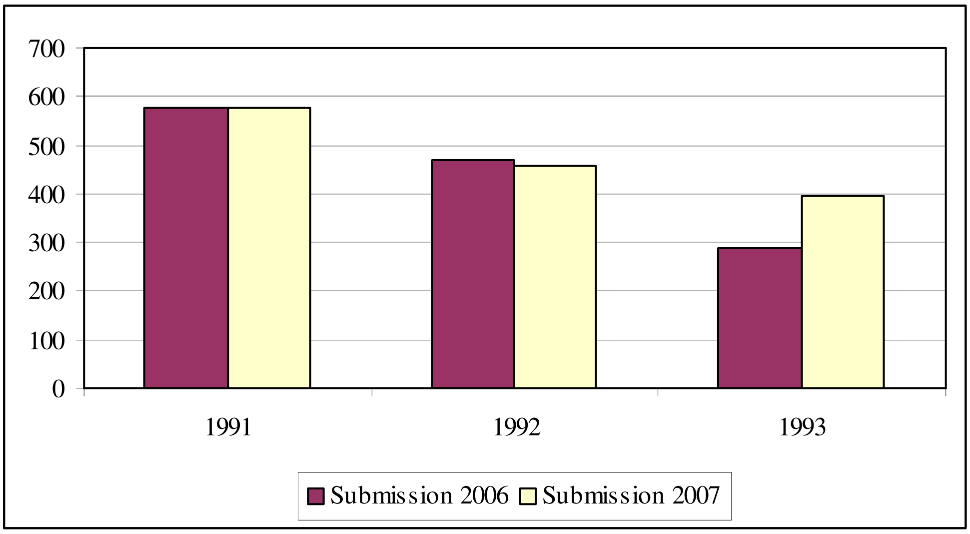


Figure 3.3.6 CO_2 eqv emissions from Railway (Gg)

3.3.5. Planned Improvements

The new version of COPERT model has been developed and COPERT 4 version is already available. In 2007, the Joint Research Centre of European Commission organized the COPERT 4 training session and Latvia participated in this training session to improve the emission calculation from road transport to next submission.

Railways are key source, but until now there was no possibility to use Tier 2 method for emission calculation, because country specific emission factors are not developed. Some activities to solve this problem should be started to do.

3.4 Other sectors (CRF 1.A.4)

3.4.1 Source category description

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. There are 4 key source categories of stationary fuel combustion with respect to Level assessment – CO_2 emissions from natural gas – 12%; liquid fuels – 4%; and solid fuels combustion – 1%; as well as CH_4 emissions from biomass – 1%; combustion. With respect to Trend Assessment there are 5 key source categories in stationary fuel combustion sector – CO_2 emissions from liquid fuels – 47.3%; natural gas – 20.2%; solid fuels – 19.6; as well as CH_4 and N_2O emissions from biomass – 4.3% and 1.3% respectively.

Table 3.4.1 Emissions from Other Sectors in 1990 – 2005 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1.A.4 Other sectors																
CO_2	5501.57	5615.24	3971.15	3281.87	2289.41	1459.43	1480.16	1234.78	1057.46	1003.85	906.36	1137.69	1105.10	1202.43	1226.78	1180.49
CH_4	11.18	12.69	11.48	12.14	12.03	12.88	13.24	12.49	12.00	11.98	11.17	12.19	12.05	11.80	12.52	12.24
N_2O	0.16	0.18	0.17	0.17	0.16	0.17	0.18	0.17	0.16	0.16	0.15	0.16	0.16	0.16	0.17	0.17

Since 1990 – 1991, decreasing of emissions in 1.A.4 Other Sectors can be observed and it is explained with crisis in economical situation caused by changes of political situation in country (Table 3.4.1.).

As it can be seen in Figure 3.4.1 emissions from 1.A.4 Other Sectors are increasing starting 2000. It can be explained with development of this sector but mostly with development of Commercial / Institutional and Residential sector in second place. Still in 2005 total direct GHG emissions have decreased for 3.5% since 2004, mostly in 1.A.4.a and 1.A.4.c sectors that is explained with decrease in agricultural activities and decrease of central heating system role in residential households, that's why emissions from 1.A.4.b sector have increased.

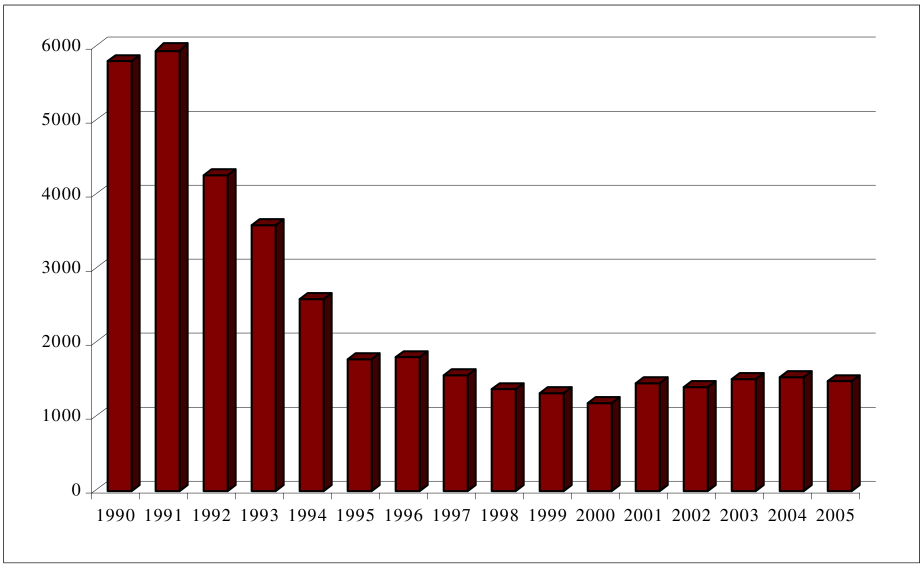


Figure 3.4.1 Total direct GHG emissions from 1.A.4 Other Sectors in 1990 – 2005 (Gg CO_2 eqv.)

Indirect GHG emissions from Other Sectors were estimated (Figure 3.4.2.). As it can be seen in Figure 3.4.2 SO_2 had biggest decrease in time period 1990 – 2005. It is 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.

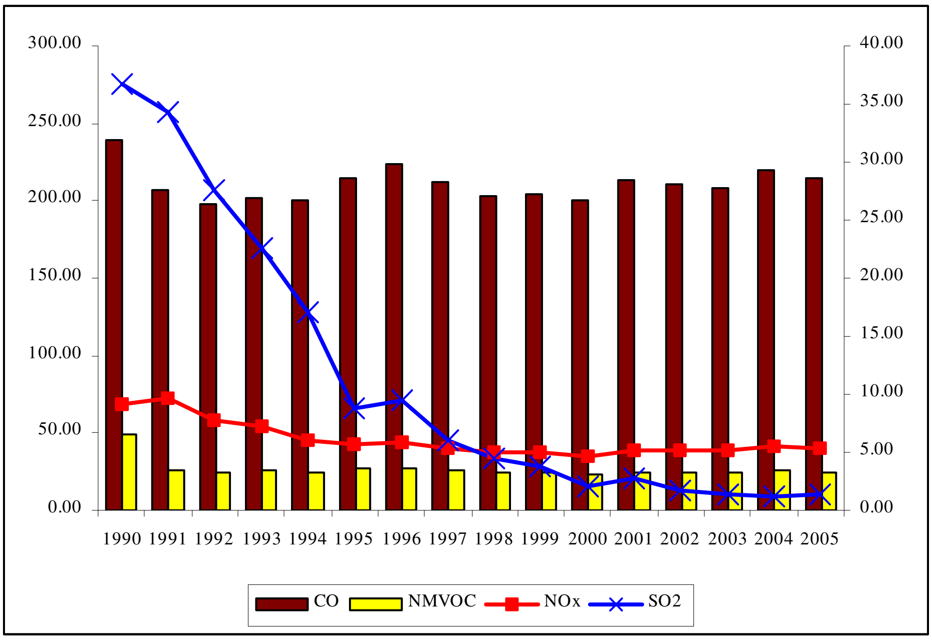


Figure 3.4.2 Total indirect GHG emissions of 1.A.4 Other Sectors in 1990 – 2005 (Gg)

3.4.2 Methodological issues

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 3.2.2).

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, NO_x, CO, NMVOC emission factors used in estimation of emission were taken from IPCC Guidelines (Table 3.4.2).

Biogas emission factors were equated to natural gas emission factors due to lack of specific methodology and emission factors.

Table 3.4.2 CH_4, N_2O, NO_x, CO, NMVOC emission factors for 1.A.4 Other Sectors

Sectors	CH_4 (Gg/PJ)	N_2O (Gg/PJ)	NO_x (Gg/PJ)	CO (Gg/PJ)	NMVOC (Gg/PJ)
1.A.4.a Commercial/Institutional					
Gasoline	0.05	0.002	0.21	27.0	1.0
Diesel oil	0.01	0.0006	0.1	0.02	0.005
RFO	0.01	0.0006	0.1	0.02	0.005
LPG	0.01	0.0006	0.1	0.02	0.005
Jet fuel	0.01	0.0006	0.1	0.02	0.005
Other kerosene	0.01	0.0006	0.1	0.02	0.005
Other liquid	0.01	0.0006	0.1	0.02	0.005
Shale oil	0.01	0.0006	0.1	0.02	0.005
Coal	0.01	0.0014	0.1	2.0	0.2
Coke	0.01	0.0014	0.3	0.15	0.02
Peat briquettes	0.3	0.004	0.1	5.0	0.6
Peat	0.3	0.004	0.1	5.0	0.6
Natural gas	0.005	0.0001	0.05	0.05	0.005
Wood	0.3	0.004	0.1	5.0	0.6
Biogas	0.005	0.0001	0.05	0.05	0.005
1.A.4.b, 1.A.4.c Residential and Agriculture/Forestry/Fishery					
Gasoline	0.05	0.002	0.21	27.0	1.0
Diesel oil	0.01	0.0006	0.1	0.02	0.005
RFO	0.01	0.0006	0.1	0.02	0.005
LPG	0.01	0.0006	0.1	0.02	0.005
Jet fuel	0.01	0.0006	0.1	0.02	0.005
Other kerosene	0.01	0.0006	0.1	0.02	0.005
Other liquid	0.01	0.0006	0.1	0.02	0.005
Shale oil	0.01	0.0006	0.1	0.02	0.005
Coal	0.3	0.0014	0.1	2.0	0.2
Coke	0.3	0.0014	0.3	0.15	0.02
Peat briquettes	0.3	0.004	0.1	5.0	0.6
Peat	0.3	0.004	0.1	5.0	0.6
Natural gas	0.005	0.0001	0.05	0.05	0.005
Wood	0.3	0.004	0.1	5.0	0.6
Biogas	0.005	0.0001	0.05	0.05	0.005

Activity data

The activity data for sub-category CRF 1.A.4 is taken from annual energy statistics. The fuel consumption data for 1.A.4 Other Sectors is presented in Table 3.4.3. 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 for 1.A.4.b Residential Sector. Official statistical information is available for all years in time series 1990 – 2005 in *Annual Questionnaires* format prepared by and for EUROSTAT.

In submission 2006, biogas consumption were reported under Other Fuels sector, but for submission 2007 biogas consumption were included in Biomass fuel because it was assumed that biogas as well as wood products are CO_2 neutral so CO_2 emission from these types of fuels have to be excluded from total emissions.

Table 3.4.3 Fuel consumption in 1.A.4 Other Sectors in 1990–2005 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1.A.4 Other Sectors																
Liquid fuels	27.83	32.50	24.22	20.81	13.50	7.54	7.49	6.49	5.72	5.70	4.97	6.48	6.02	7.05	6.97	6.31
Solid fuels	23.53	20.77	16.88	13.96	9.88	5.60	6.03	5.00	3.60	2.88	2.20	3.00	2.39	2.21	2.15	2.07
Gaseous fuels	23.20	23.44	11.31	8.44	7.00	7.15	6.80	5.49	5.73	5.92	6.23	7.07	8.11	8.81	9.47	9.65
Biomass	26.45	31.06	30.87	33.30	33.83	39.86	40.98	39.03	38.52	38.82	36.28	38.78	38.87	38.21	40.67	39.63

Also for submission 2007 autorpoducers were excluded from 1.A.1 Energy Industries sector and included in sectors where fuels were primary combusted for all years in time series 1990 – 2005 so full and consistent emission time series are reported.

Since 1992, 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. Since 1991, consumption of liquid fuels decreased significantly due to decrease of Agriculture sector activities and decrease of fuel consumption as off-road. But although consumption of liquid fuels of late years fluctuated within 1 PJ, consumption of solid fuels decreased steady (Figure 3.4.3). Since 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.

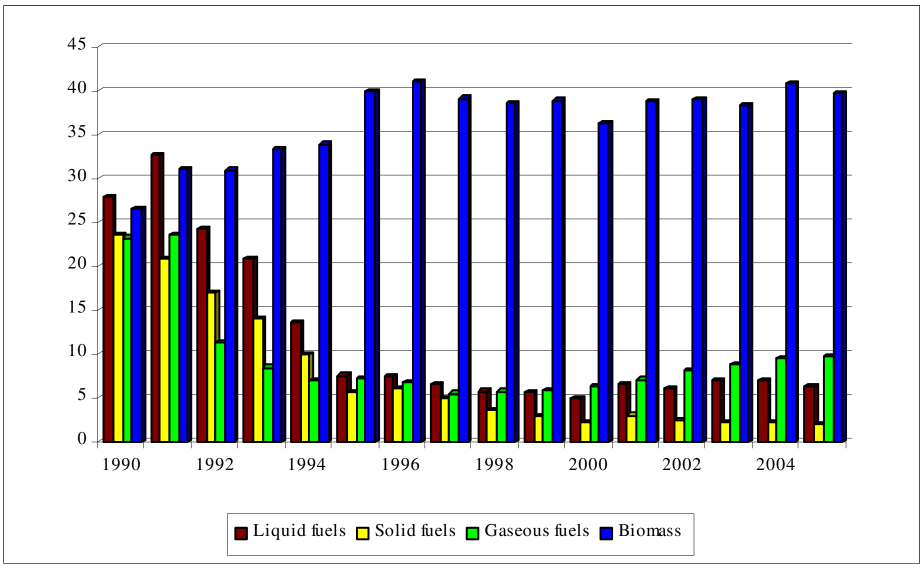


Figure 3.4.3 Fuel consumption for time period 1990 – 2005 for 1.A.4 Other Sectors (PJ)

3.4.3 Uncertainties

Uncertainty in activity data of fuel combustion in sectors 1.A.4 Other Sectors is ±2% in 2005. 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. Uncertainty of activity data for Biogas combusted in enterprises covered by 1.A.4.a Commercial / Institutional was assumed rather low – 5% because biogas is combusted together with other types of fossil fuel and uncertainty of 2% (as for all statistical data) couldn't be assumed. So it gives average uncertainty 10% for activity data.

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. As well as CO_2 emissions from biogas consumption was assigned as 10% because emission factor was equated to natural gas emission factor due to lack of methodology or country specific emission factor.

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.

3.4.4 Recalculations

Overall activity data changes in all sub-sectors of 1.A.4 Other Sectors for all years from time period 1990 – 2004. Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

CSB finished their work with historical data reconstruction so all fuel consumption data for all years in time series 1990 – 2005 is available.

CSB finished work on data of fuel consumption improvement and data of fuel consumption for autoproducers are separated from 1.A.1 Energy Industries sector and included in other sub-sector of Energy sector – all sub-sectors of 1A2 Manufacturing Industries and Construction, 1.A.4.a Commercial / Institutional and 1.A.4.c Agriculture / Forestry / Fishery, where primary fuel was combusted for all years in time series 1990 – 2005.

For submission 2007 consumption of biogas were included in total consumption of biomass according to IPCC Guidelines where it is assumed that biogas are CO_2 neutral so CO_2 emissions from biogas have to be excluded from CO_2 emissions. Previously consumption of biogas in 1A1 and 1A4a sectors was included in total consumption as Other Fuels. For submission 2007 only consumption of used tires in 1.A.2 Manufacturing Industries and Construction sector is reported.

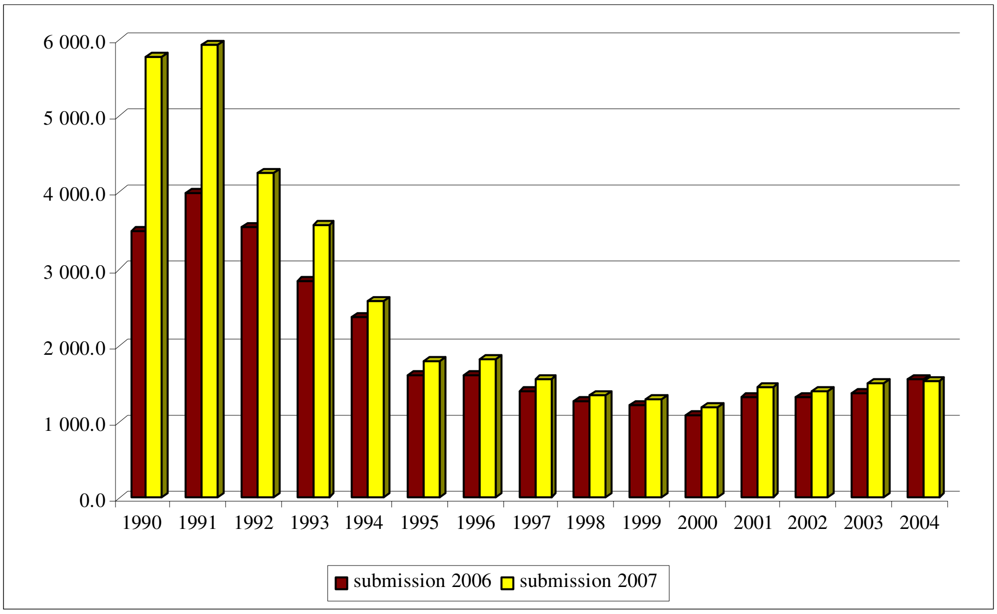


Figure 3.4.4 Direct GHG emissions difference in Other sectors for submission 2006 and 2007 (CO_2 eqv. Gg)

Difference in reported direct GHG emissions for submission 2006 and submissions 2007 is significant for early 1990-ties years but since 1995 difference is smaller due to accuracy and completeness of statistical data acquisition system (Figure 3.4.4). Difference is explained with reallocation of activity data and emissions due to data reallocation of autoproducers, changes of statistical information and correction of some previously made data mistakes.

3.4.5 Planned Improvements

CH_4 emissions from biomass stationary combustion are key source category so it is important to use Tier 2 method from IPCC Guidelines in emission estimations. Therefore country specific emission factors are needed.

The summarized necessary improvements are:

- 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.

3.5 Reference approach (CRF 1.C)

3.5.1 Source category description

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 reported for certain fuels, whereas in the RA table only stock changes are given. Also EB include "Interproduct transfers" category, data from this category is included in stock change category or RA tables for right result.

Total difference between Sectoral and Reference approaches of fuel consumption and CO_2 emissions can be seen in Table 3.5.1. For some years difference between Sectoral and Reference approach is quite significant. It is explained that emission estimation of road transport COPERT model was used; significant statistical difference appears in Latvian statistics for 1993, 1994 and

1999 – 2005 in certain types of liquid fuels – motor gasoline, diesel oil and residual fuel oil, and difference in methodology of estimation.

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

Table 3.5.1 Difference between Sectoral and Reference approach data

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Fuel consumption																
Reference approach (PJ)	143.9	124.7	105.1	97.8	94.7	78.6	81.4	69.7	69.2	58.0	48.1	51.0	48.1	52.5	54.3	55.2
Sectoral approach (PJ)	137.9	123.5	102.9	96.4	90.7	73.3	79.2	67.9	67.0	62.1	51.2	52.4	51.5	52.5	53.2	52.1
Difference (%)	2.0	-0.4	1.1	0.1	2.6	4.9	0.4	-1.2	-1.4	-12.0	-12.2	-7.8	-12.7	-6.3	-4.2	-2.1
CO_2 emissions																
Reference approach (Gg)	10358.6	9049.3	7654.6	7084.9	6874.5	5665.8	5882.6	4936.1	4858.5	4048.7	3272.5	3512.5	3265.7	3582.0	3717.6	3712.2
Sectoral approach (Gg)	10240.0	9162.0	7638.8	7158.5	6761.2	5457.6	5914.7	5043.0	4968.3	4596.3	3754.3	3835.7	3764.1	3835.5	3879.4	3802.1
Difference (%)	1.2	-1.2	0.2	-1.0	1.7	3.8	-0.5	-2.1	-2.2	-11.9	-12.8	-8.4	-13.2	-6.6	-4.2	-2.4

3.5.2 Methodological issues

Methods

The IPCC 1996 Tier 1 Reference approach for the CO_2 emission estimations and comparison of CO_2 emissions were used. 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 are based on top-down data.

Emission factors and other parameters

Carbon emission factors from IPCC 1996 are used to estimate CO_2 emissions for Reference approach. If emission factors for some types of fuels were not available from IPCC Guidelines national experts' assumptions or emission factors for neighbourhood countries submitted in their NIR were used.

Table 3.5.2 Carbon emission factors (t/TJ)

Fuel type	Carbon emission factor
Liquid Fuels	
Gasoline	18.9
Jet Kerosene	19.5
Other Kerosene	19.7
Shale oil	20.78
Gas / Diesel Oil	20.3
Residual Fuel Oil	21.1
LPG	17.2
Bitumen	22.0
Lubricants	20.0
Petroleum Coke	27.5
Other Oil	20.0
Paraffin Wax	20.0
White Spirit	22.0
Solid Fuels	
Other Bituminous Coal	25.1
Peat	28.3
Coke Oven / Gas Coke	29.5
Peat Briquettes	25.9
Gaseous Fuels	
Natural Gas	15.3
Biomass	
Solid Biomass	30.0
Gas Biomass	15.3
Other Fuels	
Industrial Wastes (used tires)	23.0

Activity data

Some types of fuel are used as feedstock in industrial production, for example, coke, but it is reported in RA although it is not reported in Sectoral tables of fuel combustion. These fuels have to be reported in 1.D Feedstocks and non-energy use of fuels. But coke consumption is not reported under this sector to avoid bigger discrepancy because this type of fuel is not given in default structure of 1.D table. Coke consumption and estimated emissions from coke use in table 1B Reference approach will not be connected to table 1.D because CO_2 emissions from coke use have to be estimated and reported as "CO_2 not emitted". But there is only one possibility to report coke consumption in CRF Reporter – as Other Fuels. So fuel consumption and CO_2 emissions from solid fuels in 1.B tables are higher than it should be and than it is reported in Sectoral approach. That's why difference between Reference approach and Sectoral approach are significant.

The same situation is observed with Paraffin Wax and White Spirit reported in 1.B tables under "Other Liquid fuels" and in 1.D tables as "Other Fuels". Emissions from Paraffin Wax and White Spirit in RA tables have to estimate as "0" because these emissions are "CO_2 not emitted". But emissions from these two types of fuels in these two tables – 1.B and 1.D, are not linked so emissions from liquid fuels in 1B tables are higher that it should be so difference between Reference approach and Sectoral approach for liquid fuels is quite high.

No problems occurred with gaseous fuels and other fuels where difference between Reference approach and Sectoral approach is within 5% for all years, except gaseous fuels in 1993 where difference is 5.6%. Data for early 1990-ties still is incomplete due to changes in statistical accounting system and sweeping changes in economical and social situation in country.

3.5.3 Uncertainties

Uncertainty in activity data of fuel combustion is ±2% in 2005. 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 Solid Biomass combustion was assigned as 15% because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass. Uncertainty of activity data for Gas Biomass was assumed rather low – 5% because biogas is combusted together with other types of fossil fuel and uncertainty of 2% (as for all statistical data) couldn't be assumed.

Carbon emission factors for all types of fuels for emission estimation with Reference approach were taken from IPCC Guidelines or from other countries submissions so uncertainty for emission factors for all types of fuels were assumed rather high to about 50%.

3.5.4 Recalculation

Overall activity data changes in all sub-sectors of 1.A.4 Other Sectors for all years in time period 1990 – 2004. Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

CSB finished their work with historical data reconstruction so all fuel consumption data for all years in time series 1990 – 2005 is available.

Activity data of Paraffin Wax and White spirit is reported in 1.B tables under Other liquid fuels category for the first time for all years in time series 1990 – 2005.

3.5.5 Planned Improvements

It is necessary to assign country specific carbon emission factors to minify difference between Sectoral approach estimations, where country specific CO_2 emission factors are used, and Reference approach where default emission factors from IPCC 1996 as well as other country's carbon emission factors are used.

3.6 Feedstocks and non-energy use of fuels

3.6.1 Source category description

Under this category consumption of different types of fuels used as feedstock is reported. Emissions from these fuels is reported as "CO_2 not emitted" because it is assumed that in CO_2 emissions is captured in industrial production and not emitted to the air.

Consumption of Bitumen, Lubricants, Paraffin Waxes and White Spirits is reported in 1.D tables for all years in time series 1990 – 2005. Paraffin Waxes and White Spirits are not default types of fuels in 1.D tables so these fuels are reported under "Other Fuels" what caused some discrepancies with 1.B tables that is described in Chapter 3.5.

3.6.2 Methodological issues

Methods

The IPCC 1996 Tier 1 Reference approach were used to calculate emissions from feedstocks and non-energy use of fuels. 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.

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

Emission factors and other parameters

Emission factors used in different neighbourhood countries during preparation of submission were used in emission estimations due to lack of national carbon emission factors:

- Bitumen and Lubricants carbon emission factors are taken from the IPCC 1996;
- Emission factor for Paraffin Wax were taken from Lithuanian submission;
- White Spirit emissions factor were taken from Denmark submission (Table 3.5.2).

Activity data

Activity data prepared by CSB and reported to EUROSTAT as well as data from Energobalance 2005 were used (Table 3.6.1).

Table 3.6.1 Activity data for 1.D Feedstocks and non-energy use of fuels in 1990 – 2005 (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Bitumen	1632.54	544.18	83.72	167.44	544.18	711.62	879.06	1632.54	2051.14	2344.16	2009.28	1506.96	2093	2176.72	2009.28	2511.6
Lubricants	1632.54	1046.5	920.92	1088.36	1004.64	962.78	962.78	879.06	1004.64	879.06	879.06	837.2	837.2	920.92	1004.64	1172.08
Paraffin Wax	-	-	-	-	-	-	-	-	-	125.58	125.58	167.44	167.44	167.44	251.16	334.88
White Spirit	83.72	83.72	83.72	83.72	83.72	83.72	83.72	83.72	125.58	83.72	125.58	125.58	83.72	83.72	125.58	125.58

3.6.3 Uncertainties

Uncertainty in activity data of fuel combustion is ±2% in 2005. 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 Solid Biomass combustion was assigned as 15% because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass. Uncertainty of activity data for Gas Biomass was assumed rather low – 5% because biogas is combusted together with other types of fossil fuel and uncertainty of 2% (as for all statistical data) couldn't be assumed.

Carbon emission factors for all types of fuels for emission estimation with Reference approach were taken from IPCC Guidelines or from other countries submissions so uncertainty for emission factors for all types of fuels were assumed rather high to about 50%.

3.6.4 Recalculation

Overall activity data changes in all sub-sectors of 1.A.4 Other Sectors for all years in time period 1990 – 2004. Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

CSB finished their work with historical data reconstruction so all fuel consumption data for all years in time series 1990 – 2005 is available.

Activity data of Paraffin Wax and White spirit is reported in 1.B tables under Other Fuels category for the first time for all years in time series 1990 – 2005.

3.6.5 Planned Improvements

It is necessary to assign country specific carbon emission factors to correctly estimate CO_2 not emitted emissions amount. Detailed activity data for fuel consumption that is no combusted but used as feedstock or for non-energy use. For this submission it was assumed that all Lubricant, Paraffin Wax and White Spirit consumption isn't combusted.

Also it is necessary to improve structure of CRF 1.B and 1.D tables so data of Paraffin Wax and White Spirit reported in both tables would be linked. If this linkage will be established so it would be possible to report coke consumption as feedstock in 1.D table.

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, NO_x and CO 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 emissions from natural gas 1990 – 2005 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CH_4 emissions	13.05	12.57	11.46	10.96	10.71	10.43	10.05	9.38	9.00	8.581	7.94	7.7	8.03	6.281	6.213	6.944
NO_x emissions	-	-	-	-	-	-	-	-	-	-	-	0.0000013	0.0000013	-	0.0000013	-
CO emissions	-	-	-	-	-	-	-	-	-	-	-	0.0000046	0.0000046	-	0.0000046	-

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 – 2005 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	0.06

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 official methodology and activity data.

3.7.2 Methodological issues

Methods

LEGMA received data about CH_4 emissions from the natural gas holding company "Latvijas Gāze" for the time period 1990 – 2005. 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 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.

End user internal gas provision systems

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

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

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:

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

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	2000-2004	2005
EF, g/kg	4.9	0.67	0.17

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 Activity data used for NMVOC emission calculation in 1990 – 2005 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline	26.75	22.75	21.65	20.99	20.11	18.13	17.91	16.46	15.40	14.87	14.83	15.53	15.22	14.69	15.35	15.04

3.7.3. 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.

3.7.4. Recalculations

Some small changes in activity data appear due to changes of updated statistical information.

3.7.5. Planned Improvements

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.

3.8 International bunker fuels

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

Emissions from marine activities have big fluctuations, due to economical reasons. While emissions from aviation are stable and in last three years there can see very small increase (Figure 3.8.1). It can project that also in next years the increase in aviation will be, because essential focus to this sector development is at present actual action.

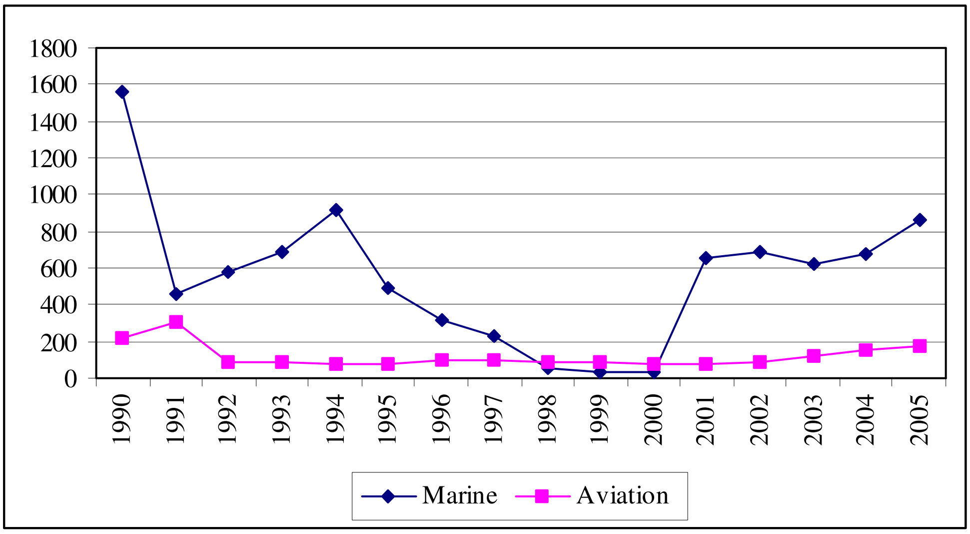


Figure 3.8.1 Emissions from International Bunkers, CO_2-eq (Gg)

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

Table 3.8.1 Energy consumption in international transport, TJ*

	1990	1995	2000	2001	2002	2003	2004	2005
Aviation								
Jet Kerosene	3067.0	1080.0	1123.0	1123.0	1166.0	1685.0	2030.0	2462.0
Navigation								
Diesel oil	5013.8	1105.0	340.0	4249.0	3612.0	3102.0	3186.8	3824.1
RFO	14737.8	5156.0	NE	3938.0	4994.0	4750.0	5278.0	7064.4

* data from Central Statistical Bureau of Latvia, 2006

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

	CO_2	CH_4	N_2O	NO_x	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
2004-2005	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
2000-2005	0,2	40,6	0,097

CSB has finished work on times series of international bunkering fuel consumption; therefore data for 1991-1994 are recalculated.

4. INDUSTRIAL PROCESSES (CRF 2)

4.1 Overview of sector

Output growth of manufacturing in the last 7 years (1999 – 2005) equalled to approximately 6.6% annually by 4.9 percentage points lagging behind the average growth indicator of the whole national economy. It should be taken into consideration, that 1999 was unfavourable for industry as production outputs declined under the impact of the Russian crisis (Figure 4.1.1).

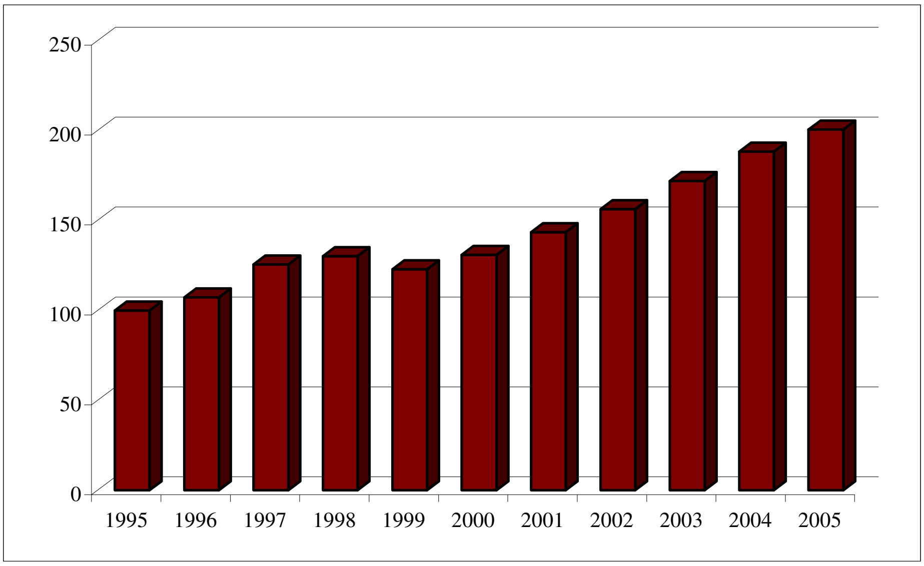


Figure 4.1.1 Manufacturing output, (1995 = 100%)

In the last five 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 industries

	2000	2001	2002	2003	2004	2005
Share of manufacturing industries in GDP (%)	13.70	13.90	13.70	13.30	13.20	12.80
Share in total employment (%)*	18.07	17.26	16.89	17.28	16.01	14.86
Growth rates (% change against the preceding year)	7.42	12.72	9.10	12.52	15.92	15.64
Share in fixed investment (%)**	13.76	15.53	16.03	15.18	15.06	16.23
Investment (% change against the preceding year)**	0.52	16.64	10.57	11.67	21.61	14.01
Share in foreign direct investment stock (%)	21.79	22.11	21.31	21.06	17.76	18.02

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

Tendencies of stable manufacturing growth continued also in 2005. 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 manufacturing industries in GDP of Latvia in 2005 was only 12.8%. 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 [16].

Food industry is the biggest sector of manufacturing in Latvia (24.27% of the total manufacturing output in 2005).

In 2005 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 6.29% of the manufacturing output. The majority of produced output (78,4% of export) is exported to the EU member states.

Chemical industry in Latvia has stable traditions, highly qualified specialists, and 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 2.97%. Exports of chemical products go in almost equal shares to all major trading partners of Latvia (EU-15, Lithuania, Estonia and Russia), 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) – 4.77% of total manufacturing out, had high growth rates in 2004 and 2005 (18.75% and 19.52% 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 11.55% of the manufacturing output. With the development of construction also the demand for ready-made metal goods is going up [16].

Industrial greenhouse gas emissions contribute 2.54% to the total anthropogenic greenhouse gas emissions in Latvia in 2005 (Table 4.1.2). The most important emission source in the Industrial Processes in 2005 is CO_2 emissions from Mineral products with the 2.79%, CO_2 emissions from Metal production with 0.51 %. F-gases contribute 0.24 % 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 in 1990 – 2005 (Gg CO_2 eqv)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial Processes - total	**525.29**	**362.26**	**173.11**	**64.50**	**201.46**	**167.86**	**183.22**	**206.34**	**209.99**	**254.00**	**201.54**	**220.54**	**236.79**	**246.58**	**255.40**	**276.74**
2.A Mineral Products	481.04	348.27	155.63	41.87	168.78	140.18	155.94	158.97	159.23	200.42	146.14	164.21	177.59	184.96	194.81	211.16
2.C Metal Production	44.25	14.00	17.47	22.64	32.68	27.14	25.67	44.39	45.44	45.82	45.54	44.55	44.00	44.26	38.99	38.92
2.F HFCs	NA	NA	NA	NA	NA	0.29	1.32	2.47	4.61	6.78	8.59	9.81	11.83	12.95	16.24	19.12
2.F SF_6	NA	NA	NA	NA	NA	0.25	0.29	0.51	0.71	0.98	1.28	1.98	3.38	4.41	5.37	7.53

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 1990 and 1993 (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.

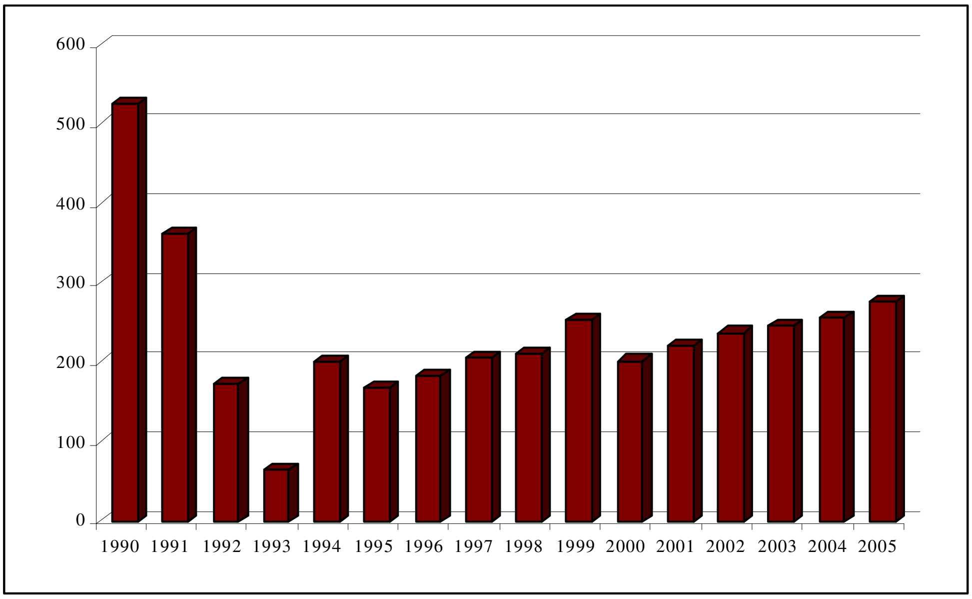


Figure 4.1.2 Total GHG emissions from Industrial Processes in 1990 – 2005 (Gg CO_2 eqv)

4.2 Mineral Products (CRF 2.A)

4.2.1 Source category description

2.A Mineral Products sector is main source of GHG emissions in Industrial Processes sector. CO_2 emissions from 2.A.1 Cement production are key source category with respect to Level Assessment without LULUCF sector – 1%. CO_2 emissions from 2.A.1 Cement Production and CO_2 emissions from 2.A.3 Limestone and Dolomite Use are key source categories with respect to Trend Assessment – 1% each respectively.

At the moment the most important for non-energy CO_2 emission sources from Industrial Processes sector are cement, lime production, bricks and tiles production and limestone use for glass and metal production. Total GHG emissions from mineral products contribute 76,3% from all GHG emissions in Industrial Processes sector.

The NMVOC emissions from road paving and asphalt roofing are included. As well as NMVOC emissions from glass fibre production are included. The SO_2 emissions from cement production are reported. NO_x and CO emissions from cement production are reported in 2.A.7 Other sector due to structure of CRF Reporter software because it is not possible to report NO_x and CO emissions in 2.A.1 Cement Production sector.

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 1999 to 2000 are influenced by economical crisis in neighbourhood country Russian Federation whom Latvia had strong foreign trade linkage.

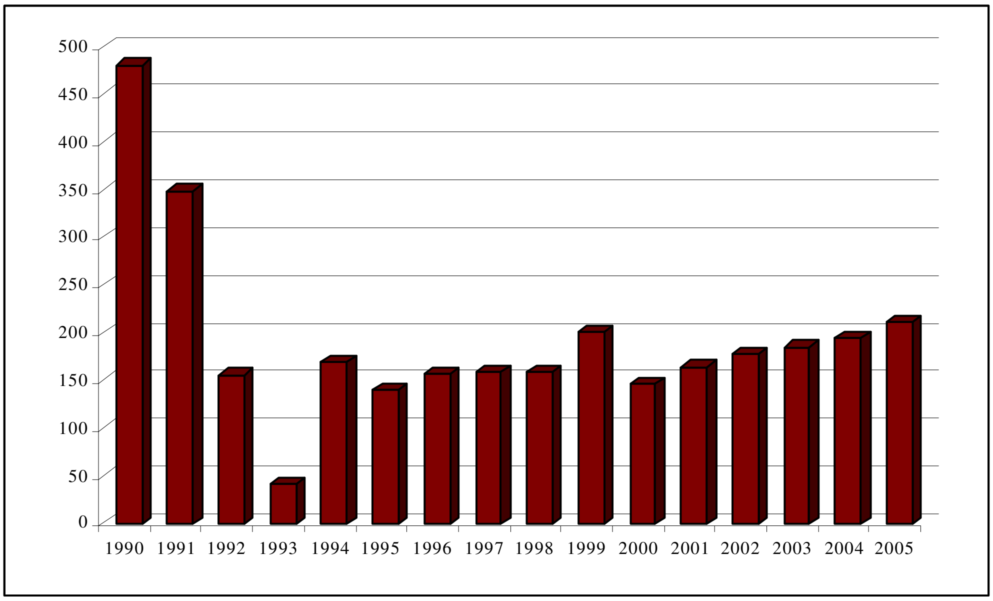


Figure 4.2.1 Carbon dioxide emissions from 2.A Mineral Products in 1990 – 2005 (Gg)

4.2.2 Methodological issues

Methods

Both the IPCC 1996 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 NO_x and NMVOC emissions from cement clinker production EMEP/CORINAIR Guidebook methodology was used.

CO_2 emissions from cement are calculated based on data of clinker production according to Tier2 method from IPCC GPG 2000 as it should be for key source category as well as CO_2 emissions from Limestone and Dolomite Use in Glass and Metal industry that are estimated with Tier2 method based on plant specific activity data and emission factors.

CO_2 emissions from Lime production are calculated based on data of dolomite use in lime production. There is only one industrial lime producer in Latvia and only dolomite that is national easy available raw material for production of lime is used for 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 4.2.2).

Emission factors

The main sources for emission factors are:

- Plant specific emissions factor for CO_2 emission estimations reported by facilities developed and used for CO_2 Emission Trading Scheme;
- IPCC 1996;
- EMEP/CORINAIR Emission Inventory Guidebook 2006.

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 CaO and CaO*MgO content is taken into account.

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 $_{kg\ dolomite}$ contains:

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 within Emission Trading Scheme.

Emission factors used in Mineral Production sub-sector are shown in Table 4.2.1.

Table 4.2.1 Average CO_2 emission factors (t CO_2 / t product or raw material)

EF / production	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	0.525
Lime (prod)	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
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	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	0.477
production of lime in Iron and Steel plant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.785
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	0.415
use of clay for production of bricks																
1. plant	-	-	-	0.042	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.048	0.145
2. plant	-	-	-	-	-	-	-	-	-	0.066	0.066	0.066	0.066	0.066	0.066	0.115
3. plant	-	-	-	-	-	-	-	-	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.112
4. plant	-	-	-	-	-	-	-	-	-	-	0.051	0.051	0.051	0.051	0.051	0.098
5. plant	-	-	-	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.045	0.018
use of clay for production of tiles	-	-	-	-	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

Estimation of CO_2 emission factor in bricks production plants is rather complicated and based on physical and chemical characteristics of raw materials and type of activity data for estimations of emissions.

Estimation of CO_2 emission factor in first bricks production – CO_2 emission factors given in Table 4.2.1 are estimated as average for amount of used raw materials – bricks.

1. plant (Table 4.2.1):

- First plant estimate CO_2 emissions based on final production according to volume of one brick, moisture content and percentage of clay in one brick after firing of bricks;
- MgO content in raw material (carbonates) – 4,9% so emission factor is 1,092 t CO_2/t MgO; CaO content in raw materials – 11,6% so emission factor is 0,785 tCO_2/t CaO. Emission factor is estimated by coherence:

$$R[tCO_2 / t_{izejv.}] = MgO_R \cdot (S_1/100) + CaO_R \cdot (S_2/100) =$$
$$= 1{,}092 \cdot (4{,}9/100) + 0{,}785 \cdot (11{,}6/100) = 0{,}1446$$

where:
R – emission factor of clay tCO_2/ t clay
MgO_R – emission factor of magnesia tCO_2/ t MgO
CaO_R - emission factor of calcium oxide tCO_2/ t CaO
S1 – content of magnesia in clay (%)
S2 – content of calcium oxide (%)

- CO_2 emission factor for this plant for time period 1993 – 2004 are taken from Commission Decision 2004/156/EC of 29 January 2004 establishing guidelines for the monitoring and reporting of GHG emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council;

- For 2005 plant specific CO_2 emission factor is used.

2., 3., 4. and 5. plant (Table 4.2.1):

- CO_2 emission factor for this plant for time period 1999 – 2005 are taken from Guidelines established for Emission Trading Scheme where emission factor is estimated with this equation:

$$X_Y\left(CO_3\right)_Z = \left[M_{CO_2}\right] / \left\{Y \times \left[M_x\right] + Z \times \left[M_{CO_3^{2-}}\right]\right\}$$

where:
X = alkali earth or alkali metal
Mx = molecular weight of X in (g/mol)
MCO2 = molecular weight of CO_2 = 44 (g/mol)
MCO3- = molecular weight of CO_3^{2-} = 60 (g/mol)
Y = stoichiometric number of X
= 1 (for alkali earth metals)
= 2 (for alkali metals)
Z = stoichiometric number of CO_3^{2-} = 1

- Emission factors are – $CaCO_3$ – 0,44 and $MgCO_3$ – 0,522.
  – CaO – 0,785 and MgO – 1,092

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 1999. CSB gives only restricted information on production and output of goods since 1999, 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 Products sector because only some or even one facility operates in each sub-category of Mineral Products sector. There is only one facility of cement production, one facility of lime production, two facilities of glass production, five facilities of bricks production and one facility of tiles production.

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

The activity data to calculate NMVOC emissions from road paving and asphalt roofing are from the CSB (Table 4.2.2).

Table 4.2.2 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	17.01	9.70	4.36	7.31
1999	56.00	31.92	14.36	24.08
2000	47.99	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	52.01	29.64	13.34	22.36
2004	47.99	27.36	12.31	20.64
2005	60.01	34.21	15.39	25.80

* data from the CSB

Emissions from dolomite and limestone use in glass and metal production are reported in 2.A.3 Limestone and Dolomite use according to recommendations of Expert Review Team. Data of lime production in Iron and Steel facility is reported under 2.A.3 sector because produced lime is used straight in Iron and Steel production process together with raw limestone and dolomite and this produced lime is not a final product of facility. Data on dolomite and soda use are available only from 2000 as new enterprise went into a business. Data of soda ash use in glass production are reported under 2.A.4 Soda Ash Production and Use sub-sector.

4.2.3. 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. CO_2 emission factors for raw materials used in glass production were taken from IPCC Guidelines or Guidelines established for Emission Trading Scheme and uncertainty was assigned as about 10 %.

Uncertainty of activity data for estimations of CO_2 emissions from Asphalt roofing and Road Paving with Asphalt as well as uncertainty of CO_2 emission factor is assumed rather high 70% because default methodology is used in estimations and default percentage for used bitumen is used.

4.2.4 Recalculations

According to the contract between LEGMA and CSB updated information of industrial production was available for time series 1999 – 2005, so clinker and shoes production data as well as pulp and paper and food and drink data were changed.

Soda use are excluded from 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". Data of used limestone and dolomite in glass and metal production were excluded from 2.A.7 Other sector and included in 2.A.4 Limestone and Dolomite Use according to recommendations from Expert Review Team.

Data of CO_2 emissions from bricks production were taken from reports that facilities submitted within Emission Trading Scheme for each producer and after that average emission factor were estimated. For previous submission average emission factor from total 5 bricks production facilities were estimated and then multiplied with activity data.

4.2.5 Planned 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.

4.3 Chemical Industry (CRF 2.B)

Although Latvia has old traditions on chemical industry, at the moment no production of in the Revised 1996 IPCC Guidelines mentioned substances are occurred.

4.4 Metal Production (CRF 2.C)

4.4.1 Source category description

Emissions from metal production contribute 14.1% from all emissions in Industrial Processes sector. CO_2 emissions from coke use as reducing agent and crude iron as input material (since 1993) in iron and steel production are included in the inventory.

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

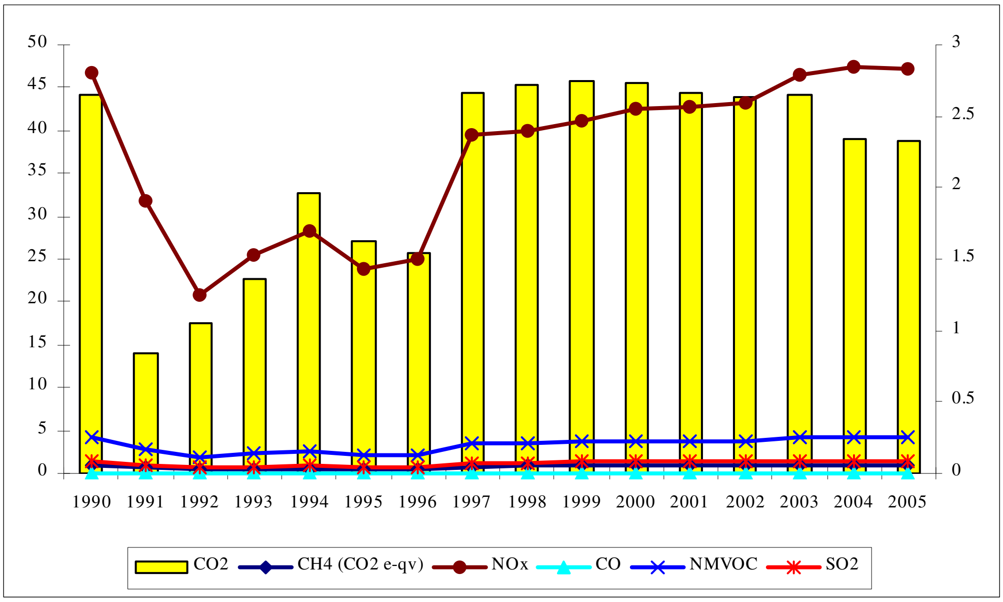


Figure 4.4.1 Direct and indirect GHG emissions from 2.C Metal Production in 1990 – 2005 (Gg)

Biggest decrease occurred in time period 1990 – 1991 due to crisis in Latvia's national economy. Decrease of CO_2 emissions in latest years occurred due to decrease of coke consumption in Iron and Steel industry although consumption of crude iron increased. It is explained with modification of production process when most Iron and Steel primary and final products are produced by melting down crude iron. Also final amount of steel products produced in only metal industry facility decreased in latest years.

4.4.2 Methodological issues

Methods

Both the IPCC 1996 Tier2 and EMEP/CORINAIR are used to calculate GHG emissions from the 2.C Metal Production 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, NO_x 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" according to EMEP/CORNAIR methodology and emission factors.

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
- IPCC 1996;
- 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 4.4.1).

Table 4.4.1 Emission factors of metal production

	CO_2	CH_4	NO_x	CO	NMVOC	SO_2
	(t/t)	(t/t)	(t/t)	(t/t)	(t/t)	(t/t)
1. Iron and Steel Production						
Steel		0,000005	0,0051	0,000001	0,00045	0,00016
Use of coke	3,489	NR	NR	NR	NR	NR
Crude iron	0,147	NR	NR	NR	NR	NR

NR- not relevant

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

Emission factors for NO_x, NMVOC and SO_2 emissions are taken from EMEP/CORINAIR Guidelines according to methodology for estimations of emissions from processes in open-heart furnaces, where 95% of total steel production is produced. In previous submission emission factors from IPCC Guidelines concerning methodology for estimations of emissions from general Iron and Steel production processes without division in technology specific methodology were used.

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 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.

4.4.3 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 5% so it is apposite for open – heat furnaces – technology mainly used in facility operated in iron and steel industry in Latvia.

4.4.4 Recalculations

CH_4, SO_2, NMVOC and NO_x emission factor for steel production was applied according to EMEP/CORINAIR Emission Inventory Guidebook – 3rd edition (2002). For submission 2006 default emission factors from IPCC 1996 were used.

Emission factors for indirect GHG emission estimations were taken from EMEP/CORINAIR Guidelines concerning plant specific open-heart furnaces technology so emission were recalculated for all year in time series 1990 – 2005.

Small and inconsiderable changes in activity data of total steel production occurred due to changes of statistical information.

4.4.5 Planned 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.

4.5 Other Production (CRF 2.D)

4.5.1 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.

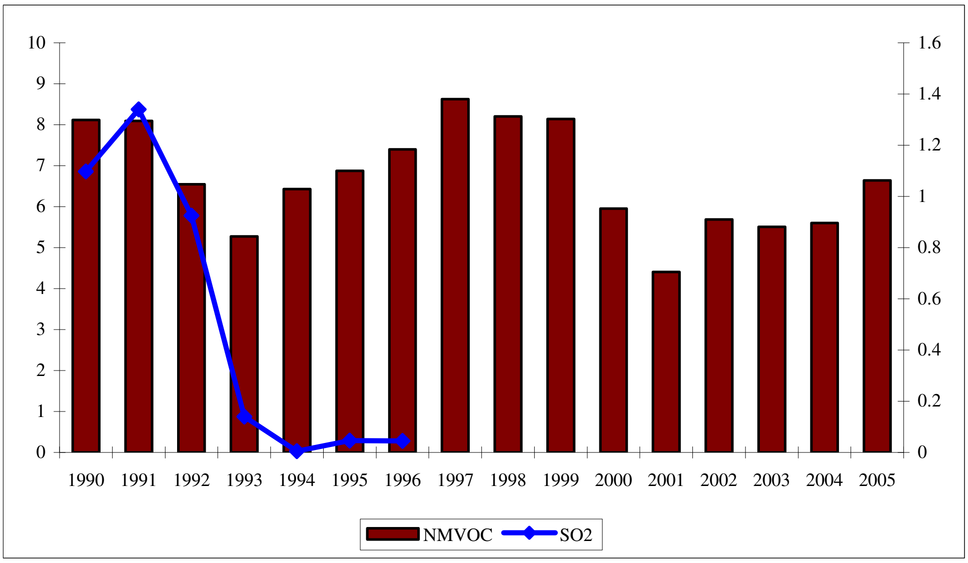


Figure 4.5.1 Total emissions from 2.D Other Production in 1990 – 2005 (Gg)

For last years in time period 2002 – 2004 NMVOC emissions were stable, biggest fluctuations occurred in time period 1991 – 1994 due to changes in economical situation in country (Figure 4.5.1). For 2005, NMVOC emissions increased sharply due to increase in food and drink industry in Latvia that was caused by increase of in country demand for food and drink production, improvement of well-being and increase of food and drink production export.

SO_2 emissions are reported for time period 1990 – 1996 when pulp and paper industry were closed due to facility closes. In latest years wood-pulp and paper industry is developing again still wood-pulp is imported and not produced in country so SO_2 emissions that occurred in pulp production processes are not emitted.

4.5.2 Methodological issues

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 as well as SO_2 emissions from pulp and paper industry are calculated at the LEGMA. Methodology of 1996 IPCC was used in estimations.

Emission factors

The NMVOC emission factors (Table 4.5.1) are taken from the IPCC 1996.

Table 4.5.1 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 4.5.2). LEGMA has signed an agreement with CSB to get data of total production of products from sectors where data are confidential.

Table 4.5.2 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	2005
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	NO
2. Food and Drink		**1212.3**	**1239.9**	**912.5**	**703.7**	**578.3**	**611.7**	**619.0**	**668.4**	**653.0**	**675.6**	**722.0**	**769.6**	**855.6**	**863.0**	**871.4**	**867.2**
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	73.4
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	1288.0
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	308.2
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	243.8
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	71.1
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	32.9
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	114.3
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	238.1

4.5.3 Uncertainty

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

4.5.4 Recalculations

In this submission data on food and drink consumption was recalculated due to actualized and revised activity data obtained from the CSB according an agreement between LEGMA and CSB.

4.5.5 Planned Improvements

Currently no future improvements are foreseen for this category.

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

Halocarbons and SF_6 are not produced in Latvia.

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

4.7.1 Source category description

Latvia has ratified *Convention for the Protection of the Ozone Layer* (Vienna, 1985) and its *Protocol on Substances Depleting the Ozone Layer* (Montreal, 1987). These documents are aimed to take out the circulation of completely halogenated alkanes (CFC-11, CFC-12, CFC-113, and CFC-114), partly halogenated alkanes (CFC-22, CFC-21) and halons, and to substitute them with alternative substances like hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (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 1995 - 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 – 0.54 (CO_2 eqv. thousand tons) in 1995 and 26.66 thousand tons in 2005 (Table 4.7.1 – Table 4.7.8, Figure 4.7.1). 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 [15].

Table 4.7.1 Actual emissions of SF_6

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2.F.8 (kg)	10.51	12.02	21.26	29.69	40.89	53.35	82.71	141.50	184.66	224.67	315.07
GWP (CO_2 eqv. Gg)	0.251	0.287	0.508	0.710	0.977	1.275	1.977	3.382	4.413	5.370	7.530

Table 4.7.2 Actual emissions of HFC – 134a

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2.IIA.F.1.1	0.067	0.091	0.103	0.115	0.139	0.163	0.187	0.223	0.271	0.331	0.381
2.IIA.F.1.2				0.010	0.019	0.030	0.073	0.098	0.137	0.199	0.218
2.IIA.F.1.3					0.003	0.008	0.024	0.022	0.026	0.038	0.047
2.IIA.F.1.6	0.029	0.865	1.718	3.001	4.281	5.367	6.193	7.144	8.173	10.851	13.108
2.F.4				0.240	0.734	0.995	0.996	1.536	1.164	0.742	0.733
2.F.9	0.050	0.045	0.040	0.048	0.037	0.035	0.039	0.031	0.030	0.034	0.038
Total emissions (t)	0.147	1.001	1.861	3.414	5.213	6.598	7.512	9.054	9.800	12.194	14.524
GWP (CO_2 eqv. Gg)	0.191	1.301	2.419	4.439	6.776	8.577	9.765	11.770	12.740	15.853	18.881

Table 4.7.3 Actual emissions of HFC – 23

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2.IIA.F.1.3 (t)	0.0083	0.002	0.0042	0.0149	NO	0.0008	0.0008	0.0017	0.01	NO	NO
GWP (CO_2 eqv. Gg)	0.0971	0.023	0.0491	0.1743	NO	0.0094	0.0094	0.0199	0.117	NO	NO

Table 4.7.4 Actual emissions of HFC – 32

Source	2004	2005
2.IIA.F.1.2 (t)	0.0401	0.0016
GWP (CO_2 eqv. Gg)	0.0261	0.0010

Table 4.7.5 Actual emissions of HFC – 125

Source	2004	2004
2.IIA.F.1.2 (t)	0.0518	0.0095
2.IIA.F.1.3 (t)	0.0028	NE
Total emissions (t)	0.0546	0.0095
GWP (CO_2 eqv. Gg)	0.1530	0.0266

Table 4.7.6 Actual emissions of HFC – 143a

Source	2004	2005
2.IIA.F.1.2 (t)	0.0072	0.0091
GWP (CO_2 eqv. Gg)	0.0274	0.0346

Table 4.7.7 Actual emissions of HFC – 227ea

Source	2001	2002	2003	2004	2005
2.F.3 (t)	0.0122	0.0122	0.0304	0.0616	0.0616
GWP (CO_2 eqv. Gg)	0.0353	0.0353	0.0882	0.1786	0.1786

Table 4.7.8 Total emissions of HFCs (CO_2 e-qv Gg)

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2.F.1:	**0.2224**	**1.2661**	**2.4165**	**4.2390**	**5.7748**	**7.2469**	**8.4291**	**9.7531**	**11.3058**	**15.0499**	**17.9417**
2.IIA.F.1.1	0.0875	0.1186	0.1342	0.1495	0.1811	0.2124	0.2434	0.2898	0.3519	0.4297	0.4953
2.IIA.F.1.2				0.0134	0.0250	0.0389	0.0943	0.1279	0.1781	0.4566	0.3459
2.IIA.F.1.3	0.0971	0.0234	0.0491	0.1743	0.0033	0.0191	0.0407	0.0480	0.1504	0.0573	0.0607
2.IIA.F.1.6	0.0378	1.1241	2.2332	3.9018	5.5655	6.9765	8.0508	9.2874	10.6253	14.1063	17.0398
2.F.3							0.0353	0.0353	0.0882	0.1786	0.1786
2.F.4				0.3121	0.9541	1.2939	1.2946	1.9967	1.5132	0.9651	0.9523
2.F.9	0.0654	0.0585	0.0516	0.0619	0.0475	0.0454	0.0508	0.0405	0.0385	0.0439	0.0494
Total HFCs (Gg CO_2 eqv.)	**0.2878**	**1.3246**	**2.4681**	**4.6130**	**6.7764**	**8.5863**	**9.8099**	**11.8257**	**12.9456**	**16.2376**	**19.1220**

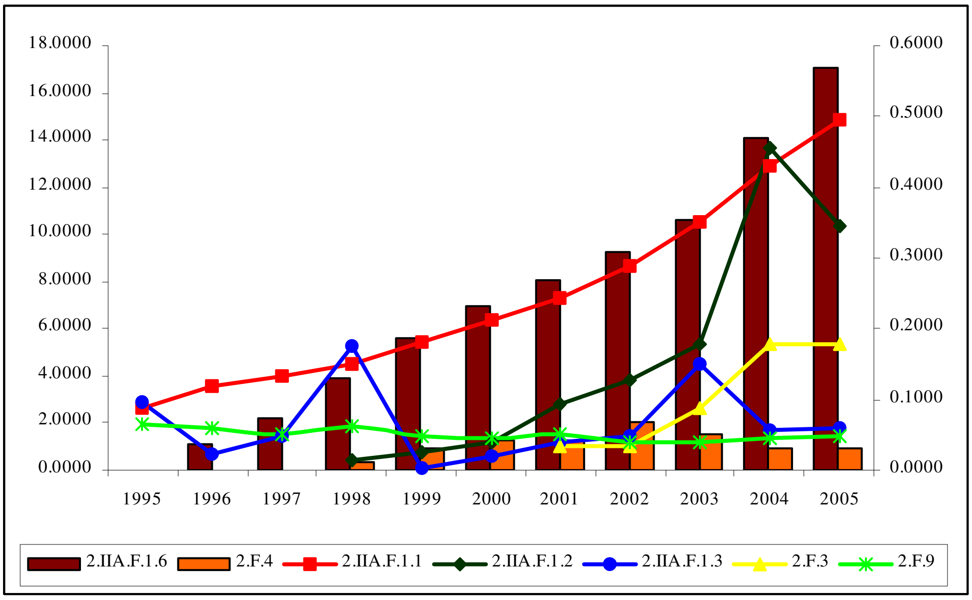


Figure 4.7.1 HFCs emissions from 2.F Consumption of Halocarbons and SF_6 sector in 1990 – 2005 (GWP Gg CO_2 eqv.)

As it can be seen in Figure 4.7.1 only HFC – 134a emissions from 2.IIA.F.1.1 Domestic refrigerators and 2.IIA.F.1.6 Mobile Air-Conditioning sector have increasing tendency. Emissions from other sectors are stable or have decreasing tendency. It is explained with decrease of HFCs gases use in Commercial and Transport refrigerators as well as gas use in medicine inhalators and fire extinguishers. Many enterprises have changed their equipment filled with these HFCs gases to other equipment filled with more environment friendly gases and use them in their existing equipment. Also new technologies that are imported in Latvia already are filled with different gases but HFCs.

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

4.7.2 Methodological issues

Methods

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

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 1992, but since 1995 used amount radical increase.

Tier 3a equation given in IPCC Guideline:

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

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 1992 and only percentage leakage is known Tier 2b was chosen to estimate SF_6 emissions:

$$E_t = 2\% \, fromE_{total} + 95\% \, fromE_{liq}$$

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. 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:

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

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 is 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:

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

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,
E8% – emissions from 8% of cars.

Fire extinguishers

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

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

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]:

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

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 4.7.9).

Table 4.7.9 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.

4.7.3 Uncertainties

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

More precise 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.

4.7.4 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 1999. Also statistical information of households for historic years changes due to updated statistical information.

Some previously made and found mistakes were fixed so it also affected total emissions.

4.7.5 Planned Improvements

Latvia has accepted *Regulation of the European Parliament and of the Council on certain fluorinated greenhouse gases*. Ministry has 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.

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

4.8.1 Source category description

Potential emissions were calculated only for 2004 – 2005 due to lack of statistical information regarding import and export of F – gases (Figure 4.8.1). 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.

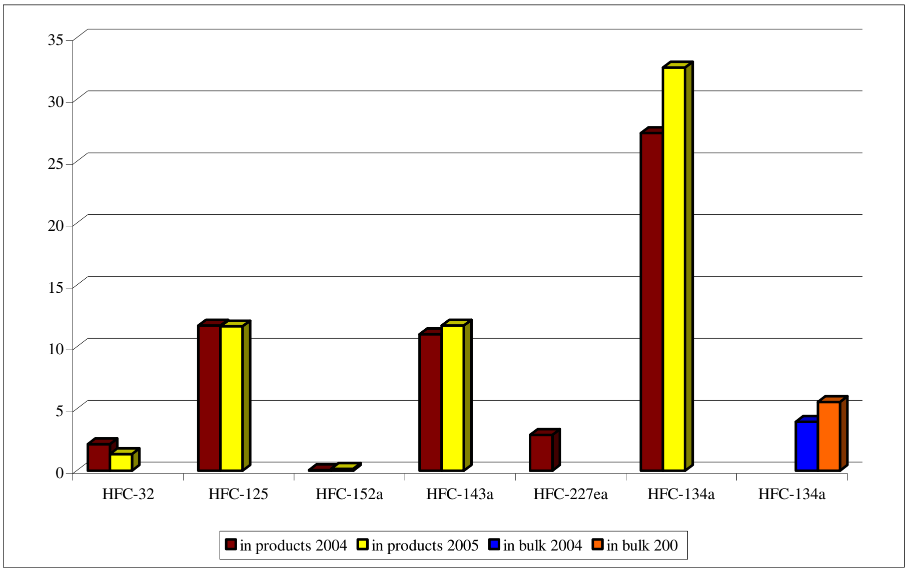


Figure 4.8.1 Total potential emissions in 2004 – 2005 (tonnes)

4.8.2 Methodological issues

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 4.8.1 Imported amounts of chemicals or chemical products 2004 – 2005

Chemicals, products	2004	2005
R 410a	1.5	-
R 407c	6.1	5.9
R 404a	19.8	21.9
R 507	1.5	0.7
R 134a	27.3	32.6
SUVA MP 39	0.5	1.2
SUVA HP 80	-	0.1
SUVA HP 81	-	0.4
Tecfoam SP-27-B5/365/245	2.9	-

Table 4.8.2 Percentage amounts of chemicals in imported products 2004 - 2005

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, SUVA HP 80, SUVA HP 81					13%	
Tecfoam SP-27-B5/365/245						100%

4.8.3 Uncertainties

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

4.8.4 Recalculations

Potential emissions of F – gases were estimated for the first time for submission 2006 and no recalculations were done for previous submitted data in this sector.

4.8.5 Planned 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.

4.9 Other (CRF 2.G)

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

4.10 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 production;
- Glass production;
- Tiles and bricks production;
- Pulp and paper industry.

Only sub-sector not completely 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.

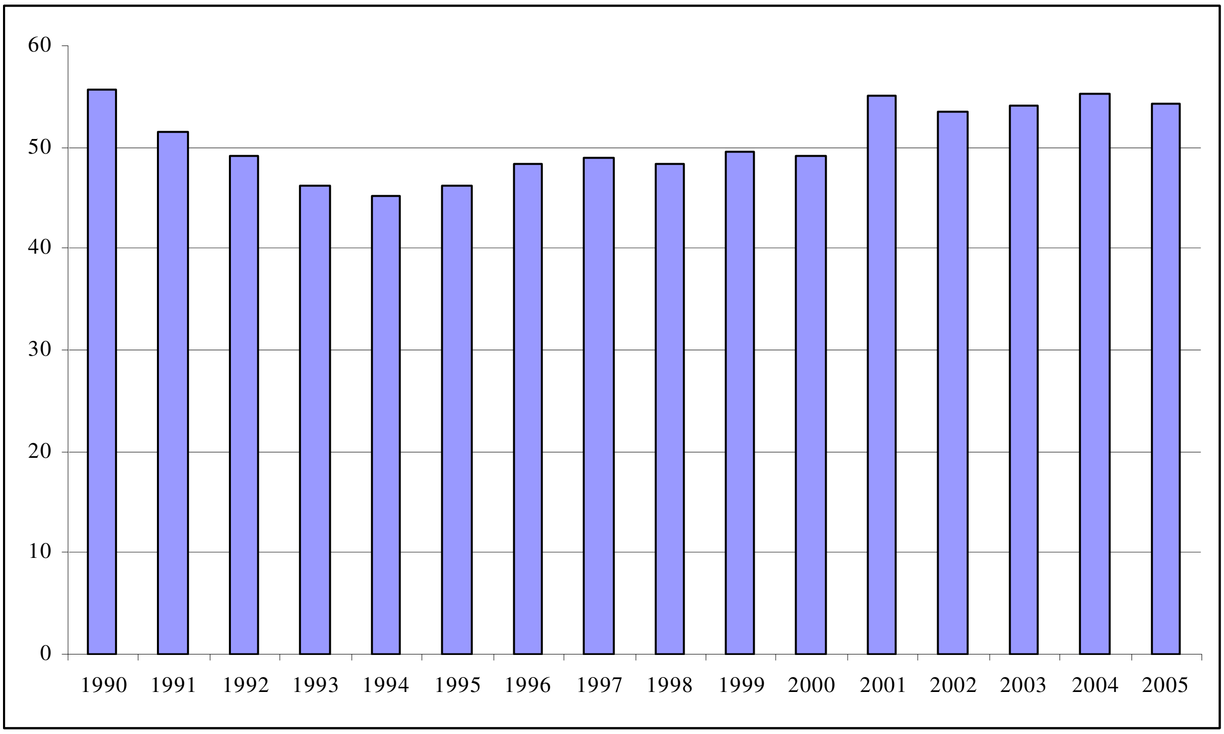
5. SOLVENT AND OTHER PRODUCT USE (CRF 3)

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 1993 and 1995, when industry was going through a crisis (Figure 5.1).



5.1 Total emissions from Solvent and Other Product Use (Gg CO2 eqv.)

The NMVOC emissions from productions of pharmaceuticals are included under Chemical Products, Manufacture and Processing for 1997-2005. 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 1990 [20], and consequently NMVOC emissions for degreasing and dry cleaning and other decreased also.

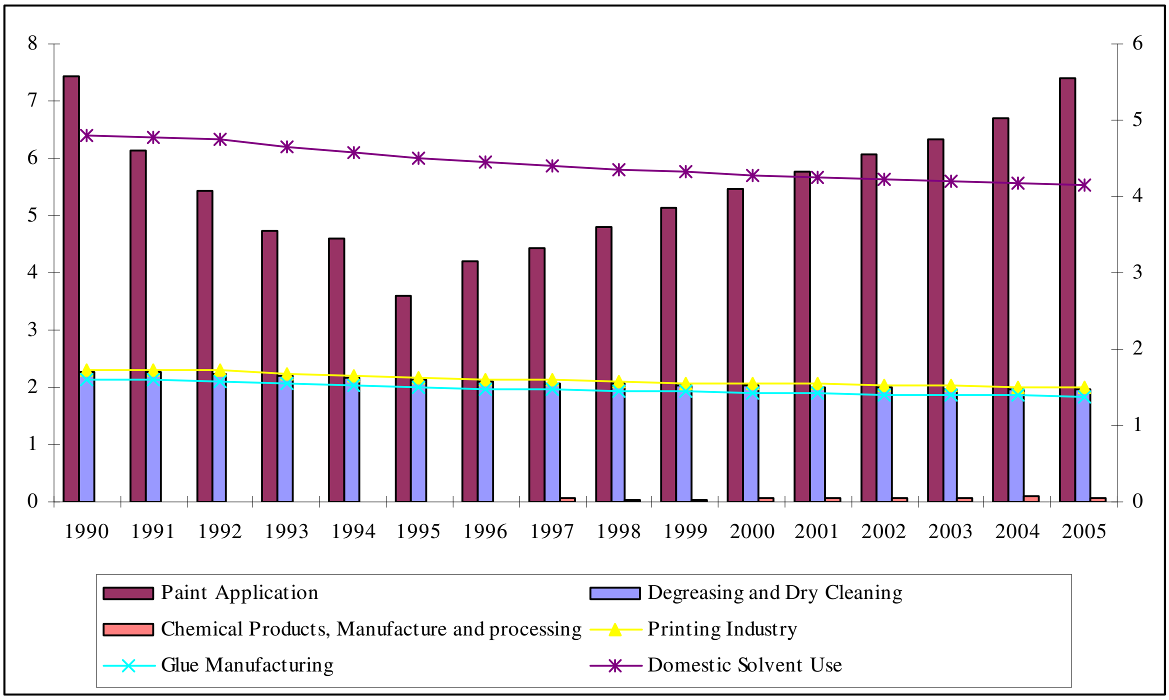


Figure 5.2 NMVOC emissions 1990-2005 (Gg)

The data for the use of N_2O in anaesthesia are available since 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).

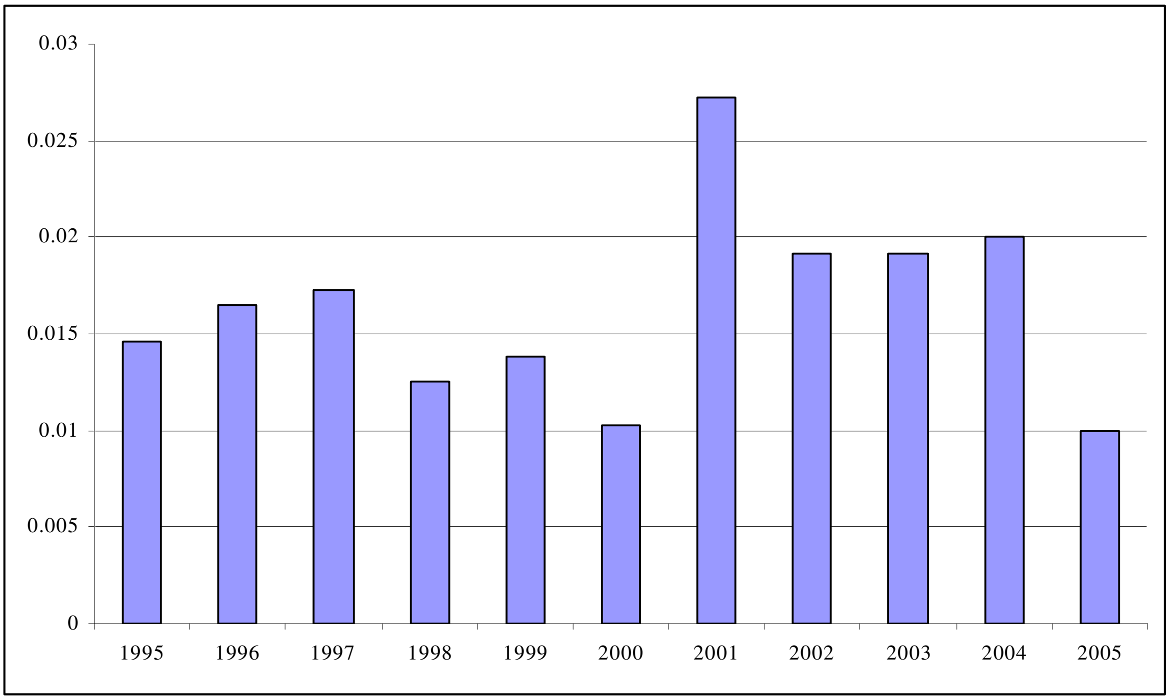


Figure 5.3 N_2O emissions 1995 – 2005 (Gg)

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.

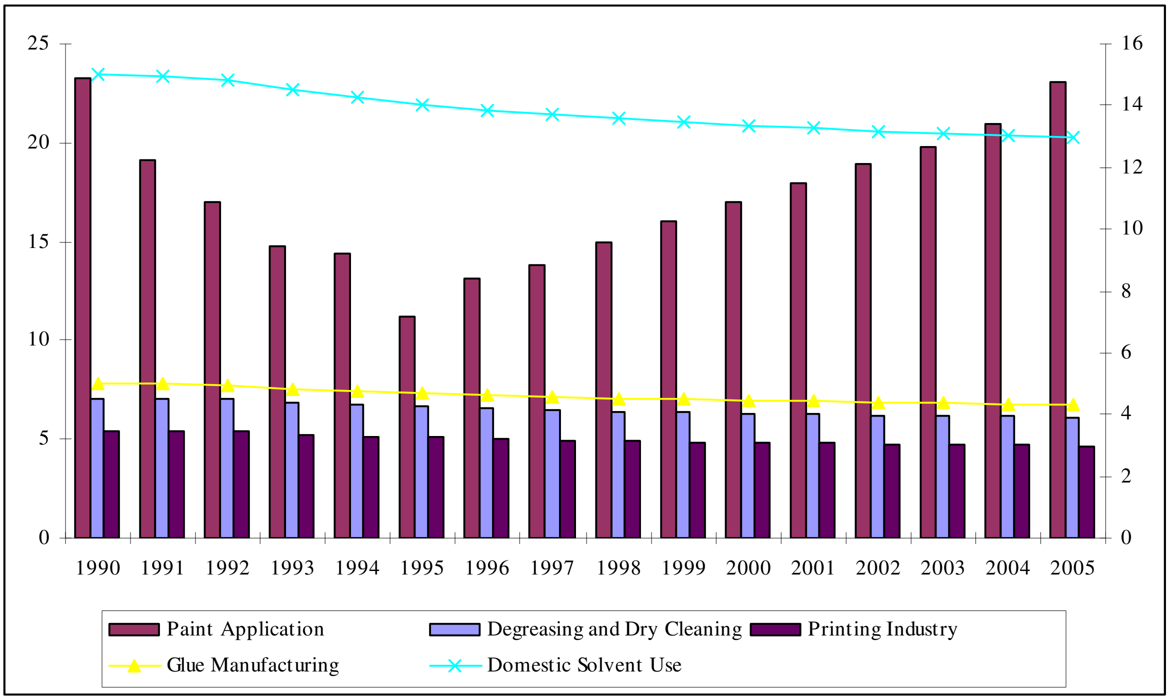


Figure 5.4 CO_2 emissions 1990-2005 (Gg)

5.2.2 Methodological issues

The IPCC 1996 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.

5.2.3 Uncertainties

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, which import and/or realise this gas. It is assumed that uncertainty is negligible (2%).

5.3 Recalculations

No recalculations done for this sector.

5.4 Planned Improvements

Currently no future improvements are foreseen for this category.

6. AGRICULTURE (CRF 4)

6.1 Overview of sector

Agriculture is one of the significant branches in Latvia. According to the data provided by the CSB in 2005 the Gross Domestic Product (GDP) of Latvia reached 8937.3 million lats showing increase of the GDP for 10.2% if compared to 2004. Low productivity and external competition are the main obstacles of the development of this sector. Development of agriculture will depend on adjustment of agricultural production facilities and products to the EU standards and quality criteria and on the external demand. Latvia's accession to the EU ensures more equal competition opportunities for farmers in the EU internal market, while support from the EU funds facilitates modernisation of agriculture and diversification of agricultural activities [2].

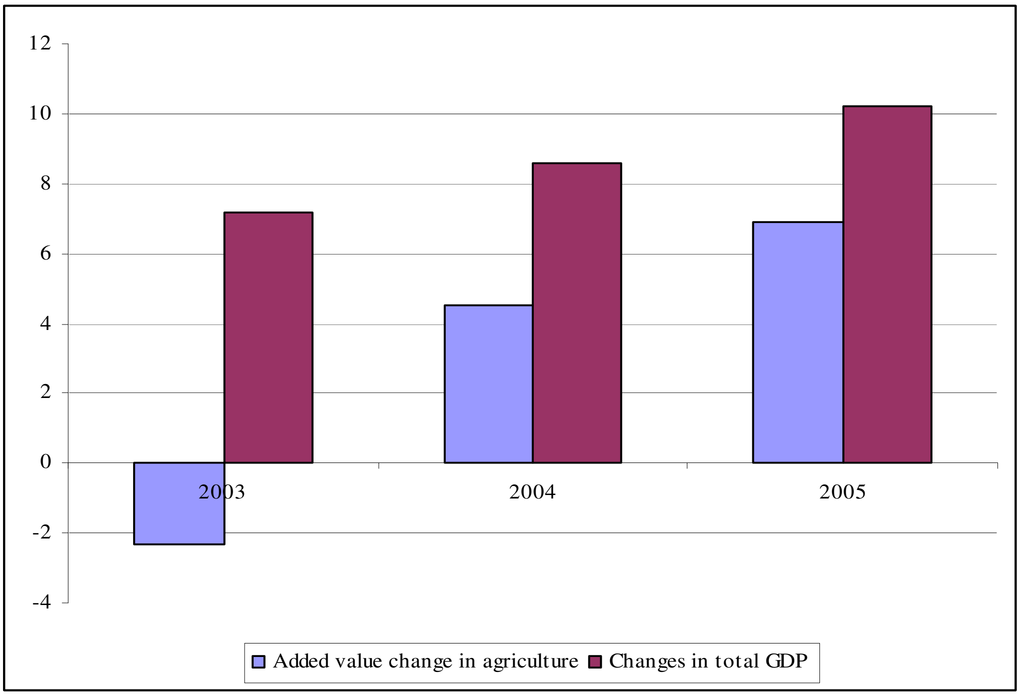


Figure 6.1 Changes of GDP added value in 2003 – 2005 (%) [2]

The emissions of greenhouse gases from the Agriculture 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.

Rise isn't cultivated in Latvia and savannas don't exist. 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.

In 2005, the Agriculture sector contributes 18% from total national emissions. Total GHG emissions from agriculture have declined approximately 68% over the period of 1990 – 2005 (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.

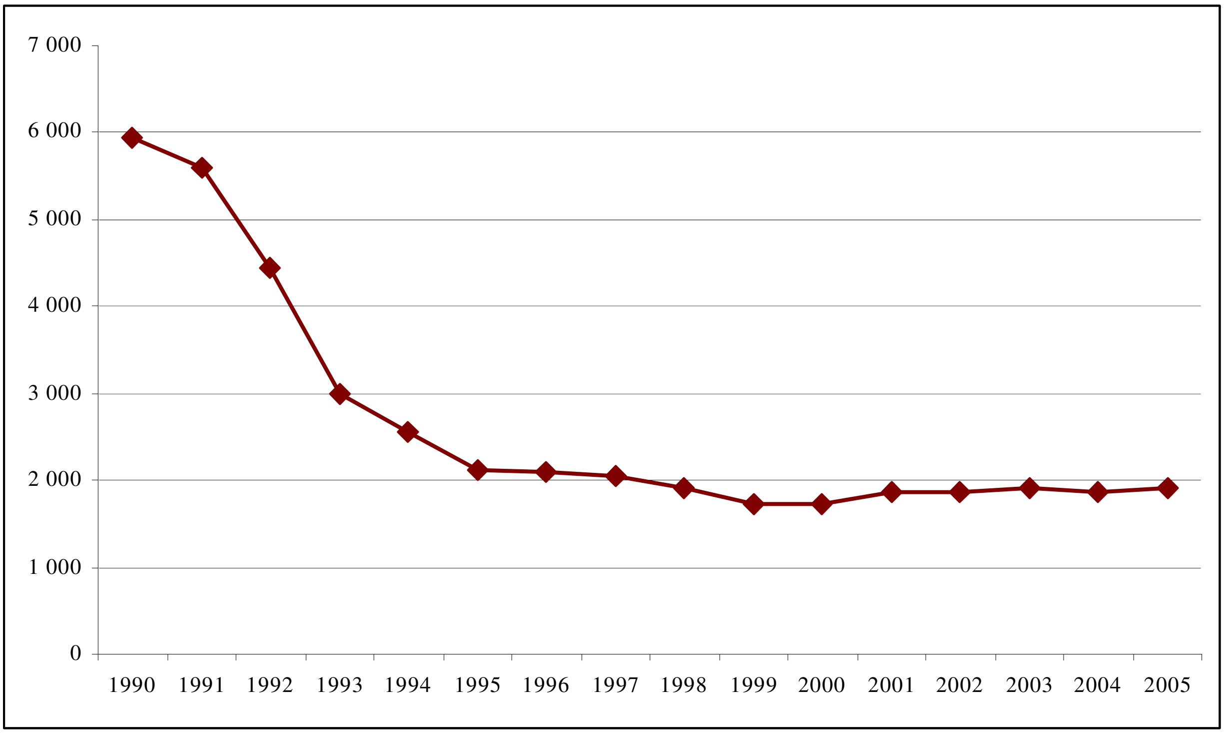


Figure 6.2 Trend in agricultural emissions in 1990 – 2005 (Gg CO_2 eqv.)

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 - 2005

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	31.47
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	27.50
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	3.97
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	4.06
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	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	3.57

6.2 Enteric Fermentation (CRF 4.A)

6.2.1 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 2005. CH_4 emissions were 27.50Gg and decreased 72% since 1990 due to decreasing number of cattle (Figure 6.3).

CH_4 emissions from Enteric Fermentation are key source accordingly level and trend assessment (including LULUCF) and contribute 2%.

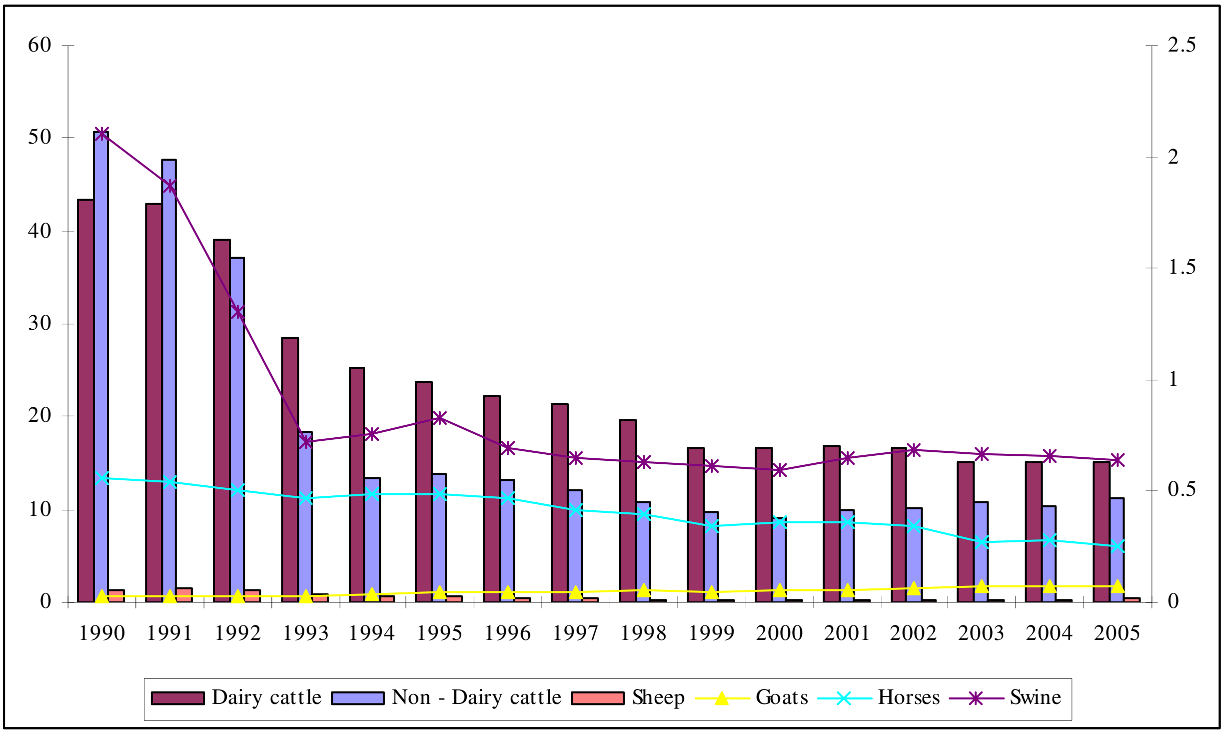


Figure 6.3 Methane emissions from Enteric Fermentation in 1990 – 2005 (Gg)

6.2.2 Methodological issues

Methods

Calculation of emissions is based on methods described in the IPCC 1996 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 IPCC 1996 (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 -2005 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
2005	185	200	42	15	14	428	4092

The source of data on the number of livestock in state farms and statutory companies are 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. 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. The sample for 2005 covers a total of 15.0 thsd farms selected by economic size and specialisation. [3].

6.2.3 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 2000).

6.3 Manure Management (CRF 4.B)

6.3.2 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 12% of total agricultural emissions (expressed in CO_2 equivalents) in 2005.

According trend assessment CH_4 and N_2O emissions from Manure Management were key source and contributes 1%.

Methane emissions from Manure Management were 3.97 Gg. CH_4 emissions from Manure Management have decreased 70 % during the time period 1990 - 2005 (Figure 6.4).

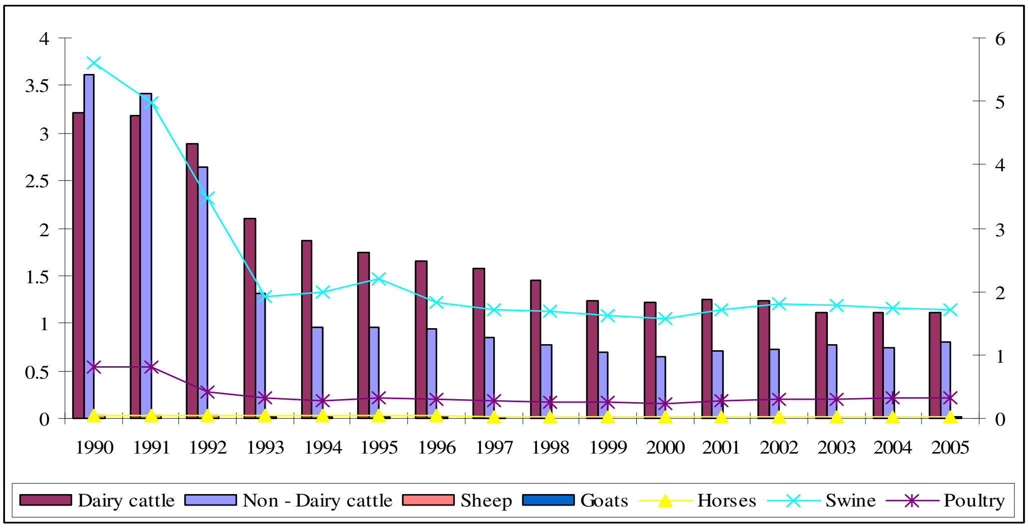


Figure 6.4 CH_4 emissions from Manure Management in 1990 – 2005 by livestock type (Gg)

In 2005, nitrous oxide emissions from Manure Management were 0.49 Gg. It is observed, that emissions from Manure management have decreased 73% from 1990 to 2005 (Figure 6.5).

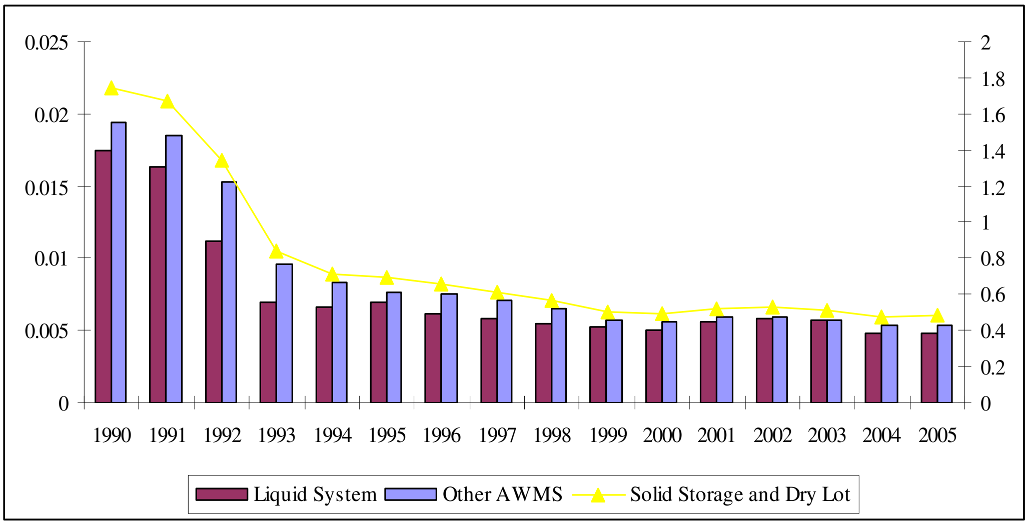


Figure 6.5 Nitrous oxide emissions from Manure Management in 1990 – 2005 by manure management system (Gg)

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.

6.3.2 Methodological issues

Methods

The IPCC 1996 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 [17].

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 2004-2005

	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 excretions per head of animal [17]

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.

6.3.3 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 default emission factors (Tier 1) and in the IPCC GPG 2000 is described that they are with very large uncertainty, therefore was used 30% uncertainty.

6.4 Rice Cultivation (CRF 4.C)

Rice is not cultivated in Latvia.

6.5 Agricultural Soils (CRF 4.D)

6.5.1 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.

Accordingly level and trend assessment (including LULUCF) of key source for 2005 direct N_2O emissions from agricultural soils consist 3% and 2% respectively but indirect N_2O emissions from Agricultural Soils consist 2% regarding trend assessment.

N_2O emissions from Agricultural Soils contribute 57.6 % of total agricultural emissions (expressed in CO_2 equivalents) in 2005. Nitrous oxide emissions from Agricultural Soils were 3.57Gg in 2005.

Emissions have decreased and fluctuated over the period 1990 – 2005 (Figure 6.6). It is due to decreased animal numbers that affected the amount of nitrogen excreted annually to soil. In the latest years can observed that emissions have increased. The main reason is increasing use of synthetic fertilizers.

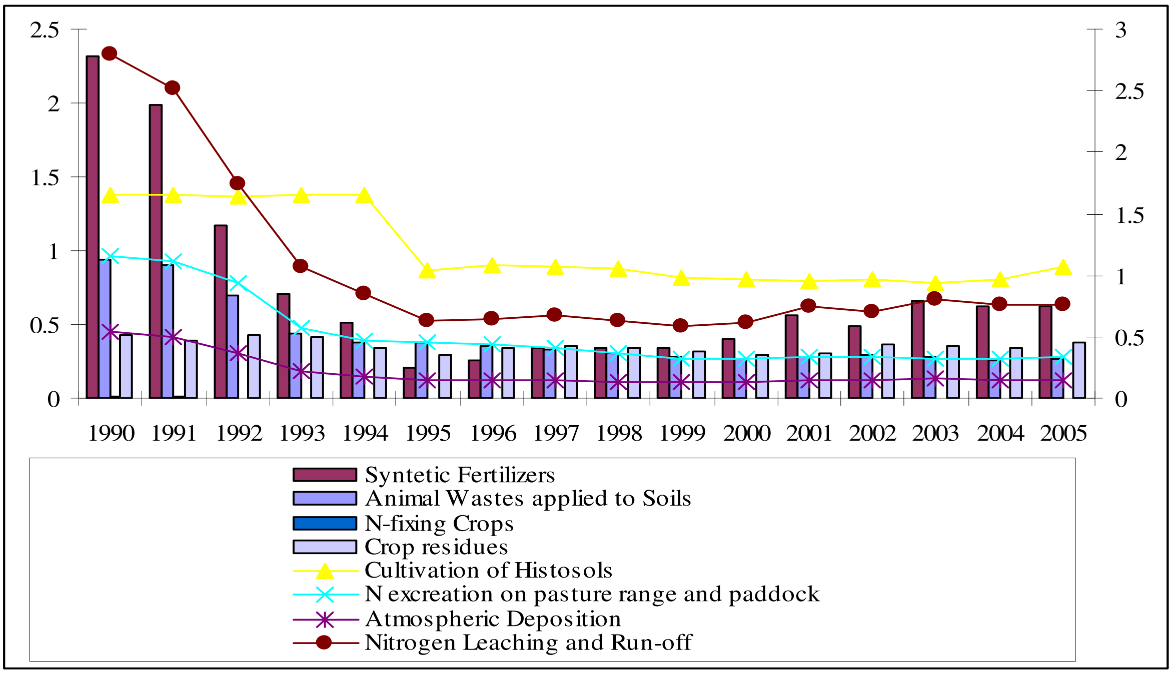


Figure 6.6 Direct and indirect N_2O emissions from Agricultural Soils by source category

6.5.2 Methodological issues

Methods

Calculation of emissions is related to the IPCC 1996 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
2005	41

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
2005	676.5	365.8	122	87.2	145.7	658.2	519.9	172.2	3.5

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 scientists and publications.

Some information from research is described below:

The biggest part of histosols consists in the fallow land and it reflects to the area, which isn't used for agriculture. Since 1990-ties 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 -2005 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 -2005

Years	%
1990 - 2002	18.6
2003	15.8
2004	13
2005	17.2

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 – 2005 [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***
2005	1091.8	12.8	628.9	*108.17*	*1212.77*	***84.89***

6.5.3 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 2000, 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 2000 - 25%.

6.6 Burning of Savannas (CRF 4.E)

Burning of Savannas does not occur in Latvia.

6.7 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 aren't estimated.

6.8 Recalculations

For 2004 was a reassessed N_2O emission from Manure Management regarding sheep, because weren't using correct % of distribution of pasture range and paddock.

6.9 Planned Improvements

There are necessary following improvements:

1. As CH_4 emissions from Enteric Fermentation is key source then necessary to use detailed methodology for calculation and therefore try to define national CH_4 emission factors;
2. Assessment of uncertainties for Agriculture sector is very incomplete and necessary to work together with national experts for improving data.

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

7.1 Overview of sector

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 2950 thsd. ha in 2005 and it covers 45% of total land area of Latvia.

In submission 2007, 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 was 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 2007, 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.

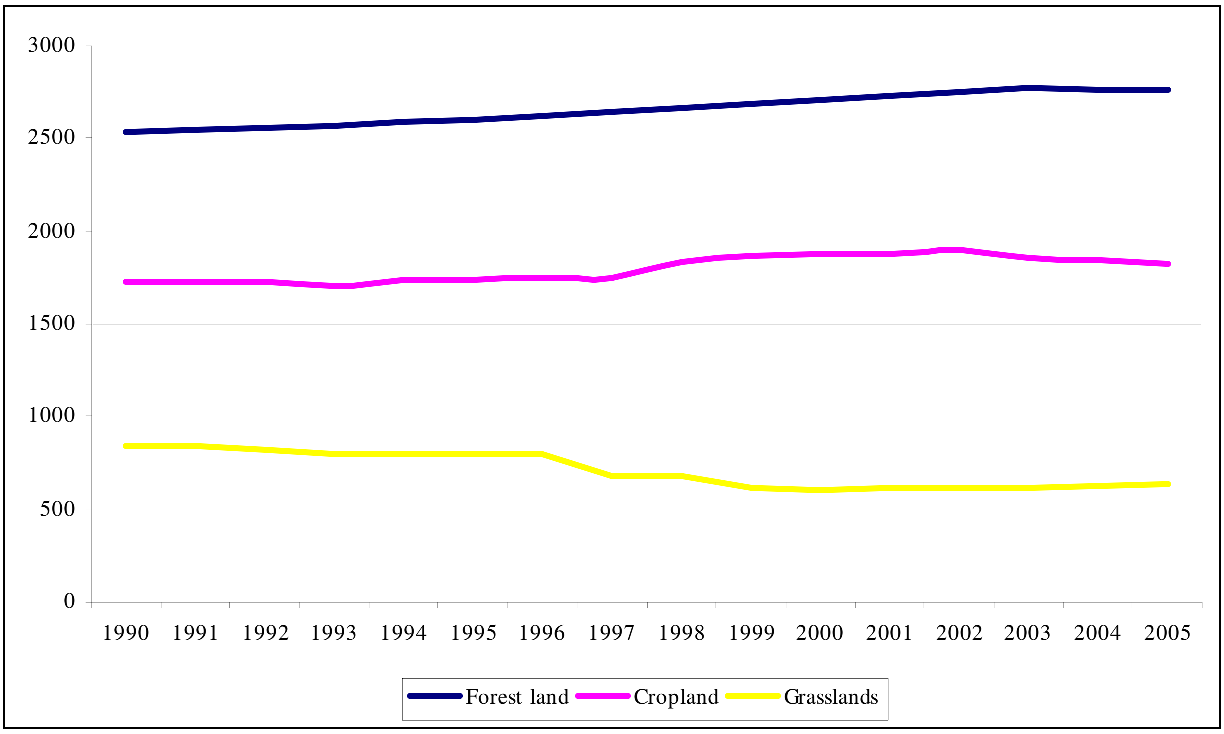


Figure 7.1 Dynamics of Forest land, Cropland and Grassland (thsd.ha)

In 2005, the LULUCF sector in Latvia 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 1990-2005

	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**
2005	-14141	58	-387	**-14470**

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

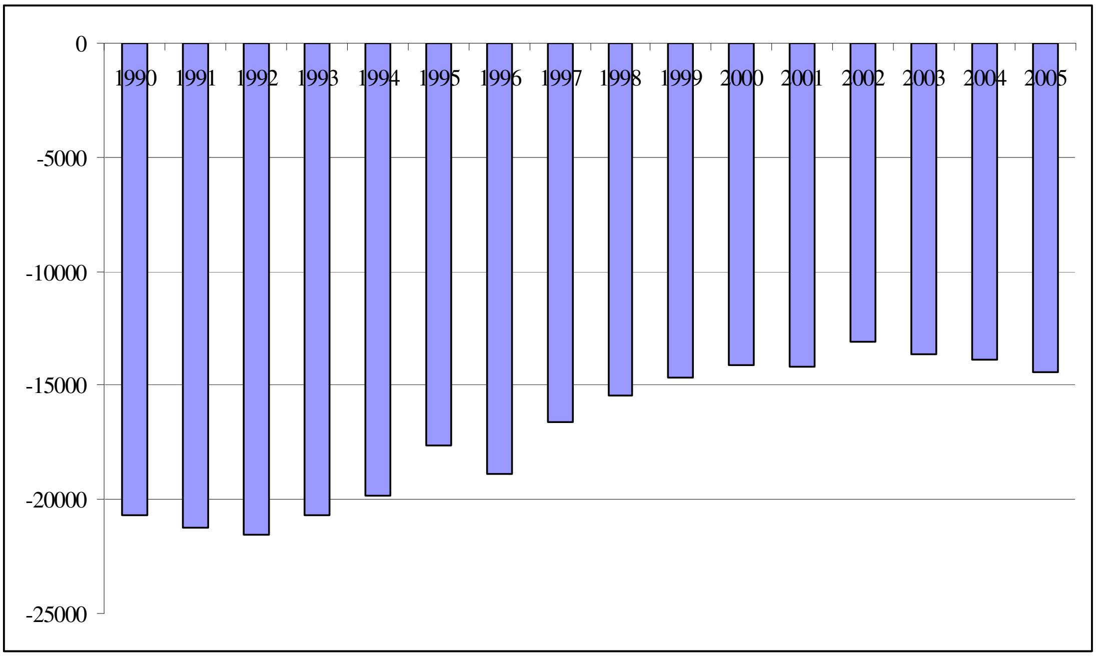


Figure 7.2 Total GHG removals from LULUCF (Gg CO_2 eqv.)
(negative figures – GHG removals)

If compared CO_2 removal changes from 1990 and 2005 then CO_2 removals was decreased approximately by 30%.

7.2 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 and not changed in period from 1990 to 2005.

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

Forest Land is general key source by the level and trend assessment for 2005 with 56%, 27% respectively.

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

7.2.1.1 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 emissions from on – site burning in the forests are shown.

7.2.1.2 Methodological issues

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 7.2.1

Table 7.2.1 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 7.2.2).

Table 7.2.2 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
NO_x	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 [9].

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 7.2.3 and 7.2.4.

Table 7.2.3 Area of Forest Land, thsd.ha

	Land converted to forest land	Forest land remaining forest land	Unmanaged forestland	Total forest area
1990	228.7	2535.7	13.7	2778
1991	227.5	2547.3	13.7	2789
1992	226.4	2558.9	13.7	2799
1993	230.6	2565.2	13.7	2810
1994	220.8	2585.5	13.7	2820
1995	250.5	2605.8	13.7	2870
1996	242.2	2626.1	13.7	2882
1997	223.9	2646.4	13.7	2884
1998	190.6	2666.8	13.7	2871
1999	176.2	2687.1	13.7	2877
2000	165.9	2707.4	13.7	2887
2001	160.6	2727.7	13.7	2902
2002	170.3	2748	13.7	2932
2003	141	2768.3	13.7	2923
2004	167	2763.3	13.7	2944
2005	178,0	2758,3	13,7	2950

Table 7.2.4 Timber Harvesting Volume (m^3)

1990	5000
1991	4400
1992	4000
1993	4800
1994	5700
1995	6900
1996	6800
1997	8900
1998	10000
1999	10800
2000	11000
2001	11200
2002	12200
2003	11700
2004	10800
2005	11290

7.2.2 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).

7.2.2.1 Source category description

Land Use Change to Forest Land changes in carbon stock is 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.

7.2.2.2 Methodological issues

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).

7.3 Cropland (5 B)

7.3.1 Source category description

Under category Cropland is included CO_2 removals from Orchards and consist 60.96 Gg C in 2005. CO_2 emissions are released from agricultural soils during different management practices and liming of agricultural soils. In submission 2007 are include emissions only from organic soils witch were 76.42 Gg C in 2005. Emissions from agricultural liming were 0.40 Gg C in 2005.

7.3.2 Methodological issues

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 CO_2 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 7.3.1) from IPCC GPG 2003.

Table 7.3.1 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 7.3.2) were obtained from State Land Service and information from MoA.

Table 7.3.2 Area of orchards

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	60.9

Activity data about limestone was obtained from CSB (Table 7.3.3). 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 7.3.3 Limes used per ha of area treated

90-95	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
3.5	3.1	1.2	1.9	2	3.3	6.1	10.2	13.9	2.9	3.5

The development of the area estimate for organic soils for period 1990 – 2005 is described in Chapter 6 Agriculture.

7.4 Grassland (CRF 5.C)

7.4.1 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.

CO_2 removal from Grassland was assessed as eighth key source regarding level assessment (2%), but seventh as trend assessment (3%).

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 387 Gg in 2005.

7.4.2 Methodological issues

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 7.4.1 (IPCC GPG LULUCF 2003).

Table 7.4.1 Default emission factors for emission calculation related burning of last year's grass

CO_2	1498
CO	59
CH_4	2
NO_x	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 7.4.2) and data are available started from 1993.

Table 7.4.2 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
2005	2088.876

7.5 Recalculations

Recalculation wasn't done.

7.6 Planned Improvements

The necessary improvements are:

- Improvement of activity data according IPCC GPG LULUCF 2003;
- Researches on default emission factors given in the IPCC GPG 2000, for adaptation to Latvia's circumstances;
- Uncertainties analyses regarding this sector.

8. WASTE (CRF 6)

8.1 Overview of sector

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 main directions in the waste management are the development of the construction of polygons and collecting system for non–hazardous 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 to IPPC directive. According to Latvian Waste management plan for 2006-2012 there will be 11 waste polygons in Latvia. Biogas collection and use for energy production from biodegradable wastes and sludge is set as one of priorities in Latvia. In 2006 - 3 regional waste management plans have been accepted in Cabinet of Ministers, other regional plans will be accepted in 2007.

Main activity data sources for GHG emissions calculations in Waste sector are databases "3-Wastes", "2-Water" and data from CSB.

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 1990-ties and on the basis of the assessment and projections by waste management experts. Since 2002, databases 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 polluting 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". State statistical survey "2-Water" must be filled by all enterprises which have permits on water use, water resources use or mineral deposits quarry use, or else A and B category polluting activity permit or C category acknowledgment. However, for calculation of the emission data about population from CSB were used as activity data.

GHG emissions from Waste sector have been increased since 1990. In 2005, emissions were 11.15% higher than in 1990. Emissions from the Waste sector were 758.94 CO_2 equivalents Gg in 2005; it contributes about 6.98% of total GHG emissions in 2005 (excluding LULUCF). Total emissions from Waste sector are shown in Figure 8.1.

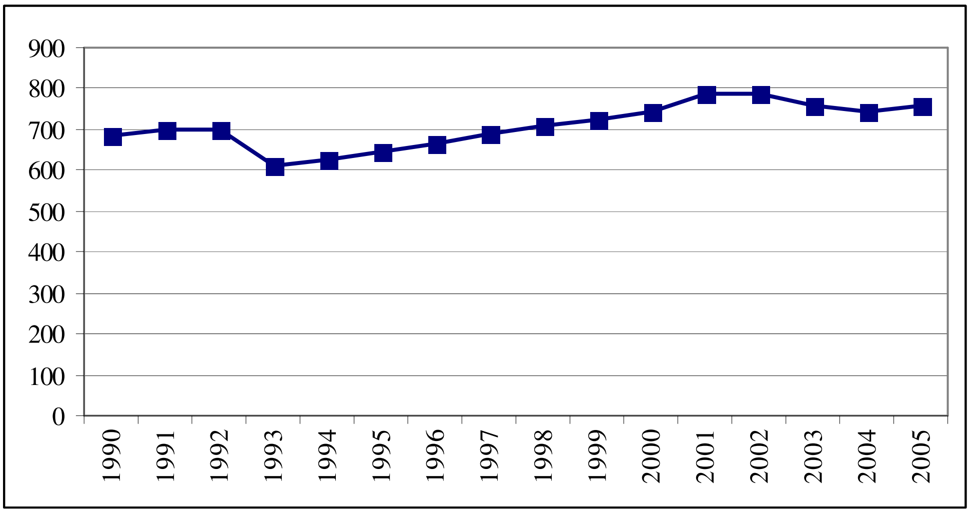


Figure 8.1 Total emissions from Waste sector in CO_2 equivalent (Gg)

Emissions from Solid Waste Disposal (SWD) and Wastewater Handling (WWH) in 1990 do not have big difference. In 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 (Tier 2) method for calculations is used and methane collection and recovery in landfills is not yet well developed.

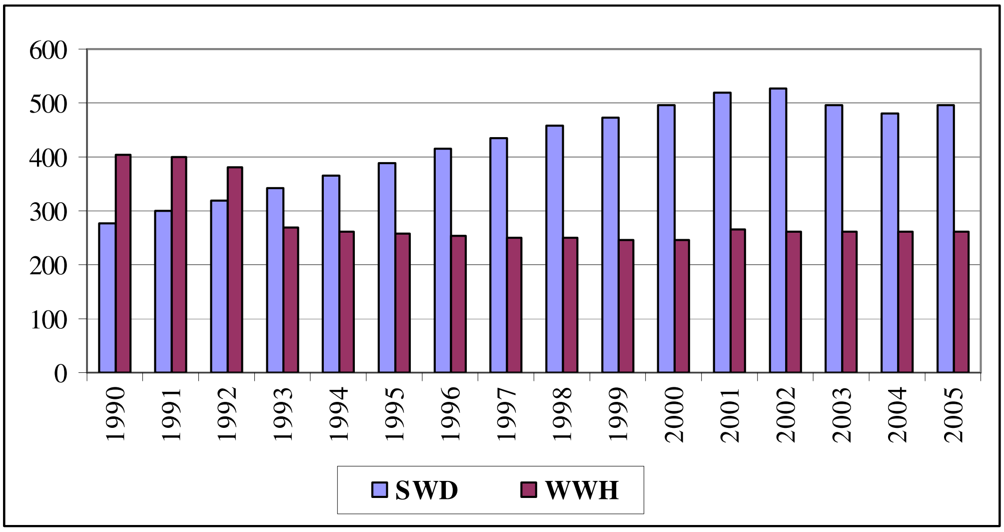


Figure 8.2 Emissions from SWD and WWH sectors in CO_2 equivalent (Gg)

Emissions from Waste Incineration (WI) and Composting (Comp.) in last years, when emissions from these sectors were calculated, are very small in comparison with other sectors (SWD and WWH).

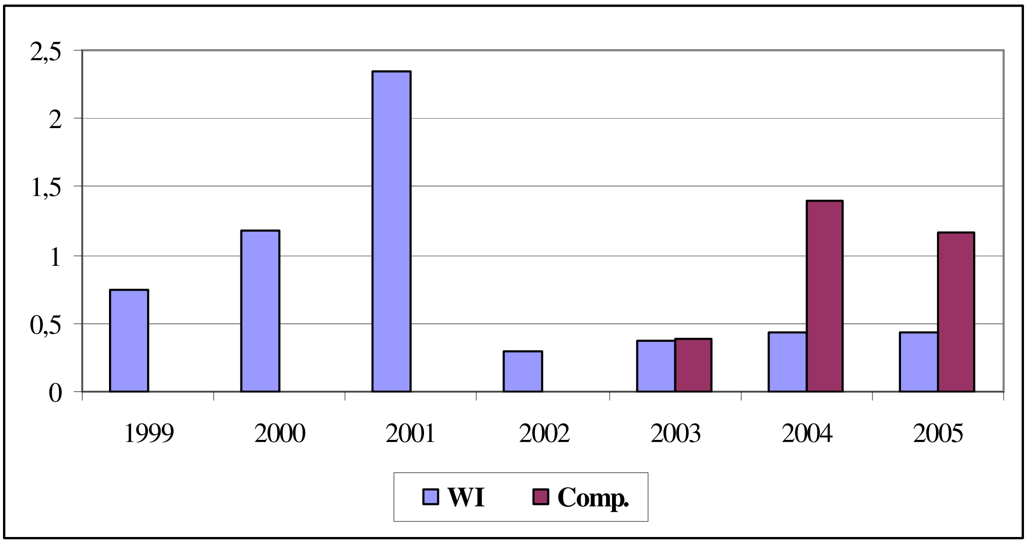


Figure 8.3 Emissions from WI and Comp. sectors in CO_2 equivalent (Gg)

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

Table 8.1 Generated wastes in Latvia (Gg)

Year	Municipal (non-hazardous) 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
2005	1230,62	27,93	1258,55

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 five years.

To properly evaluate CH_4 emissions from wastewater according to the IPCC 1996 and IPCC GPG 2000, the project *Wastewater Management in Latvia and the Formation of Methane* (2003) was worked out. Equation for calculation is given in section 8.3.2.

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 are available only since 1999, for earlier years no information about incinerated waste amounts without energy recovery. Calculation of indirect GHG emissions from cremation is shown in section 8.4.4.

CH_4 and N_2O are emitted from waste composting. Data available only from 2003, when composting facilities start to report within State statistical survey about wastes composting. For emission calculations IPCC 2006 Guidelines and default factors were used.

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

8.2.1 Description of source categories

CH_4 emissions from solid waste disposal are a key source. According to level assessment in 2005, when LULUCF not included, CH_4 emissions from solid waste disposal on land contributes about 5% of emissions, when LULUCF is included – 2%. According to trend assessment in 2005, when LULUCF not included, CH_4 emissions from solid waste disposal on land contributes about 5% of emissions, if LULUCF is included – 3%.

To estimate CH_4 emissions with First Order Decay (Tier2) method from landfills, time series for disposed waste amounts till 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. Disposed amount and landfill type for 1990 – 2000 are expert estimation, which is done according to some waste projects in biggest Latvia's cities. According to information, which is received from Regional environmental boards (REB), number of active waste disposal sites decreased from 558 in 1997 to 109 in 2005. Data about waste disposal on land for 2001 - 2005 are taken from database "3-Wastes". All calculations are done for unsorted wastes, because waste composition is hard to estimate for previous years.

According to Waste management plan 2006 – 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 8.4.

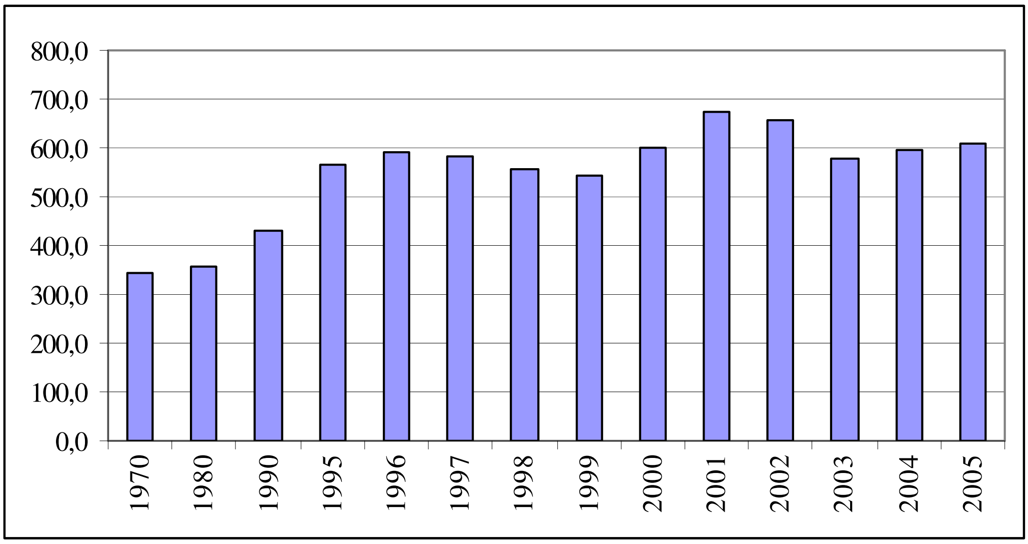


Figure 8.4 Disposed waste amounts in Latvia (Gg)

Since October 2002 CH_4 recovery from landfills are in progress. For 2005 only in two waste facilities (SIA Getlini EKO, SIA Liepajas RAS) CH_4 recovery was realised. In SIA Getlini EKO polygon methane was collected from old waste disposing area and from new waste disposing cells, which is specially build for waste disposing with biogas collection. In SIA Liepajas RAS methane collection also is developed in old landfill Skede and in new polygon Kivites. In total 4,599 Gg of CH_4 was collected and recovered. According to Latvia's Waste Management plan 2006-2012, CH_4 recovery from landfills is one of priorities in waste management. CH_4 emission from waste disposing in SWD sites is presented in Figure 8.5.

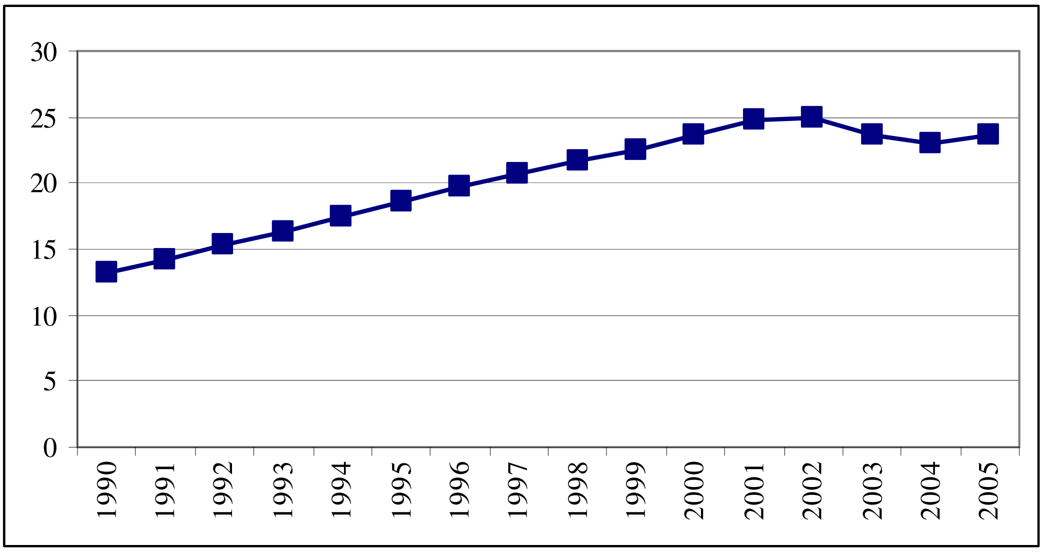


Figure 8.5 CH_4 emissions from waste landfilling (Gg)

8.2.2 Methodological issues

IPCC (Tier 2) method is used for CH_4 emissions calculation and is based on equations:

$$L_o\, CH_{4\ \text{potential emission}} = MSW_L * MCF * DOC * DOC_F * F * 16/12$$

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

$$CH_4 \text{ year emission (t)} = [CH_{4\ RE(t)} - R_{(t)}] * (1 - OX)$$

where:
L_o – potential annual methane emission (Gg);
MSW_L - annual MSW landfilled (Gg);
MCF – CH_4 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);
$CH_{4\ RE}$ – 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.

8.2.3 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 %.

8.3 Wastewater Handling (CRF 6.B)

8.3.1 Description of source categories

CH_4 emissions from Wastewater Handling are a key source, which contributes 2% in Level Assessment and 1% of Trend Assessment in 2005, when LULUCF is not included.

LEGMA data show that 226 million m³ of wastewater in 2005 was released, from which 133 million m³ were treated by different wastewater treatment plants, ~90% from which were biological plants.

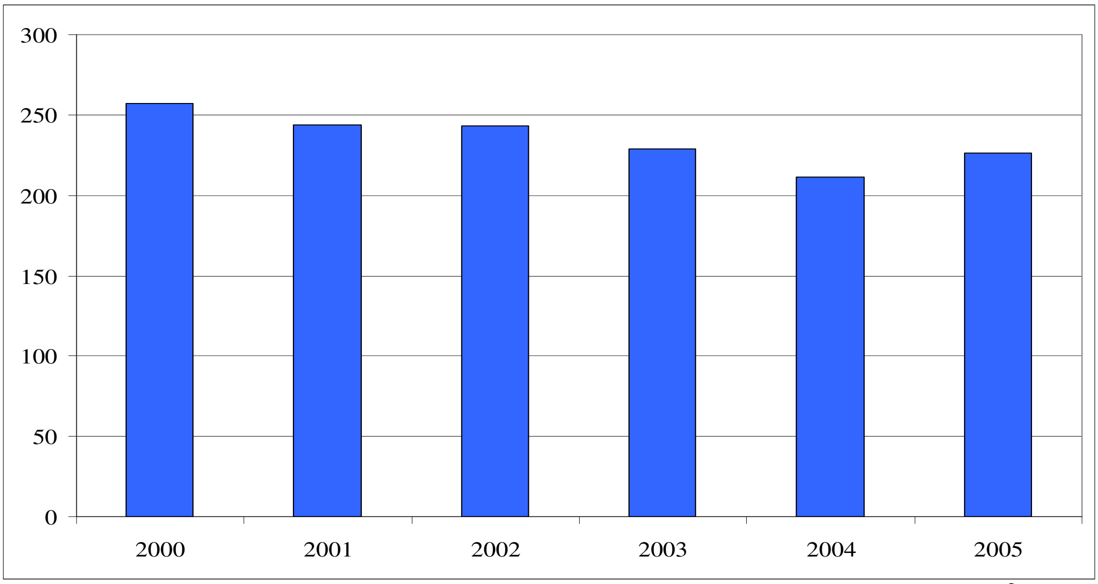


Figure 8.6 Amount of discharged wastewater in last six years (mio m³)

In most cases urban 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.

The handling of urban wastewater is the main source of the CH_4 emissions from Wastewater Handling sector. Emission from food processing industry is much lower, reaching ~13 % (2005) from total CH_4 emission from Wastewater Handling sector.

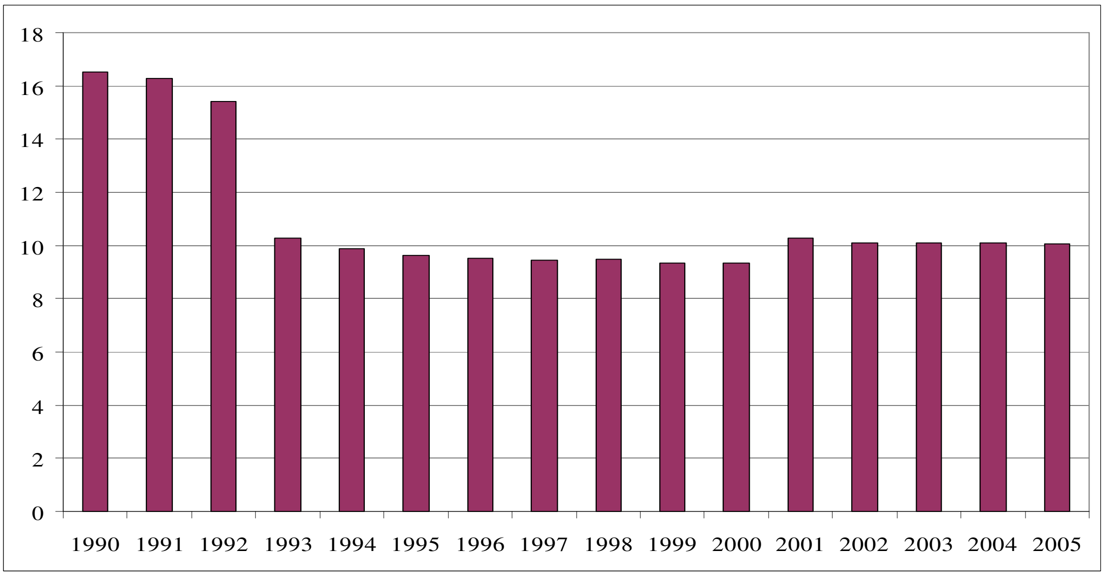


Figure 8.7 Emissions of methane from wastewater handling (total), Gg

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 calculated.

There are no significant changes in emissions from year to year.

8.3.2 Methodological issues

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 population; P = 2,306 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.

$$WM = 2{,}306 \times 10^{6} \times 60 \times 0{,}5 \times 0{,}6 \times 0{,}8 \times 365 \times 10^{-12} = 0{,}0121 \text{ (Tg)}$$

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 0.637 mio inhabitants connected to treatment plant), and thus:

$$WM = 0{,}0121 - 0{,}637 \times 10^{6} \times 60 \times 0{,}5 \times 0{,}6 \times 0{,}8 \times 365 \times 10^{-12} = 0{,}0088 \text{ (Tg)}$$

Emission from industrial wastewater was calculated as

$$WM = P \times V \times C \times PFM \times 10^{-9},$$

where:
WM – total CH_4 emissions from industrial waste water in one year, Tg;
P – amount of food production produced in one year, t;
V – output of wastewater for each tonne of production produced, m^3/t;
C – organic load in wastewater (COD), kg/m^3;
PFM – emission factor of CH_4, kgCH_4/kgCOD; PFM = 0,25.

Amount of food production of all relevant types produced were taken from national statistics.

Following values were assumed in calculation of emissions from industrial wastewater handling:

1. Output of waste water for each tonne of production produced
   a. Processing of milk production – 5 m^3;
   b. Processing of meat production – 16 m^3;
   c. Processing of fish production – 10 m^3.
2. Organic load (COD) in industrial waste water
   a. Processing of milk production – 3000 mg/l;
   b. Processing of meat production – 3000 mg/l;
   c. Processing of fish production – 2000 mg/l.

Also emissions from local anaerobic treatment plants are taken in consideration. The research claims that emissions from such treatment plants are 0,113 Tg of CH_4 each year.

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, and emission factor 0,16 kg N / kg protein. All of these values were acquired from the research "Wastewater Handling in Latvia and Formation of Methane" (Riga, 2003) [23].

8.3.3 Uncertainties

The following uncertainties were used for Wastewater Handling sector for activity data and emission factors:

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 IPCC guidelines.

8.4 Waste Incineration (CRF 6.C)

8.4.1 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 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 without energy recovery. 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 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 8.4.4), 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 2001 large increase of emissions are shown, because one enterprise reported huge amount of incinerated wastes, but another year's amount is much smaller. CO_2 emissions from Waste Incineration are presented in Figure 8.8.

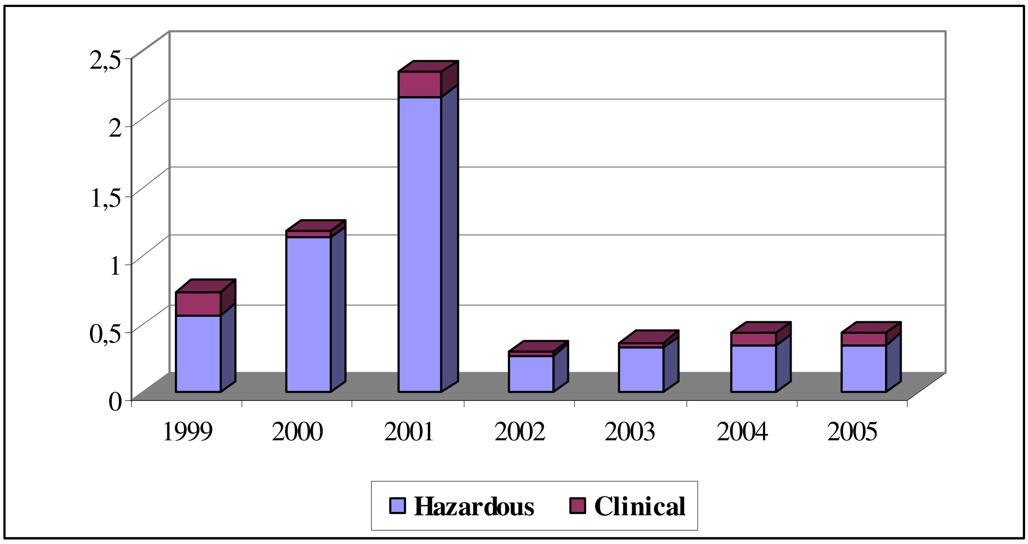


Figure 8.8 CO_2 emissions from Waste Incineration by waste type (Gg)

8.4.2 Methodological issues

According to the IPCC GPG 2000 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 that 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:

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

where:
i = waste type (hazardous waste, clinical waste);
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.

There are no national factors for carbon and fossil carbon amounts in each type of waste; therefore default factors from the IPCC GPG 2000 were used (Table 8.3).

Table 8.3 Default emission factors for CO_2 emission calculation

	Clinical waste	**Hazardous waste**
C contents in waste (CCW)	0,6	0,5
Fossil C contents in waste (FCF)	0,4	0,9
Incineration effectiveness (EF)	0,95	0,995

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.

Table 8.4 Incinerated waste amounts

Year	Hazardous waste (Gg)	Clinical waste (Gg)	Total (Gg)
1999	0,34721	0,20142	0,54863
2000	0,69028	0,05641	0,74669
2001	1,31927	0,21331	1,53258
2002	0,165643	0,032247	0,19789
2003	0,201813	0,040607	0,24242
2004	0,210125	0,112325	0,32245
2005	0,215127	0,102127	0,317254

8.4.3 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 %.

8.4.4 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 as indirect GHG. These amounts are counted in Incinerated Biogenic Waste sector. Calculations were based on emission factors given by the EMEP/CORINAIR methodology.

Indirect 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 1995 - 2005 in Riga crematorium is available (assumed to be 1750), therefore emissions are identical for these years:

$$SO_{x\ emissions} = 1750 \times 6{,}364 \times 10^{-2} kg/body = 111{,}37\ kg \Rightarrow 0{,}000111\ Gg$$

$$NO_{x\ emissions} = 1750 \times 4{,}552 \times 10^{-1} kg/body = 796{,}6\ kg \Rightarrow 0{,}000797\ Gg$$

$$CO_{emissions} = 1750 \times 2{,}121 \times 10^{-1} kg/body = 371{,}175\ kg \Rightarrow 0{,}000371\ Gg$$

$$NMVOC_{emissions} = 1750 \times 1{,}30 \times 10^{-2} kg/body = 22{,}75\ kg \Rightarrow 0{,}000022\ Gg$$

8.5 Other (CRF 6.D) - Compost production

8.5.1 Description of source categories

Under Other 6.D sector emissions from waste composting are calculated. Composting is set as one of priorities in waste treatment in Latvia. For composting biological degradable wastes are useful. In Latvia these are mostly "park - garden" and "food production" wastes. Composting in private households was very popular for many years, but about these activities no correct data or estimation about composted waste amounts. Data become available since 2003, when waste treatment companies start waste composting and get IPPC permits on this activity. From composting CH_4 and N_2O emissions are calculated according IPCC Guidelines 2006. In previous IPCC Guidelines was not provided emission factors for composting. Data about composted amounts are taken from "3-Waste" database.

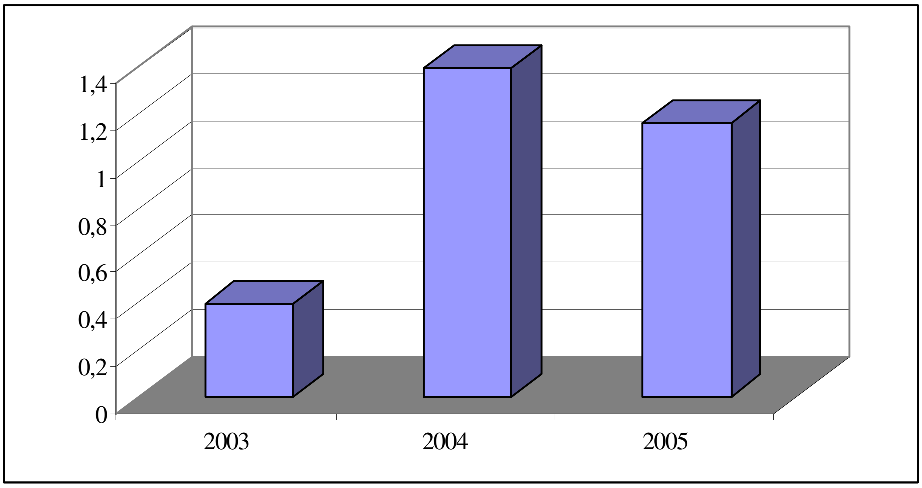


Figure 8.9 Total emissions from waste composting in CO_2 equivalent (Gg)

8.5.2 Methodological issues

IPCC Guidelines 2006 is used for composting calculations. Composted waste amount is multiplied by emission factor. Composted waste amount is taken from "3-Waste" database. R3 - Recycling/reclamation of organic substances that are not used as solvents (including composting and other biological transformation processes), recovery operation for determination of composted amounts was used.

Default emission factors for composting were used:

1. 4 g CH_4/ kg composted wastes;
2. 0.3 g N_2O/ kg composted wastes.

Table 8.5 Composted waste amounts and emissions

Year	Composted amount (Gg)	CH_4 emission (Gg)	N_2O emission (Gg)
2003	2,224	0,008896	0,0006672
2004	7,905	0,03162	0,0023715
2005	6,564	0,026256	0,0019692

8.5.3 Uncertainties

Emission factor uncertainties are calculated according range, which is published in IPCC Guidelines 2006 Volume 5, Chapter 4. For N_2O range is 0.06 – 0.6, for CH_4 0.03 – 8. Uncertainty for N_2O emission factor is 90%, for CH_4 – 100%. Activity data uncertainty is estimated as 20%.

8.6 Recalculations

Emission recalculation from solid waste disposal for 2004 was done due to new information became available about CH_4 recovery.

Emissions from composting about 2003, 2004 and 2005 are added to submission, because default emission factors from IPCC 2006 Guidelines became available.

8.7 Planned 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, composting and disposing of waste.

Till 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 became more easily.

9. RECALCULATIONS AND IMPROVEMENTS

The details of the recalculations can be found in the sectoral chapters. The latest recalculations were made on January – March 2007, because some activity data in the Energy sector (including Transport) were changed as well as some incorrectness's regarding data input were corrected.

Detailed information about planed improvements is described in the sectoral chapters. Generally it is planed to assess uncertainties for indirect gases and use of higher Tier methods for emission calculations is planned.

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25. http://www.lm.gov.lv/?sadala=255

ANNEX 1

KEY SOURCE ANALYSES FOR 1990 WITH AND WITHOUT LULUCF AND FOR 2005 WITH LULUCF

Table 1 Key sources – Level Assessment in 1990 without LULUCF

IPCC Source Categories (LULUCF not included)	Direct GHG	Base Year (1990), CO_2 eqv. Gg	Level Assessment, %	Cumulative, %
Emissions from Stationary Combustion-oil	CO_2	7300.20	0.28	0.28
Emissions from Stationary Combustion-gas	CO_2	5488.89	0.21	0.49
Emissions from Stationary Combustion-coal	CO_2	2826.08	0.11	0.60
Mobile Combustion: Road Vehicles	CO_2	2396.66	0.09	0.69
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057.23	0.08	0.77
Emissions from Agricultural Soils	Direct-N2O	1658.35	0.06	0.83
Emissions from Nitrogen Used in Agriculture	Indirect-N2O	1033.87	0.04	0.87
Emissions from Manure Management	N2O	551.63	0.02	0.89
Mobile Combustion: Railways	CO_2	525.64	0.02	0.91
Emissions from Wastewater Handling	CH_4	347.00	0.01	0.93
Emissions from Cement Production	CO_2	345.91	0.01	0.94
Emissions from Manure Management	CH_4	279.52	0.01	0.95

Table 2 Key sources –Level Assessment in 1990 with LULUCF

IPCC Source Categories	Direct GHG	Base year (1990), CO_2 eqv. Gg	Level Assessment, %	Cumulative, %
Removals from Forest Land	CO_2	-20666.28	0.44	0.44
Emissions from Stationary Combustion-oil	CO_2	7300.20	0.15	0.59
Emissions from Stationary Combustion-gas	CO_2	5488.89	0.12	0.71
Emissions from Stationary Combustion-coal	CO_2	2826.08	0.06	0.77
Mobile Combustion: Road Vehicles	CO_2	2396.66	0.05	0.82
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057.23	0.04	0.86
Emissions from Agricultural Soils	Direct-N_2O	1658.35	0.04	0.90

IPCC Source Categories	Direct GHG	Base year (1990), CO_2 eqv. Gg	Level Assessment, %	Cumulative, %
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	347.00	0.01	0.95

Table 3 Key sources –Level Assessment in 2005 without LULUCF

IPCC Source Categories (LULUCF not included)	Direct GHG	2005, CO_2 eqv. Gg	Level Assessment, %	Cumulative, %
Emissions from Stationary Combustion-gas	CO_2	3156.48	0.29	0.29
Mobile Combustion: Road Vehicles	CO_2	2585.52	0.24	0.53
Emissions from Stationary Combustion-oil	CO_2	913.97	0.09	0.62
Emissions from Agricultural Soils	Direct-N_2O	721.15	0.07	0.69
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	577.51	0.05	0.74
Emissions from Solid Waste Disposal Sites	CH_4	496.88	0.05	0.79
Emissions from Stationary Combustion-coal	CO_2	298.39	0.03	0.81
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	283.23	0.03	0.84
Emissions from Stationary Combustion-biomass	CH_4	260.29	0.02	0.86
Mobile Combustion: Railways	CO_2	255.04	0.02	0.89
Emissions from Wastewater Handling	CH_4	211.26	0.02	0.91
Emissions from Manure Management	N_2O	153.43	0.01	0.92
Fugitive Emissions from Oil and Gas Operations	CH_4	145.82	0.01	0.94
Emissions from Cement Production	CO_2	140.14	0.01	0.949

ANNEX 1

Table 4 Key sources -Trend assessment in 2005 without LULUCF

IPCC Source Categories (LULUCF not included)	Direct GHG	Base year, CO_2 eqv. Gg	2005, CO_2 eqv. Gg	Level Assessment, %	Trend Assessment	Contribution to Trend, %	Cumulative, %
Emissions from Stationary Combustion-oil	CO_2	7300.20	913.97	0.09	0.473	0.29	0.29
Mobile Combustion: Road Vehicles	CO_2	2396.66	2585.52	0.24	0.361	0.22	0.52
Emissions from Stationary Combustion-gas	CO_2	5488.89	3156.48	0.29	0.202	0.13	0.64
Emissions from Stationary Combustion-coal	CO_2	2826.08	298.39	0.03	0.196	0.12	0.77
Emissions from Solid Waste Disposal Sites	CH_4	278.79	496.88	0.05	0.086	0.05	0.82
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057.23	577.51	0.05	0.061	0.04	0.86
Emissions from Stationary Combustion-biomass	CH_4	167.29	260.29	0.02	0.043	0.03	0.88
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	1033.87	283.23	0.03	0.032	0.02	0.90
Emissions from Manure Management	N_2O	551.63	153.43	0.01	0.017	0.01	0.91
Emissions from Wastewater Handling	CH_4	347.00	211.26	0.02	0.015	0.01	0.92
Emissions from Stationary Combustion-biomass	N_2O	34.10	73.57	0.01	0.013	0.01	0.93
Emissions from Lime Production	CO_2	125.17	1.95	0.00	0.011	0.01	0.94
Mobile Combustion: Road Vehicles	N_2O	15.90	51.10	0.00	0.010	0.01	0.95
Emissions from Limestone and Dolomite use	CO_2	0.35	41.84	0.00	0.009	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 (2005) Estimate	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2005	Type A sensitivity	Type B sensitivity	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 eqv.	Gg CO_2 eqv.	%	%	%	%	%	%	%	%	%
CO_2 Emissions from Stationary Combustion-oil	7300.20	913.97	2%	5%	5%	1%	-10%	5%	-1%	0%	1%
CO_2 Emissions from Stationary Combustion-coal	2826.08	298.39	2%	5%	5%	0%	-4%	2%	0%	0%	0%
CO_2 Emissions from Stationary Combustion-gas	5488.89	3156.48	2%	5%	5%	2%	5%	16%	0%	0%	1%
Mobile Combustion: Road Vehicles	2396.66	2585.52	5%	5%	7%	2%	9%	14%	0%	1%	1%
Mobile Combustion: Waterborne Navigation	17.46	45.07	50%	5%	50%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Aircraft	0.07	2.47	20%	5%	21%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Railways	525.64	255.04	2%	5%	5%	0%	0%	1%	0%	0%	0%
Emissions from Cement Production	345.91	140.14	2%	2%	3%	0%	0%	1%	0%	0%	0%
Emissions from Lime Production	125.17	1.95	2%	2%	3%	0%	0%	0%	0%	0%	0%
Emissions from Limestone and Dolomite use	0.35	41.84	2%	10%	10%	0%	0%	0%	0%	0%	0%
Emissions from Soda Ash Production and Use	1.12	1.30	2%	10%	10%	0%	0%	0%	0%	0%	0%
Emissions from Asphalt Roofing	0.01	0.01	70%	70%	99%	0%	0%	0%	0%	0%	0%
Emissions from Road Paving with Asphalt	9.60	14.78	70%	70%	99%	0%	0%	0%	0%	0%	0%
Emissions from other mineral products	4.68	11.15	2%	10%	10%	0%	0%	0%	0%	0%	0%
Emissions from the Iron and Steel Industry	44.19	38.87	2%	2%	3%	0%	0%	0%	0%	0%	0%
Emissions from Solvent and Other Product Use	55.70	51.13	25%	50%	56%	0%	0%	0%	0%	0%	0%
Emissions from Waste Incineration	0.74	0.44	20%	50%	54%	0%	0%	0%	0%	0%	0%

Table 2 The uncertainties in CH_4 emissions

IPCC Source Categories (LULUCF not included)	Base Year (1990) Estimate	Current Year (2005) Estimate	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2003	Type A sensitivity	Type B sensitivity	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 eqv.	Gg CO_2 eqv.	%	%	%	%	%	%	%	%	%
Non-CO_2 Emissions from Stationary Combustion-oil	12.93	2.13	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO_2 Emissions from Stationary Combustion-coal	59.61	6.86	2%	50%	50%	0%	-1%	0%	0%	0%	0%
Non-CO_2 Emissions from Stationary Combustion-gas	6.21	3.14	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO_2 Emissions from Stationary Combustion-biomass	167.29	260.29	10%	50%	51%	7%	5%	7%	2%	1%	3%
Mobile Combustion: Road Vehicles	9.60	11.53	5%	40%	40%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Waterborne Navigation	0.00	0.00	50%	10%	51%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Aircraft	0.00	0.00	20%	10%	22%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Railways	0.63	0.29	2%	10%	10%	0%	0%	0%	0%	0%	0%
Fugitive Emissions from Oil and Gas Operations	274.05	145.82	2%	2%	3%	0%	0%	4%	0%	0%	0%
Emissions from the Iron and Steel Industry	0.06	0.06	2%	5%	5%	0%	0%	0%	0%	0%	0%
Emissions from Enteric fermentation in Domestic Livestock's	2057.23	577.51	2%	40%	40%	13%	-14%	17%	-5%	0%	6%
Emissions from Manure Management	279.52	83.39	2%	30%	30%	1%	-2%	2%	-1%	0%	1%
Emissions from Solid Waste Disposal Sites	278.79	496.88	20%	15%	25%	7%	10%	14%	2%	4%	4%
Emissions from Wastewater Handling	347.00	211.26	2%	10%	10%	1%	1%	6%	0%	0%	0%
Emissions from Compost production	0.19	0.55	20%	100%	102%	0%	0%	0%	0%	0%	0%

Table 3 The uncertainties in N_2O emissions

IPCC Source Categories (LUCF not included)	Base Year (1990) Estimate	Current Year (2005) Estimate,	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2003	Type A sensitivity	Type B sensitivity	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 eqv.	Gg CO_2 eqv.	%	%	%	%	%	%	%	%	%
Non-CO_2 Emissions from Stationary Combustion-oil	19.21	2.46	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO_2 Emissions from Stationary Combustion-coal	16.41	1.46	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO_2 Emissions from Stationary Combustion-gas	3.05	1.75	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO_2 Emissions from Stationary Combustion-biomass	34.10	73.57	10%	50%	51%	3%	2%	2%	1%	0%	1%
Mobile Combustion: Road Vehicles	15.90	51.10	5%	50%	50%	2%	1%	1%	1%	0%	1%
Mobile Combustion: Waterborne Navigation	0.01	0.02	50%	10%	51%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Aircraft	0.00	0.02	20%	10%	22%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Railways	63.67	31.00	2%	10%	10%	0%	0%	1%	0%	0%	0%
Emissions from Solvent and Other Product Use	4.53	3.10	25%	50%	56%	0%	0%	0%	0%	0%	0%
Emissions from Manure Management	551.63	153.43	40%	30%	50%	6%	-2%	4%	-1%	3%	3%
Emissions from Agricultural Soils	1658.35	721.15	40%	25%	47%	25%	2%	21%	0%	12%	12%
Emissions from Nitrogen Used in Agriculture	1033.87	283.23	30%	40%	50%	10%	-4%	8%	-1%	3%	4%
Emissions from Wastewater Handling	56.98	49.20	2%	10%	10%	0%	1%	1%	0%	0%	0%
Emissions from Compost production	0.21	0.61	20%	90%	92%	0%	0%	0%	0%	0%	0%

ANNEX 3

DIRECT GHG EMISSION TRENDS 1990-2005

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	2005
	(Gg)															
1. Energy	**18 554.99**	**17 089.36**	**13 785.06**	**11 687.70**	**10 140.13**	**8 864.70**	**8 934.39**	**8 382.40**	**8 001.41**	**7 361.50**	**6 782.38**	**7 238.59**	**7 152.82**	**7 284.77**	**7 219.03**	**7 272.20**
A. Fuel Combustion (Sectoral Approach)	18 554.99	17 089.36	13 785.06	11 687.70	10 140.13	8 864.70	8 934.39	8 382.40	8 001.41	7 361.50	6 782.38	7 238.59	7 152.82	7 284.77	7 219.03	7 272.20
1. Energy Industries	6 332.41	5 806.01	4 955.43	3 993.68	3 749.17	3 442.41	3 566.67	3 327.76	3 368.53	2 944.29	2 490.47	2 442.76	2 335.33	2 269.90	2 077.51	2 068.24
2. Manufacturing Industries and Construction	3 781.19	2 905.24	2 378.32	2 106.67	1 909.16	1 869.93	1 827.84	1 772.91	1 554.17	1 421.88	1 184.07	1 066.80	1 125.91	1 107.76	1 121.41	1 135.36
3. Transport	2 939.82	2 762.88	2 480.16	2 305.48	2 192.39	2 092.93	2 059.73	2 046.95	2 021.25	1 991.48	2 201.48	2 591.34	2 586.48	2 704.68	2 793.33	2 888.11
4. Other Sectors	5 501.57	5 615.24	3 971.15	3 281.87	2 289.41	1 459.43	1 480.16	1 234.78	1 057.46	1 003.85	906.36	1 137.69	1 105.10	1 202.43	1 226.78	1 180.49
2. Industrial Processes	**525.24**	**362.22**	**173.08**	**64.47**	**201.43**	**167.29**	**181.58**	**203.32**	**204.61**	**246.19**	**191.62**	**208.70**	**221.53**	**229.16**	**233.74**	**250.03**
A. Mineral Products	481.04	348.27	155.63	41.87	168.78	140.18	155.94	158.97	159.23	200.42	146.14	164.21	177.59	184.96	194.81	211.16
C. Metal Production	44.19	13.96	17.45	22.61	32.65	27.11	25.64	44.34	45.39	45.77	45.49	44.49	43.95	44.20	38.93	38.87
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	51.13
5. Land Use, Land-Use Change and Forestry	**-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**	**-14 469.76**
A. Forest Land	-20666.28	-21236.15	-21663.19	-20811.56	-19846.56	-17468.95	-18677.73	-16430.53	-15254.28	-14404.33	-13874.87	-13892.19	-12848.48	-13371.09	-13605.27	-14140.85
B. Cropland	168.22	168.66	269.47	258.85	212.65	23.18	36.78	47.16	42.78	32.29	31.21	22.25	39.86	47.54	38.08	58.15
C. Grassland	-192.99	-193.00	-193.91	-194.15	-193.91	-242.52	-264.34	-277.37	-295.28	-313.63	-328.20	-355.46	-360.47	-352.56	-374.51	-387.07
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**	**0.44**
C. Waste Incineration	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	0.44
Total CO2 emissions including net CO2 from LULUCF	**-1 555.12**	**-3 757.44**	**-7 580.34**	**-8 948.50**	**-9 441.00**	**-8 614.66**	**-9 746.17**	**-8 031.48**	**-7 256.35**	**-7 032.06**	**-7 150.76**	**-6 729.03**	**-5 746.96**	**-6 113.69**	**-6 439.38**	**-6 895.97**
Total CO2 emissions excluding net CO2 from LULUCF	**19 135.93**	**17 503.05**	**14 007.28**	**11 798.36**	**10 386.82**	**9 073.63**	**9 159.13**	**8 629.26**	**8 250.44**	**7 653.61**	**7 021.10**	**7 496.36**	**7 422.12**	**7 562.42**	**7 502.32**	**7 573.79**
Memo Items:																
International Bunkers	**1 720.94**	**747.43**	**653.67**	**756.88**	**963.41**	**554.55**	**408.28**	**324.25**	**137.42**	**121.78**	**106.14**	**697.03**	**733.83**	**714.82**	**786.45**	**1 001.55**
Aviation	221.15	299.00	84.10	84.07	77.87	77.87	99.67	99.67	90.33	90.33	80.98	80.98	84.10	121.47	146.39	177.50
Marine	1 499.79	448.44	569.57	672.81	885.54	476.68	308.61	224.58	47.09	31.45	25.16	616.05	649.74	593.35	640.06	824.05
CO2 Emissions from Biomass	2 964.00	3 476.22	3 466.26	3 865.99	4 028.20	4 773.32	5 114.07	5 187.73	5 346.61	5 360.58	5 019.19	5 470.32	5 609.39	5 708.13	6 202.11	6 416.23

Table 2 CH_4 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	2005
	(Gg)															
1. Energy	25.25	26.19	23.80	23.93	23.56	24.12	24.17	22.79	21.97	21.50	20.06	20.87	21.10	19.18	19.95	20.48
A. Fuel Combustion (Sectoral Approach)	12.20	13.62	12.34	12.97	12.85	13.69	14.12	13.41	12.97	12.92	12.12	13.17	13.07	12.90	13.74	13.54
1. Energy Industries	0.27	0.26	0.25	0.24	0.24	0.24	0.27	0.32	0.34	0.29	0.29	0.27	0.30	0.32	0.30	0.31
2. Manufacturing Industries and Construction	0.26	0.20	0.17	0.18	0.17	0.18	0.23	0.22	0.24	0.23	0.22	0.25	0.25	0.27	0.33	0.43
3. Transport	0.49	0.47	0.43	0.42	0.41	0.39	0.38	0.37	0.39	0.41	0.45	0.46	0.47	0.50	0.58	0.57
4. Other Sectors	11.18	12.69	11.48	12.14	12.03	12.88	13.24	12.49	12.00	11.98	11.17	12.19	12.05	11.80	12.52	12.24
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	6.94
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	6.94
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**	**0.00**
C. Metal Production	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	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**	**31.47**
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	27.50
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	3.97
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**	**1.65**
A. Forest Land	0.90	1.06	0.97	1.15	1.39	1.67	1.64	2.16	2.43	2.61	2.67	1.63	1.77	1.70	1.56	1.64
C. Grassland	NE,NO	NE,NO	NE,NO	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.05	0.06	0.03	0.01
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**	**33.69**	**33.08**	**33.75**
A. Solid Waste Disposal on Land	13.28	14.24	15.25	16.30	17.39	18.53	19.70	20.78	21.72	22.57	23.58	24.79	25.01	23.56	22.95	23.66
B. Waste-water Handling	16.52	16.28	15.42	10.28	9.88	9.63	9.51	9.46	9.47	9.33	9.34	10.27	10.11	10.11	10.10	10.06
Total CH_4 emissions including CH4 from LULUCF	**167.23**	**164.88**	**144.21**	**106.25**	**98.01**	**98.56**	**96.81**	**94.39**	**91.46**	**87.38**	**86.26**	**89.65**	**90.35**	**85.83**	**85.33**	**87.35**
Total CH4 emissions excluding CH4 from LULUCF	**166.33**	**163.82**	**143.24**	**105.10**	**96.62**	**96.89**	**95.16**	**92.22**	**89.02**	**84.76**	**83.58**	**88.00**	**88.54**	**84.07**	**83.73**	**85.71**
Memo Items:																
International Bunkers	0.10	0.03	0.04	0.04	0.06	0.03	0.02	0.01	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.05
Aviation	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	0.00
Marine	0.09	0.03	0.04	0.04	0.06	0.03	0.02	0.01	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.05

ANNEX 3

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	2005
	(Gg)															
1. Energy	**0.50**	**0.50**	**0.45**	**0.40**	**0.38**	**0.40**	**0.42**	**0.42**	**0.42**	**0.41**	**0.40**	**0.42**	**0.44**	**0.47**	**0.53**	**0.54**
A. Fuel Combustion (Sectoral Approach)	0.50	0.50	0.45	0.40	0.38	0.40	0.42	0.42	0.42	0.41	0.40	0.42	0.44	0.47	0.53	0.54
1. Energy Industries	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
2. Manufacturing Industries and Construction	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05
3. Transport	0.26	0.26	0.23	0.17	0.16	0.17	0.17	0.18	0.17	0.17	0.19	0.20	0.21	0.24	0.28	0.28
4. Other Sectors	0.16	0.18	0.17	0.17	0.16	0.17	0.18	0.17	0.16	0.16	0.15	0.16	0.16	0.16	0.17	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**	**0.01**
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**	**3.91**	**4.06**
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	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	3.57
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**	**0.01**
A. Forest Land	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	0.01
C. Grassland	NE,NO	NE,NO	NE,NO	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
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**	**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	0.16
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00	0.00	0.00
Total N2O emissions including N2O from LULUCF	**12.31**	**11.47**	**8.98**	**6.51**	**5.69**	**4.45**	**4.54**	**4.57**	**4.39**	**4.05**	**4.10**	**4.48**	**4.46**	**4.71**	**4.63**	**4.78**
Total N2O emissions excluding N2O from LULUCF	**12.30**	**11.46**	**8.98**	**6.50**	**5.68**	**4.44**	**4.53**	**4.56**	**4.37**	**4.03**	**4.08**	**4.47**	**4.45**	**4.69**	**4.62**	**4.77**

Memo Items:																
International Bunkers	**0.19**	**0.04**	**0.04**	**0.06**	**0.11**	**0.05**	**0.04**	**0.03**	**0.02**	**0.02**	**0.01**	**0.14**	**0.12**	**0.11**	**0.11**	**0.13**
Aviation	0.01	0.01	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
Marine	0.18	0.03	0.03	0.06	0.11	0.04	0.03	0.03	0.02	0.01	0.01	0.14	0.12	0.10	0.11	0.13

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	2005
	(Gg)										
Emissions of HFCs - (Gg CO_2 equivalent)	**0.29**	**1.32**	**2.47**	**4.61**	**6.78**	**8.59**	**9.81**	**11.83**	**12.95**	**16.24**	**19.12**
HFC-23	0.00	0.00	0.00	0.00	NA,NO	0.00	0.00	0.00	0.00	NA,NE,NO	NA,NE,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	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	0.00
HFC-134a	0.00	0.00	0.00	0.00	0.01	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	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	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**	**5.37**	**7.53**
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ANNEX 4

EMISSION FACTORS AND ACTIVITY DATA RELATED ENERGY SECTOR

Table 1 SO_2 emission factors per fuel type

Type of fule	Suphur content												EF (Gg/PJ)										
	1990-1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	NCV	1990-1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel	0.3	0.3	0.3	0.3	0.3	0.035	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	0.016
RFO	2	2	2	2	2	1	1	1	1	1	1	40.6	0.966	0.966	0.966	0.966	0.966	0.483	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	0.015	43.97	0.007	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	0.05	43.2	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Jet fuel	0.05	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	0.023
Coal	1.8	1.8	1.20	1.19	1.18	1.12	1.12	0.82	0.68	0.66	0.70	26.22	1.236	1.236	0.825	0.820	0.807	0.770	0.769	0.564	0.467	0.454	0.480
Coke	1.8	1.8	1.20	1.19	1.18	1.12	1.12	0.82	0.68	0.66	0.70	26.79	1.209	1.209	0.808	0.802	0.790	0.753	0.753	0.552	0.457	0.444	0.469
Shale oil	1	1	1	1	1	1	1	1	1	1	0.57	39.35	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.290
Peat	0.3	0.3	0.24	0.21	0.21	0.21	0.21	0.27	0.25	0.24	0.15	10.05	0.507	0.507	0.411	0.359	0.362	0.355	0.364	0.456	0.419	0.412	0.259

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

ANNEX 4

Table 2 CO_2 REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH, AND ENERGOBALANCE OF LATVIA 2005

Table 1 Reference approach estimations (Table 1.B)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV [(1)]	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
Liquid Fossil	Primary Fuels	Crude Oil	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Orimulsion	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Natural Gas Liquids	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
	Secondary Fuels	Gasoline	TJ		18 159.610	2 945.990	NO	351.760	14 861.860	1.000	NCV	14 861.860	18.900	280.889	NA	280.889	0.990	1 019.628
		Jet Kerosene	TJ		7 129.650	NO	2 462.970	4 666.680		1.000	NCV		19.500		NA		0.990	
		Other Kerosene	TJ		86.420	NO	NO	86.420		1.000	NCV		19.700		NA		0.990	
		Shale Oil	TJ		157.400			NO	157.400	1.000	NCV	157.400	20.780	3.271	NA	3.271	0.990	11.873
		Gas / Diesel Oil	TJ		38 283.490	4 928.840	3 824.100	892.290	28 638.260	1.000	NCV	28 638.260	20.300	581.357	NO	581.357	0.990	2 110.325
		Residual Fuel Oil	TJ		9 906.400	11 895.800	7 064.400	-12 220.600	3 166.800	1.000	NCV	3 166.800	21.100	66.819	NA	66.819	0.990	242.555
		Liquefied Petroleum Gas (LPG)	TJ		3 233.340	683.100		NO	2 550.240	1.000	NCV	2 550.240	17.200	43.864	NO	43.864	1.000	160.835
		Ethane	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Naphtha	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Bitumen	TJ		2 511.600	NO		NO	2 511.600	1.000	NCV	2 511.600	22.000	55.255	55.255		0.990	
		Lubricants	TJ		9 334.780	669.760	NO	7 492.940	1 172.080	1.000	NCV	1 172.080	20.000	23.442	23.442	0.000	0.990	0.000
		Petroleum Coke	TJ		659.600	NO		230.860	428.740	1.000	NCV	428.740	27.500	11.790	NA	11.790	0.990	42.799
		Refinery Feedstocks	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other Oil	TJ		1 290.905	NO		73.766	1 217.139	1.000	NCV	1 217.139	20.000	24.343	NA	24.343	0.990	88.364
Other Liquid Fossil												460.460		9.879	NO	9.879		35.861
White Spirit			TJ	NO	125.580	NO	NO	NO	125.580	1.000	NCV	125.580	20.000	2.512	NO	2.512	0.990	9.117
Paraffin Waxes			TJ	NO	334.880	NO	NO	NO	334.880	1.000	NCV	334.880	22.000	7.367	NO	7.367	0.990	26.744

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV (1)	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
Liquid Fossil Totals												55 164.579		1 100.909	78.697	1 022.212		3 712.239
Solid Fossil	Primary Fuels	Anthracite (2)	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Coking Coal	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other Bituminous Coal	TJ	NO	3 041.520	NO	NO	-104.880	3 146.400	1.000	NCV	3 146.400	25.100	78.975	NA	78.975	0.980	283.782
		Sub-bituminous Coal	TJ	NO	NO	NO	NO	NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Lignite	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Oil Shale	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Peat	TJ	120.600	NO	40.200		NO	80.400	1.000	NCV	80.400	28.320	2.277	NA	2.277	0.980	8.182
	Secondary Fuels	BKB(3) and Patent Fuel	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Coke Oven/Gas Coke	TJ		214.320	NO		26.790	187.530	1.000	NCV	187.530	29.500	5.532	NO	5.532	0.980	19.879
Other Solid Fossil												NO		NO	NO	NO		NO
Peat briquettes			TJ	NO	NO	NO	NO	NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
Solid Fossil Totals												3 414.330		86.784	NA,NO	86.784		311.843
Gaseous Fossil		Natural Gas (Dry)	TJ	NO	60 122.772	NO		3 191.347	56 931.426	1.000	NCV	56 931.426	15.300	871.051	NO	871.051	0.995	3 177.884
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												56 931.426		871.051	NA,NO	871.051		3 177.884
Total												115 510.335		2 058.744	78.697	1 980.047		7 201.965
Biomass total												59 572.877		1 781.146	NA,NO	1 781.146		NA,NO
		Solid Biomass	TJ	83 214.000	195.000	24 261.000		-14.000	59 162.000	1.000	NCV	59 162.000	30.000	1 774.860	NA	1 774.860	NA	NA
		Liquid Biomass	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Gas Biomass	TJ	410.877	NO	NO		NO	410.877	1.000	NCV	410.877	15.300	6.286	NA	6.286	NA	NA

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Table 3 Comparison of CO_2 emissions from fuel combustion (Table 1.C)

FUEL TYPES	REFERENCE APPROACH			SECTORAL APPROACH [1]		DIFFERENCE [2]	
	Apparent energy consumption [3] (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) [4] (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
Liquid Fuels (excluding international bunkers)	55.165	51.020	3 712.239	52.138	3 802.079	-2.143	-2.363
Solid Fuels (excluding international bunkers) [5]	3.414	3.414	311.843	3.226	298.394	5.830	4.507
Gaseous Fuels	56.931	56.931	3 177.884	56.547	3 156.481	0.679	0.678
Other [5]	0.184	0.184	15.243	0.184	15.244	0.000	-0.007
Total [5]	***115.695***	***111.550***	***7 217.208***	***112.096***	***7 272.198***	***-0.487***	***-0.966***

Table 4 Energobalance of Latvia in year 2005 (TJ)

ENERGOBALANCE 2005 (TJ)

sectors	**oil Products**	motor and aviation petrol	kerosene	kerosene type jet fuel	petrol type jet fuel	diesel oil	residual 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	fuel wood	wood wastes	wood chips	wood briquettes	pelleted wood	charcoal	biogas[1]	biodiesel[1]	**heat energy**	**hydro energy***	**electricity**
NCV		44.00	43.20	43.20	43.21	42.49	40.60	45.54	41.86	41.86	29.23	32.98	40.60	41.86	41.86	**26.22**	39.35	26.20	**33.59**	10.05	26.37	6.70	6.70	6.70	17.00	18.00	30.00		37.20	**3.60**	**3.60**	**3.60**
production of primary energy resources	42														42					120		37861	13273	26545	391	5130	420	*	*		12139	
recycled products	292										292							184														
import	90992	18160	86	7130	475	38241	9906	3233	126	335	584	660	209	2512	9335	3041	157		60123		214	34	80	81					*			10278
export	21124	2946				4929	11896	683							670					40		2493	2057	14150	425	5130	180		*			2545
bunkering	10888					3824	7064																									
interproduct transfer	-523		-86	-4624	-475	340	11815								-7493																-12139	12139
stock changes	-1523	-352		-43		-1232	406				-29	-231			-42	105			-3191		-27	74	27	-389	68	234						
statistical differences	388	176				212																										
gross energy - total	**57656**	**15038**		**2463**		**28808**	**3167**	**2550**	**126**	**335**	**847**	**429**	**209**	**2512**	**1172**	**3146**	**157**	**184**	**56931**	**80**	**187**	**35476**	**11323**	**12087**	**34**	**234**	**240**	*****	*****			**19872**
transformation sector	2183					**43**	**2111**				**29**					**236**			**34596**	**60**		**1594**	**2553**	**7873**				*****		**31144**		**5515**
public CHP	568						568												21900				154	1106				*		14238		5234
public heat plants	1574					43	1502				29					157			10580	40		596	1548	4369						13367		
autoproducer CHP																			772				20					*		439		281
autoproducer heat plants	41						41									79			1344	20		998	831	2398						3100		
autoproducer electricity plants																												*				*
charcoal production																						858										
Energy sector**	253					212	41									26			873	20		47	33	34						1091		1756
Losses																			168							36				5033		3010

sectors	**oil Products**	motor and aviation petrol	kerosene	kerosene type jet fuel	petrol type jet fuel	diesel oil	residual 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	fuel wood	wood wastes	wood chips	wood briquettes	pelleted wood	charcoal	biogas[1]	biodiesel[1]	**heat energy**	**hydro energy***	**electricity**
Final consumption:	**55220**	**15038**		**2463**		**28553**	**1015**	**2550**	**126**	**335**	**818**	**429**	**209**	**2512**	**1172**	**2884**	**157**	**184**	**21295**		**187**	**32977**	**8737**	**4180**	**34**	**198**	**240**	*****	*****	**25020**		**20625**
industry	**3320**	**44**				**892**	**447**	**91**	**126**	**335**	**789**	**429**	**167**			**891**	**118**	**184**	**12226**		**187**	**757**	**6305**	**3021**	**17**	**144**				**634**		**5749**
transport:	**42487**	**14730**		**2463**		**23029**		**1093**							**1172**				**68**										*****			**533**
air	2463			2463																												
road	36540	14730				19545		1093							1172				68										*			288
railways	3484					3484																										144
pipelines																																101
other sectors:	**9413**	**264**				**4632**	**568**	**1366**			**29**		**42**	**2512**		**1993**	**39**		**9002**			**32220**	**2432**	**1159**	**17**	**54**	**240**	*****		**24386**		**14343**
agriculture / forestry / hunting	894	44				850										53			739			274	281	174		18				155		537
fisherie						892	162															7										25
construction	3149	44				510	41						42	2512		26			134			74	94	228						50		371
residential	2466	132				1105		1229								944			4199			28810					240			18360		5659
other consumers	1850	44				1275	365	137			29					970	39		3929			3055	2057	757	17	36		*		5821		7751

[1] confidential data

* including wind energy

** energy sector includes consumption of electric energy in power stations, technological consumption in power lines, the consumption in energy sector.