LATVIA'S

NATIONAL INVENTORY REPORT

Submitted under United Nations Convention on Climate Change and the Kyoto Protocol

Common Reporting Formats (CRF)
1990 – 2006

2008

PREFACE

Latvia's National Inventory Report under the United Nations Framework Convention on Climate Change (UNFCCC) and the voluntary submission under Kyoto Protocol contain the following parts:

1. Latvia's national greenhouse gas emission inventory report (NIR) prepared using the reporting guidelines of UNFCCC and relevant parts of the Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol.

2. CRF (Common Reporting Format) data tables for 1990-2006.

In the NIR information is included regarding national system (chapter 1), registry (chapter 10) as well as recalculations and improvements are described in the chapter 9 and under each sub sector. Information on emissions and removals related to Kyoto Protocol Article 3, paragraphs 3 and 4 will be included in the inventory submission from 2010.

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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
GDP – Grand domestic product
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)
IPCC 2006 – 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
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
ERT – Expert review team
EU – European Union
ETS – Emisions trading scheme
IPPC - Integrated Pollution Prevention Control

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 [6].

As a party to the UNFCCC and the Kyoto Protocol 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 from following sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use, Land Use Change and Forestry and Waste.

Latvia is a member of European Union since May, 2004 and Latvia's climate change policy is based on European 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 implementation of 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. These gases are not included in the Kyoto Protocol.

Greenhouse gas inventory covers the years 1990-2006. For the preparation of the 2008 submission CRF Reporter v.3.2.0 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 "Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11"(FCCC/SBSTA/2006/9).

Greenhouse gas inventory is compiled according 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 1990-2006. Estimated GHG emissions for 1990, 1995 and 2000 – 2006 are presented in Table 1, which shows GHG emissions by sectors, expressed in CO_2 equivalent.

Table 1 Aggregated GHG emissions (1990, 1995, 2000 - 2006)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2001	2002	2003	2004	2005	2006
	CO_2 equivalent (Gg)								
CO2 emissions including net CO2 from LULUCF	-1 550.978	-8 601.584	-7 163.505	-7 517.828	-6 688.199	-6 097.801	-7 087.700	-6 710.627	-9 592.343
CO2 emissions excluding net CO2 from LULUCF	19 157.111	9 106.467	7 031.170	7 452.646	7 456.215	7 635.929	7 641.980	7 782.385	8 259.885
CH4 emissions including CH4 from LULUCF	3 512.112	2 062.834	1 794.051	1 864.366	1 875.607	1 799.957	1 781.260	1 828.553	1 771.823
CH4 emissions excluding CH4 from LULUCF	3 493.278	2 027.738	1 737.862	1 831.853	1 840.131	1 763.080	1 747.849	1 793.891	1 739.639
N2O emissions including N2O from LULUCF	3 807.312	1 361.500	1 247.650	1 367.758	1 360.320	1 435.171	1 425.022	1 531.231	1 584.053
N2O emissions excluding N2O from LULUCF	3 805.400	1 357.909	1 241.823	1 364.195	1 356.087	1 430.642	1 421.263	1 527.599	1 579.372
HFCs	IE,NA,NE,NO	0.288	8.586	9.810	11.826	12.946	16.238	19.058	35.426
SF6	NA,NE,NO	0.251	1.275	1.977	3.382	4.413	5.370	7.530	7.124
Total (including LULUCF)	**5 768.447**	**-5 176.711**	**-4 111.942**	**-4 273.917**	**-3 437.064**	**-2 845.314**	**-3 859.811**	**-3 324.255**	**-6 193.917**
Total (excluding LULUCF)	**26 455.789**	**12 492.653**	**10 020.716**	**10 660.482**	**10 667.640**	**10 847.011**	**10 832.699**	**11 130.463**	**11 621.446**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2001	2002	2003	2004	2005	2006
	CO_2 equivalent (Gg)								
1. Energy	19 276.418	9 541.888	7 365.555	7 794.365	7 791.773	7 945.906	7 967.190	8 105.967	8 544.224
2. Industrial Processes	510.405	144.546	148.829	166.598	182.997	198.957	209.071	230.475	249.939
3. Solvent and Other Product Use	55.698	46.166	49.106	55.161	53.412	54.074	55.318	54.231	64.032
4. Agriculture	5 930.505	2 115.080	1 714.034	1 855.327	1 851.458	1 890.347	1 855.693	1 980.852	1 998.828
5. Land Use, Land-Use Change and Forestry(5)	-20 687.343	-17 669.364	-14 132.658	-14 934.398	-14 104.704	-13 692.325	-14 692.510	-14 454.718	-17 815.364
6. Waste	682.763	644.972	743.191	789.031	788.000	757.727	745.427	758.938	764.423
Total (including LULUCF)(5)	**5 768.447**	**-5 176.711**	**-4 111.942**	**-4 273.917**	**-3 437.064**	**-2 845.314**	**-3 859.811**	**-3 324.255**	**-6 193.917**

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

In 2006, Latvia's total GHG emissions without LULUCF showed a decrease of 56 % from the base. Emissions have risen by about 4.5 % compared to the total GHG emissions in 2005.

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.

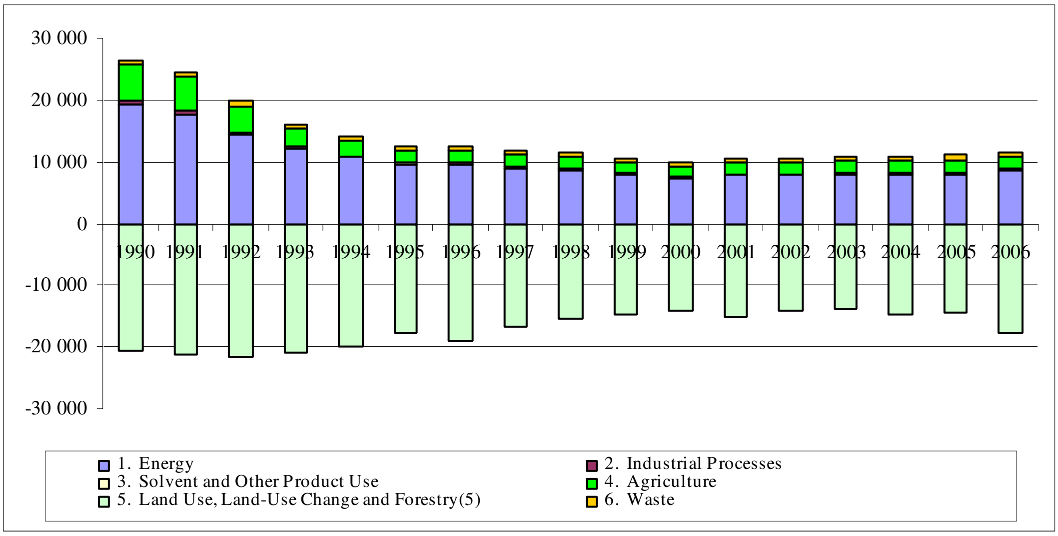


Figure 1 Latvia's greenhouse gas emission trends by sector (Gg CO_2 eqv.)

The **Energy sector** is the most significant source of GHG emissions with over 73.5% share of the total emissions in the 2006. 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 40.4% of total CO_2 eqv energy emissions and 29.7% of total CO_2 Gg eqv emissions. GHG emissions from Transport sector rose by 9.4% compared to last year.

Agriculture is the second most significant source of GHG emissions, with approximately 17% of Latvia's total emissions. The total emissions from agriculture have a clearly stable trend in the latest years. The annual emissions have reduced approximately by 66% since 1990 due to decreases in the number of livestock and in nitrogen fertilisation.

The **Industrial Processes** category contributes approximately 2.1% 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 have a slightly increasing tendency. It is explained with development of Latvian industry.

Solvent and Other Product Use made only about 0.55% 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 2006, emissions were ~12% higher than in 1990. In 2006, emissions from the Waste sector were 764.42 Gg CO_2 equivalents; it contributes about 6.57 % 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 2006, CO_2 removals were 17815.4 Gg CO_2 compared to 20687.3 Gg CO_2 in the base year, that is, 14% lower than in 1990.

In 2006, the main sink is Forestland with net removals of 17608.9 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	66.95	382.24	94.41	101.42
1991	61.14	328.68	65.88	82.95
1992	51.53	307.56	60.20	71.51
1993	45.02	316.36	58.48	67.20
1994	42.22	314.99	59.22	66.57
1995	39.91	313.51	58.81	48.35
1996	39.98	322.10	60.81	54.46
1997	39.58	312.52	62.00	39.16
1998	39.57	302.96	60.64	35.64
1999	38.68	300.91	61.04	29.14
2000	37.07	301.87	56.27	9.61
2001	37.61	308.05	55.14	7.85
2002	37.72	305.34	57.37	6.24
2003	39.26	316.18	59.50	4.83
2004	39.63	321.77	60.13	3.88
2005	40.30	327.57	62.71	3.61
2006	43.83	329.71	64.95	3.25

In the period from 1990 to 2002 indirect emissions have decreased, but starting from 2003 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 [6].

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 [26].

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.

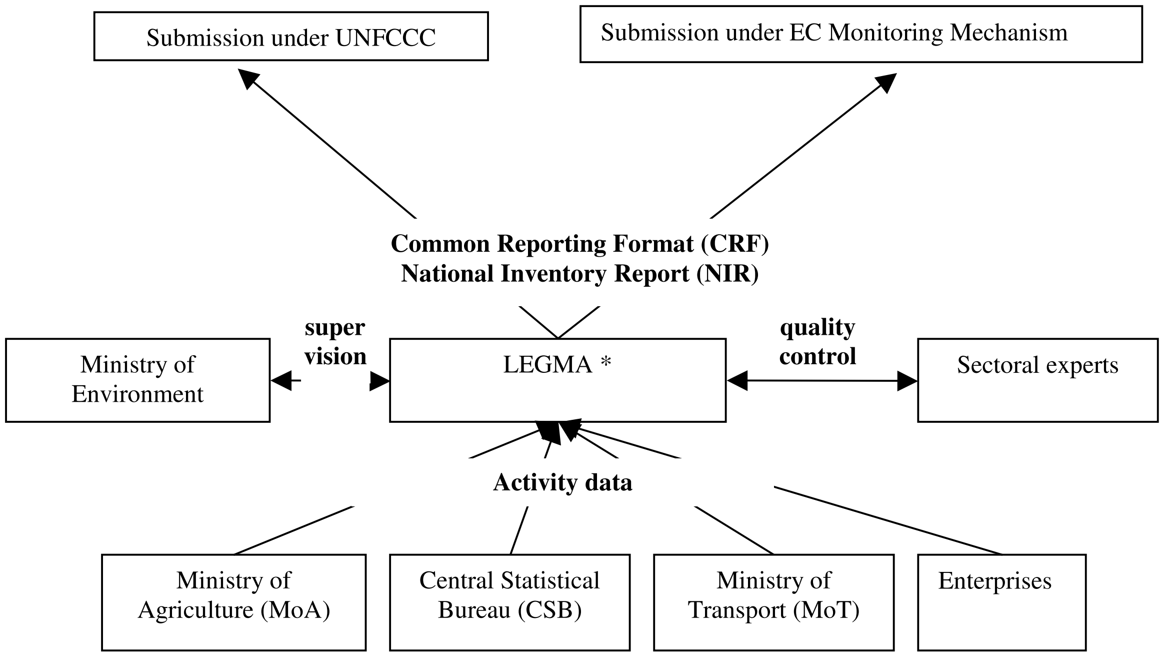
As a party of the UNFCCC, Kyoto Protocol and European Union Latvia is required to produce and regularly update report on GHG emissions and removals.

This report is the annual submission of the Latvia to the UNFCCC, Kyoto Protocol and European Comission. It presents the GHG inventory, the process and the methods used for the compilation of the inventory for 1990 to 2006. The structure of this NIR follows the UNFCCC reporting guidelines on annual inventories.

1.2 A description of the institutional arrangement for inventory preparation

At present the National system in Latvia was designated by the "Climate change mitigation programme for 2005-2010" which was approved by the Cabinet of Ministers of the Republic of Latvia (Ordinance No 220, 06.04.2005). There is under development a new legislation, where detailed functions (roles) and responsibilities of institutions involved in the preparation of the National inventory will be prescribed, including the designation of an institution controlling the QA/QC procedures for every institution.

A schematic model for the national system (NIS) is shown in the Figure 1.1.



*Latvian Environment, Geology and Meteorology Agency

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 Energy balances for EUROSTAT according to additional agreement.

Starting from spring 2006 information about activity data, emissions, emission factors and other parameters in the several Industrial Processes sub-sectors covered by the EU Emission Trading Scheme - lime, bricks, tiles, glass and iron and steel production (raw material use) 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. The annual process of compilation of the Latvia's inventory is summarized in Table 1.2

1.2 Annual process of compilation of the Latvia's inventory

Element	Activity	Responsible performers	Procedures	Due date
Activity data, emission factors, emissions and descriptions according to Regulation	Submission to LEGMA	EU Emission Trading Scheme (EU ETS) operators	EU ETS operators send to LEGMA activity data, CO_2 emission factors, CO_2 emissions and descriptions as GHG report for enterprises involved in EU ETS LEGMA uses these data in GHG inventory	Till 30th March
Activity data, emissions and descriptions according to Regulation	Submission to LEGMA	Involved institutions	Involved institutions send to LEGMA activity data, emissions and descriptions for LULUCF sector	1 November -1 December
CRF data Short NIR according to Decision 280/2004/EC	Inventory preparation, including QC activities	LEGMA	LEGMA send to MoE data in CRF and draft NIR for approval	1 week before 15 January
CRF data Draft NIR according to Decision 280/2004/EC	CRF, NIR	LEGMA MoE	After corrections made by LEGMA, MoE send to EC CRF tables and draft NIR through the Permanent Representation. LEGMA electronically sent to EC CRF tables and draft NIR and data and report uploaded in the EIONET CDR.	15 January
Quality control checks	QA/QC procedures, reports according to QC plan	LEGMA	According to QC plan internal review was carried out.	January - February
Draft NIR	NIR	LEGMA	LEGMA send to involved institutions Draft NIR for comments and approving.	end of January
Draft NIR	NIR	Involved institutions	Involved institutions send to LEGMA comments about NIR and approval.	end of February
Quality control checks	QC	LEGMA	Verification of national data in EC inventory and updates as necessary and response to EC. This process includes collaboration with involved institutions for preparing of response to EC.	1 March to 15 March
CRF data NIR according to Decision 280/2004/EC	CRF, NIR	MoE LEGMA	MoE send to EC final CRF tables and final NIR according to Decision 280/2004/EC requirements through the Permanent Representation. LEGMA electronically sent to EC CRF tables and final NIR and data and report uploaded in the EIONET CDR.	15 March
NIR and emission data in CRF	Inventory submission	MoE, LEGMA	LEGMA coordinating with MoE send approved GHG inventory to UNFCCC (uploaded to ftp)	15 April
Quality control checks	Inventory submission	LEGMA, Involved institutions	Preparing of Response regarding the status of submission and review of inventory by UNFCCC	May – end of year

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 3.20 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 were 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 and IPCC 2006 were used to estimate emissions from Waste sector.

The Table 1.3 presents the main data sources used for activity data as well as information on actual calculations:

Table 1.3 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 and the trend of emissions 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 N_2O greenhouse gas emissions was 1990.

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 2006 without LULUCF – 13 and with – 12. The key sources identified according to trend assessment without LULUCF was 13, but with LULUCF – 14.

The key sources for 2006 with LULUCF are shown in Table 1.4 and Table 1.5, but for 1990 key sources are included in Annex 1 in the same way as key sources, which determined without LULUCF.

1.4 Key sources - Level Assessment in 2006 with LULUCF

	IPCC Source Categories	GHG	2006 CO_2 eq. Gg	LA, %	Cumulative, %
1	Removals from Forest Land	CO_2	17608.85	0.59	0.59
2	CO_2 Emissions from Stationary Combustion-gas	CO_2	3267.89	0.11	0.70
3	Mobile Combustion: Road Vehicles	CO_2	3069.05	0.10	0.81
4	CO_2 Emissions from Stationary Combustion-oil	CO_2	1051.08	0.04	0.84
5	Emissions from Agricultural Soils	direct-N_2O	773.74	0.03	0.87
6	Emissions from Enteric fermentation in Domestic Livestock's	CH_4	565.69	0.02	0.89
7	Emissions from Solid Waste Disposal Sites	CH_4	514.00	0.02	0.91
8	CO2 Emissions from Stationary Combustion-coal	CO_2	323.91	0.01	0.92
9	Emissions from Nitrogen Used in Agriculture	indirect-N_2O	318.00	0.01	0.93
10	Removals from Grassland	CO_2	307.41	0.01	0.94
11	Non-CO2 Emissions from Stationary Combustion-biomass	CH_4	247.43	0.01	0.95
12	Mobile Combustion: Railways	CO_2	223.94	0.01	0.95

1.5 Key sources - Trend assessment in 2006 with LULUCF

IPCC Source Categories (LULUCF is included)	GHG	Base year 1990, CO_2 eq.Gg	2006, CO_2 eq. Gg	Level Assessment	Trend Assessment	Contribution to trend, %	Cumulative, %
Removals from Forest Land	CO_2	20666.28	17608.85	0.60	0.25	0.32	0.32
CO_2 Emissions from Stationary Combustion-oil	CO_2	7421.58	1051.08	0.04	0.19	0.25	0.57
Mobile Combustion: Road Vehicles	CO_2	2313.57	3069.05	0.10	0.09	0.11	0.68
CO_2 Emissions from Stationary Combustion-coal	CO_2	2835.42	323.91	0.01	0.08	0.10	0.78
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057.23	565.69	0.02	0.04	0.05	0.83
Emissions from Solid Waste Disposal Sites	CH_4	278.79	514.00	0.02	0.02	0.02	0.85
Emissions from Nitrogen Used in Agriculture	indirect -N_2O	1033.87	318.00	0.01	0.02	0.02	0.88
Emissions from Agricultural Soils	direct-N_2O	1649.85	773.74	0.03	0.01	0.02	0.89
Emissions from Manure Management	N_2O	551.63	157.86	0.01	0.01	0.01	0.91
Removals from Grassland	CO_2	194.53	307.41	0.01	0.01	0.01	0.92
CO_2 Emissions from Stationary Combustion-gas	CO_2	5477.34	3267.89	0.11	0.01	0.01	0.93
Non-CO_2 Emissions from Stationary Combustion-biomass	CH_4	167.29	247.43	0.01	0.01	0.01	0.94
Mobile Combustion: Railways	CO_2	525.64	223.94	0.01	0.01	0.01	0.95

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 2008 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% and the trend uncertainty is 2.3%. The Tables 1; 2; 3 in the Annex 2 show the uncertainties separate for each direct GHG. The overall uncertainty for CO_2 is 3.5%, for CH_4 – 17% and for N_2O – 28%. The trend uncertainty is calculated for CO_2 – 1.5%, for CH_4 – 7% and for N_2O – 14%. Uncertainties for CH_4 and N_2O are higher basically due to use default emission factors.

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.

At present Ministry of Environment works on development of legislation which will designate an institution to be responsible for the coordination of QA/QC procedures for every institution.

LEGMA is responsible for coordination of the whole process of annual greenhouse gas inventory and has an approved QA/QC program. The QA/QC program consists of aims related to GHG inventory, QA/QC plan and defined responsibilities as well as inner documentation (protocols), where detailed emission calculation procedures, used activity data, etc. from each sector (except from LULUCF) as well as sectoral data checking are described . The QC program determines internal expert reviewer per category for stated specific category (for example, expert who is responsible for Energy sector reviews Transport sector). The program includes Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000.

For submission 2008, GHG inventory quality improvement plan was prepared according to Quality Control and Quality Assurance program made by LEGMA and "Report of the review of the initial report of Latvia" made by UNFCCC (FCCC/IRR/2007/LVA 14 December 2007). In the improvement plan planned aims for inventory and status of implementation are described. Detailed description is included in Annex 7.

QC activities were carried out at the various stages of the inventory compilation process - processing, handling, and documenting, cross-checking, recalculations.

These activities are implemented by sectoral experts and inventory compiler.

QC system includes various activities aimed to ensure transparent data flow through all inventory process:

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

For submission 2008, each expert reviewer checked and filled in QC form for each category taking into account above mentioned criteria's. After checking the QC form was submitted to sectoral expert who is responsible for specific sector. The sectoral expert fills comments in the QC form and presents back to the expert reviewer and NIC. All these QC forms were archived.

National inventory report was send to CSB and Ministries of Environment and Agriculture for approving.

Every annual inventory (CRF tables and NIR) is archived by LEGMA.

LEGMA co-ordinates the participation of the institutions involved to the preparing of inventory as responses to issues raised by the reviews of the UNFCCC Secretariat.

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 1.6 shows the Latvia's data submission completeness. For submission 2008, completeness was assessed by taking into account sub-sectors. In Energy the completeness compared to last submission is improved by 1%, in Industrial Processes it has grown by 3%, in Solvents – by 3%, in Waste sector – by 5%, in LULUCF it increased by 3% and in Agriculture there are no changes regarding completeness. The overall inventory completeness is increased by 1%. Detailed information about changes in inventory is explained in each sector's description.

Table 1.6 Completeness in submission 2008

Sector	Submission 2008 2006		Submission 2007 2005	
	NE	Completeness	NE	Completeness
Energy	19	90%	23	89%
Industrial Processes	15	92%	14	91%
Solvents	4	80%	4	67%
Agriculture	28	66%	28	66%
LULUCF	62	26%	58	19%
Waste	18	62%	15	66%
Total	**147**	**76%**	**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).

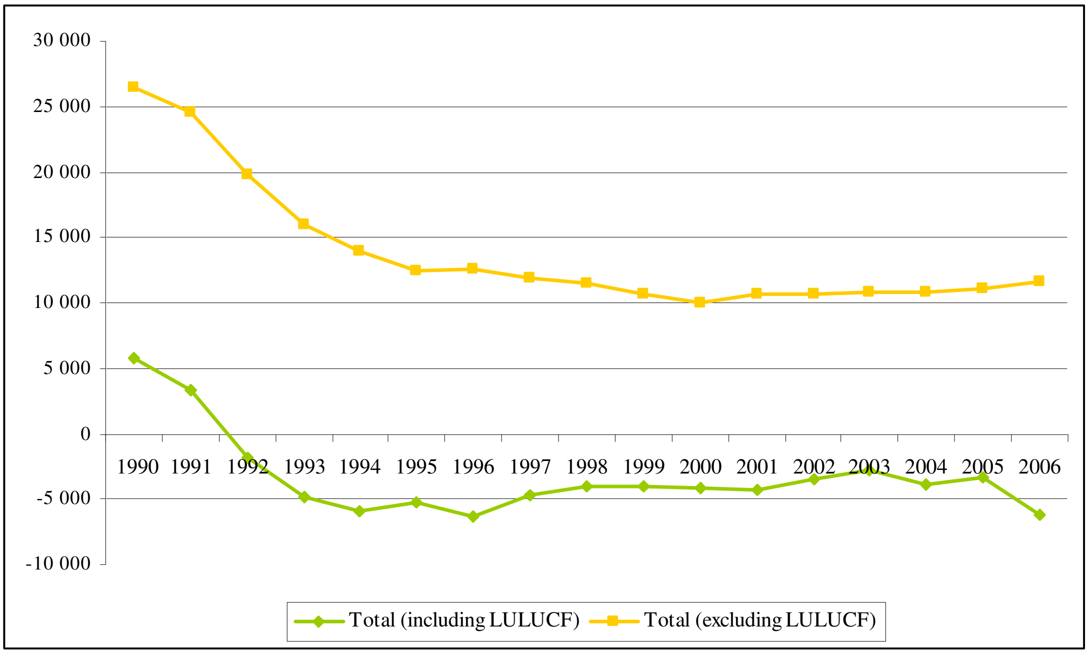


Figure 2.1 Latvia's aggregated greenhouse gas emissions in 1990-2006 (Gg CO_2 eq.)

As illustrated in Figure 2.1, Latvia's GHG emissions have decreased considerably since the 1990-ties. 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 2006, Latvia's total greenhouse gas emissions were approximately 11626 Gg in CO_2 equivalents. This was about 56 % 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.

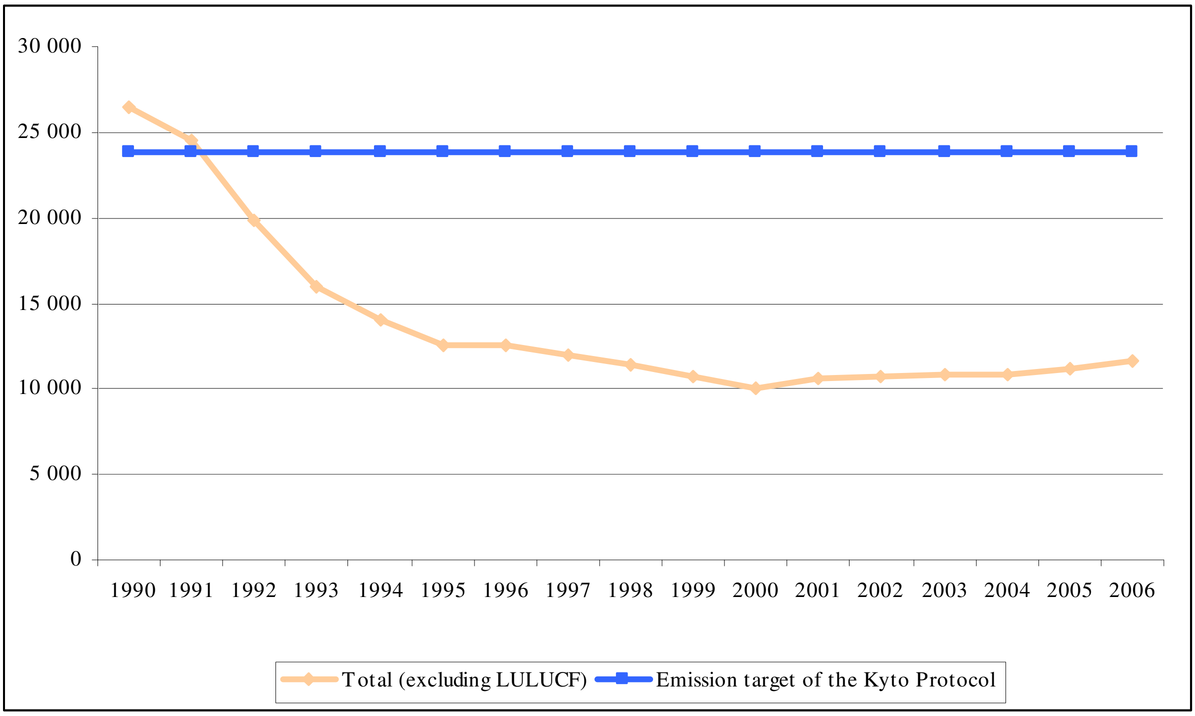


Figure 2.2 Trends in Gg CO_2 eq. emissions and emission target of the Kyoto Protocol

Latvia's total base year emissions for 1990 under Kyoto Protocol are 25909.16 Gg CO_2 eq. according to UNFCCC Report of the review of the initial report of Latvia (FCCC/IRR/LVA, 14 December 2007).

In submission 2008, for UNFCCC reporting the base year emissions changed because it wasn't possible to correct all ERT identified problems during review of Latvia's AAU.

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 2006, CO_2 emissions contribute 71% of Latvia's total greenhouse gas emissions. In 2006, total CO_2 emissions had decreased by approximately 56% since 1990.

The most important source of CO_2 emissions (Gg) in 2006 was fossil fuel combustion – 96.8%, including Energy Industries – 25.3%; Manufacturing Industries and Construction – 14.8%; Transport – 40.4%, Other sectors (Agriculture, Forestry, etc.) – 16.7%.

Other anthropogenic emission sources of CO_2 are Industrial Processes – 2.5%, Solvent and Other Product Use approximately 0.63% 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 2006, forests in Latvia removed 17852.23 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 2006 contribute approximately 14.9% of total GHG emissions. The methane emissions (Gg) decreased by 50% in 2006 since 1990.

Agricultural soils are the main source of N_2O emission in Latvia generating 85.7% of all N_2O emissions (Gg) in 2006. 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 58.5% in 2006, mainly due the decrease in the emissions from agriculture.

Emissions from HFCs and sulphur hexafluoride (SF_6) consumption are reported for the period 1995-2006. Total HFCs emissions (Gg CO_2 eqv.) increased by 46.2% in 2006 compared with 2005. It is explained with improvement of data collection system when number of enterprises that reported their operations with f-gases in 2006 increased by 90.4% compared with 2005. The biggest emission source is HFC-134a from Mobile air-conditioning and contributes 64.4% from total HFCs emissions that is explained with sharply increasing number of new cars exploited in Latvia. SF_6 emissions from electrical equipment are reported and contribute 7.12 Gg CO_2 eqv. in 2006.

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.

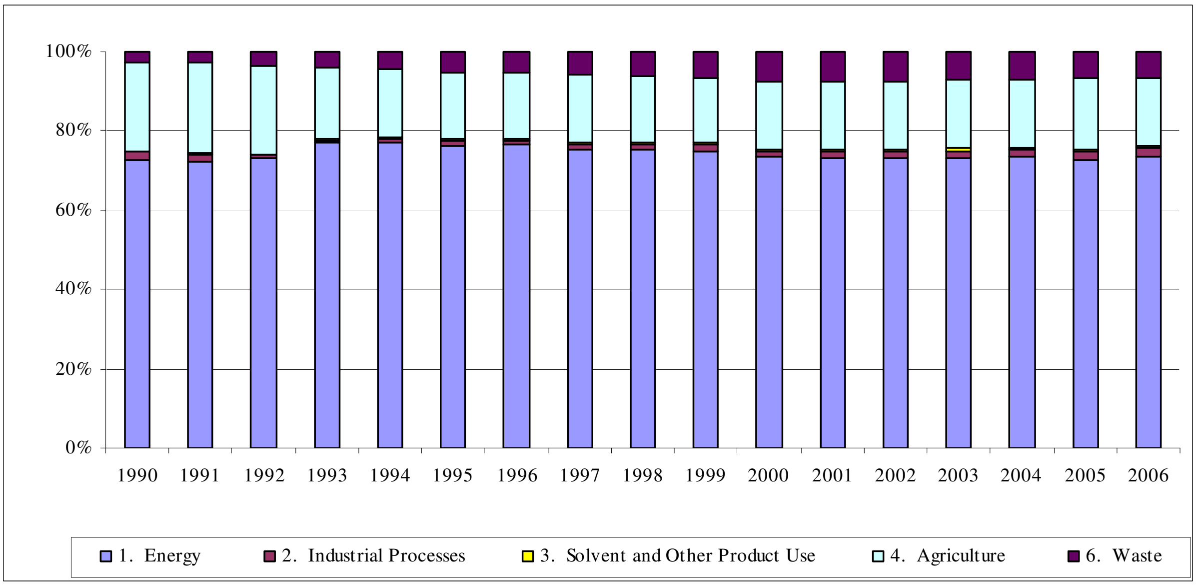


Figure 2.3 Latvia's greenhouse gas emissions by source 1990–2006 excluding LULUCF

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.

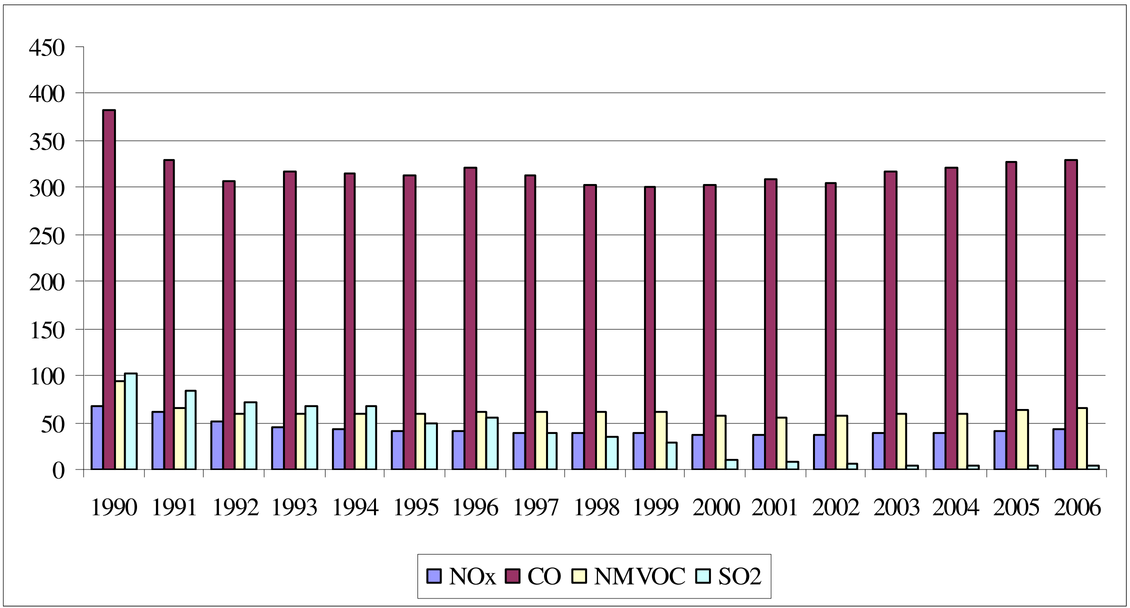


Figure 2.4 Total indirect greenhouse gas emissions trend 1990-2006 (Gg)

In 2006, the sulphur **dioxide emissions** were 3.25 Gg from which 92.6% originated in the Energy sector, where Energy Industries generated 22.3%, but Other sectors 40.4% of total SO_2 emissions.

Nitrogen oxides were generated generally in the Energy sector 89.8% and 8.9% in the Industrial Processes. In 2006, the total emissions were 43.83Gg. The Transport sector was responsible for 54.5% of the total emissions. Energy Industries, Manufacturing Industries and Construction as well as Other sectors generated 14%, 8.9% and 12.4% of the total emissions, respectively.

In 2006, **Carbon monoxide** emissions were 329.71 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 66.4% and Transport 22.3%.

In 2006, total emissions of **non-methane volatile organic compounds** were 64.95 Gg from which Energy sector generated 52.9%, Solvent and Other Product Use approximately 25.9%, but Industrial Processes 21.2%.

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 fuels (wood, peat, hydro resources) are 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.

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

Consumption of Energy Resources	1990	1995	2000	2004	2005	2006
Energy consumption – total	317,7	181,5	156,7	177,9	181,335	186,422
of which:						
Natural gas	99,5	41,3	45,1	55,3	56,8	58,7
Light fuel products and other oil products	81,0	39,7	43,4	55,1	56,2	62,2
Heavy oil, shale oil	63,1	36,2	13,0	3,9	3,3	2,3
Coal	26,0	7,2	2,8	2,6	3,1	3,4
Peat, coke and other types of solid fuel	4,4	4,4	2,7	0,3	0,3	0,2
Firewood and other wood products	27,6	42,1	39,7	49,5	49,5	49,7
Electrical power (HPPs, wind generators)	16,2	10,6	10,2	11,4	12,1	9,9

* 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 34.58%, including heavy fuel with about 1.22%. The biggest consumers of heavy oil are public heat and electricity supply (51.9%) and industry (23.3%). 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 26,7% in 2005 by the side of 1990 when firewood consumption was only about 8.7% from total energy consumption. The biggest users of firewood are households – 62,7%, industry (including autoproducers and mainly wood processing companies) – 12,8%, commercial / institutional consumers – 12.8% and public heat and electricity supply companies – 9.3%.

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		2006	
	Electricity	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**
Production	16186	99439	10573	46112	10163	31867	11369	31093	12139	31144	9878	4453
Own use and losses	6 883	15171	6372	8215	5202	7160	4975	6512	4767	6124	4576	5670
Import	25700	-	9529	-	7589	-	9839	-	10278	-	10116	-
Export	12798	-	1408	-	1159	-	2290	-	2545	-	1087	-
Final consumption												
CRF 1.A.2.	11 484	32 929	5 130	1 969	5 159	659	5 882	608	6 120	684	6 332	634
CRF 1.A.3.	918	-	677	-	547	-	500	-	533	-	540	-
CRF 1.A.4.	17 550	51 339	10 267	35 928	10 411	24 048	13 072	23 973	13 972	24 336	15 188	23 752
TOTAL	**29952**	**84268**	**16074**	**37897**	**16117**	**24707**	**19454**	**24581**	**20625**	**25020**	**22060**	**24386**

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 73.5% share of the total emissions in the 2006 (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 eqv 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 40.4% of total CO_2 eqv energy emissions and 29.7% of total CO_2 Gg eqv emissions. GHG emissions from Transport sector rose by 9.4% compared to last year.

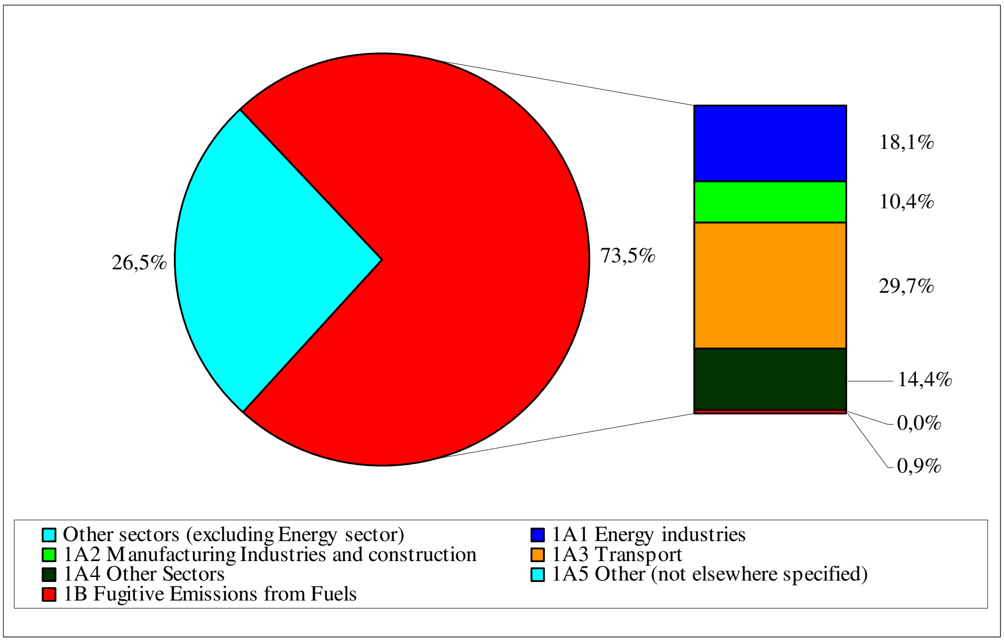


Figure 3.1.1 Emissions from the Energy sector in 2006

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 – 2006 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
A Fuel combustion																	
CO_2	18591.1	17059.5	13819.1	11690.8	10140.4	8920.8	8991.9	8447.4	8051.0	7437.2	6845.2	7248.8	7240.7	7405.9	7405.0	7527.0	8004.5
CH_4	12.2	13.6	12.4	13.0	12.9	13.3	13.7	13.0	12.2	12.0	11.3	12.4	12.2	12.8	13.2	13.3	13.0
N_2O	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	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	5.0

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

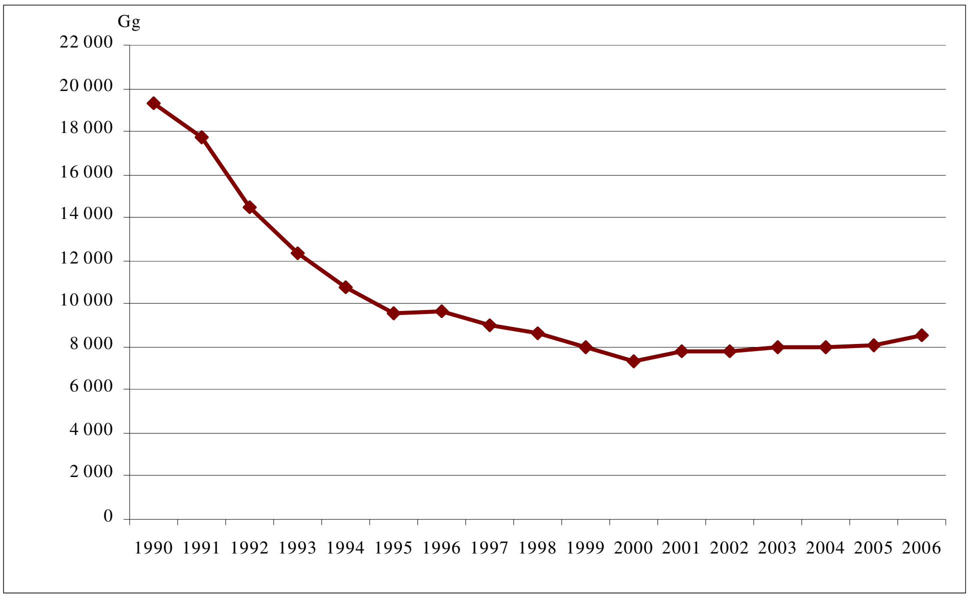


Figure 3.1.2 GHG emissions from Energy sector 1990 – 2006 (Gg CO_2 eqv)

It is seen that emissions expressed in CO_2 equivalents in 1.A Energy sector decreased year by year till 2000. Decrease of emissions depends on economical and social situation in the 90-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 8 004.5 Gg (including Transport sector) and accounted 97% of the total emissions in 2006.

CH_4 emissions from fuel combustion were 12.99 Gg (including Transport sector). The biggest part of CH_4 emissions contributes Other sectors – 11.9 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 10.6% of the total N_2O emissions in 2006.

Emissions from fuel combustion are presented in the Figure 3.1.3.

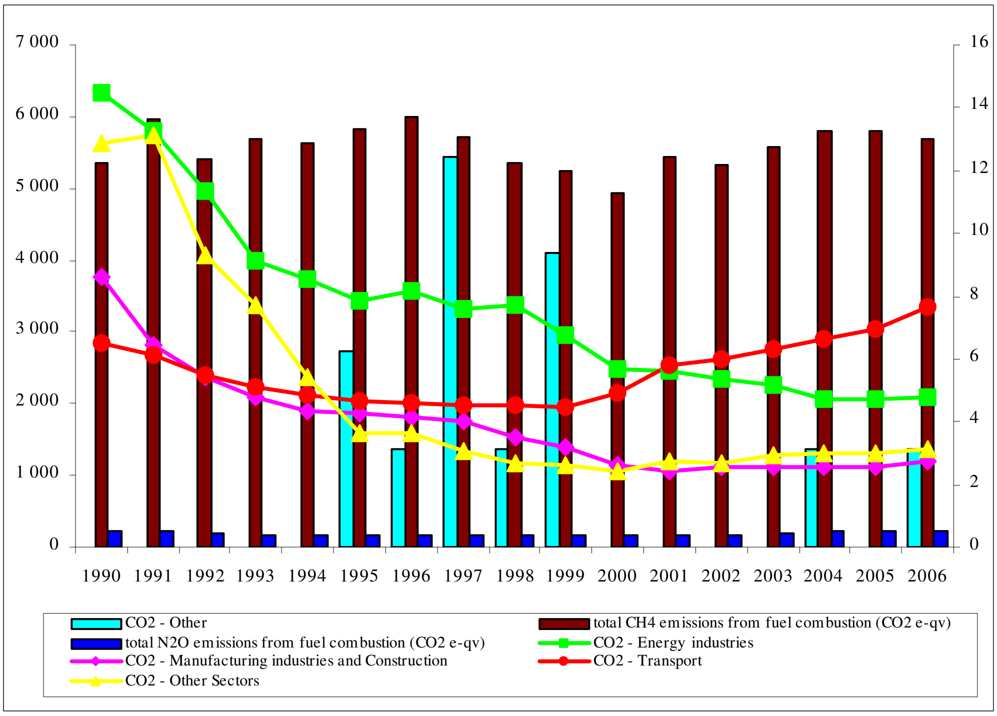


Figure 3.1.3 Total direct GHG emissions from fuel combustion in 1990 – 2006 (Gg)

The following indirect greenhouse gases NO_x, CO, NMVOC, SO_2 are calculated. Total emissions from Energy sectors for 1990 – 2006 are presented in Figure 3.1.4.

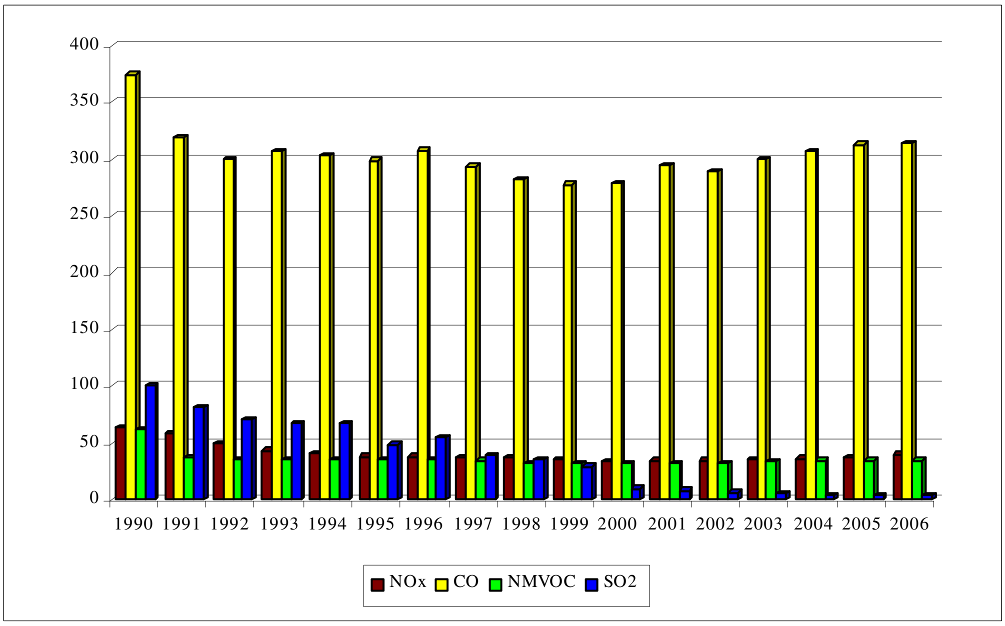


Figure 3.1.4 Total indirect GHG emissions from fuel combustion in 1990 – 2006 (Gg)

In 2006, 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 approximately 100 Gg in 1990 to 3.0 Gg emissions in 2006. 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.

The emissions from 1.A.1 and 1.A.2 sectors by relevant subcategories and gases in time period 1990 – 2006 are presented in Table 3.2.1.

Table 3.2.1 Emissions from Energy industries and Manufacturing Industries and Construction sub-sectors in 1990 – 2006 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1.A.1 Energy industries																	
CO_2,	6332.17	5805.70	4955.13	3990.00	3748.76	3440.44	3565.90	3327.26	3368.30	2944.78	2490.22	2442.60	2335.07	2269.73	2077.39	2067.76	2094.63
CH_4	0.27	0.26	0.25	0.24	0.24	0.23	0.25	0.29	0.28	0.23	0.22	0.20	0.20	0.23	0.21	0.18	0.20
N_2O	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03
1.A.2 Manufacturing industries and construction																	
CO_2,	3772.61	2824.39	2373.72	2103.01	1897.51	1862.44	1822.77	1766.83	1545.06	1398.01	1147.18	1054.65	1108.99	1107.79	1105.35	1126.61	1188.89
CH_4	0.26	0.19	0.17	0.18	0.17	0.16	0.17	0.17	0.18	0.17	0.15	0.19	0.18	0.18	0.22	0.25	0.28
N_2O	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03

Emissions from these two sectors are decreasing year by year (Figure 3.2.1). In the beginning of 90-ties it is explained with economical crisis caused by political and social situation in the country. In the middle of 90-ties curve of direct GHG emissions fluctuated. At the end of 90-ties it started to decrease and continued till 2004. Decreasing in the end of 90-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 2004, emissions are increasing due to development of nation economy and industry as well as increase of demand of industrial production and improvement of well-being of population and increase of amount of heat consumers.

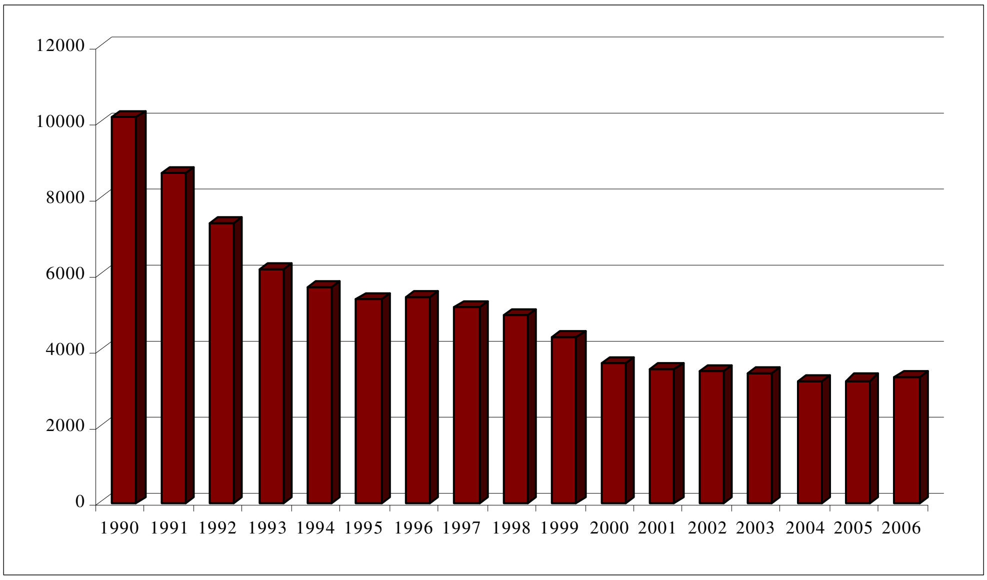


Figure 3.2.1 Total direct GHG emissions of Energy Industries and Manufacturing industries and construction in 1990 – 2006 (Gg CO_2 eqv)

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 – 2006. It is explained with fuel switching to natural gas and biomass where sulphur dioxide emissions did not occurred. Other indirect GHG emissions in last years increased due to increase of wood and wood waste and natural gas consumption.

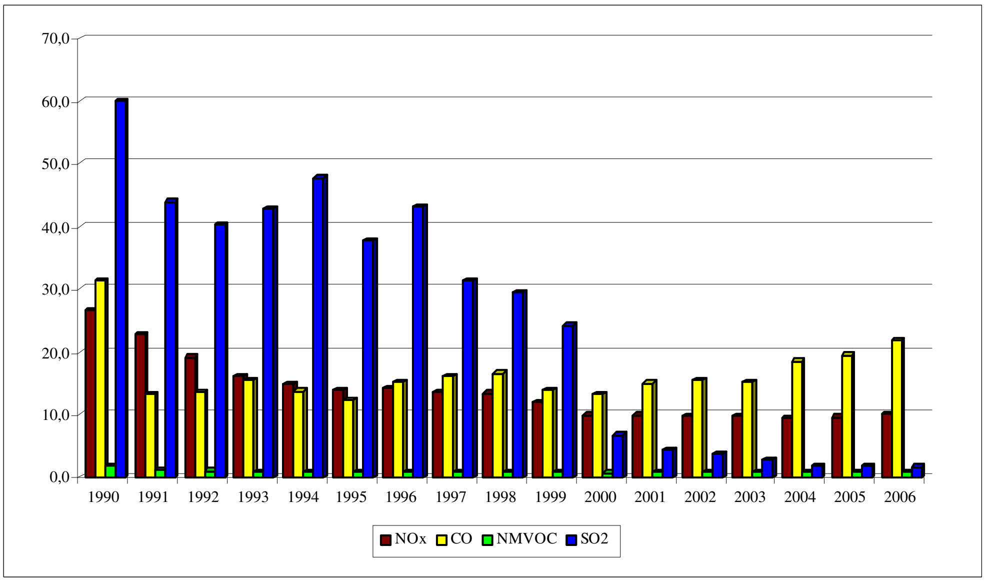


Figure 3.2.2 Total indirect GHG emissions of Energy industries and Manufacturing industries and construction in 1990 – 2006 (Gg)

3.2.2 Methodological issues

IPCC 1996 Tier1 Sectoral approach and Reference approach for the comparison of CO_2 emissions as well as EMEP/CORINAIR 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.

Although in CO_2 emissions country specific emission factors are used according to IPCC 1996 it is Tier1 method. According to 2006 IPCC Guidelines it is Tier2 approach if country specific emission factors and fuel consumption in specific source category are used in emission estimations.

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 1996 and used fuel type of physical characteristics [13].

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 [13].

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

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 is MJ/m³
***** for wood – Q_z^d is TJ/1000m³
****** 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 by using following equation.

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

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 (Gg/PJ)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
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 – 2006 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.

Table 3.2.4 Fuel consumption in Energy industries (CRF 1.A.1) and Manufacturing Industries and Construction (CRF 1.A.2) in 1990 – 2006 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1.A.1 Energy industries																	
Liquid fuels	40.48	33.25	28.44	27.17	30.86	20.52	27.34	17.44	20.66	17.49	7.90	5.28	5.08	3.62	3.17	2.40	1.51
Solid fuels	5.26	4.75	5.51	5.58	4.52	5.21	4.15	3.96	2.78	1.77	2.75	1.64	1.29	0.87	0.28	0.24	0.14
Gaseous fuels	49.03	50.29	40.18	24.41	16.77	24.11	18.83	28.45	27.08	25.73	28.86	33.57	32.55	34.14	32.41	33.35	35.23
Biomass	0.44	0.59	0.67	0.83	1.30	1.05	1.60	3.39	4.09	3.66	3.19	3.62	4.10	5.50	5.48	4.71	5.33
1.A.2 Manufacturing industries and construction																	
Liquid fuels	28.96	18.77	16.01	16.56	16.02	16.34	15.98	15.69	12.67	11.16	7.50	4.89	4.61	4.73	4.48	3.65	4.26
Solid fuels	1.55	0.90	0.98	1.64	1.46	0.67	0.61	0.48	0.42	0.44	0.25	0.25	0.25	0.26	0.22	0.94	1.36
Gaseous fuels	25.83	23.69	19.19	12.51	9.75	10.00	9.89	9.55	9.79	9.15	9.86	11.60	12.85	12.75	13.09	13.55	13.26
Biomass	0.62	0.60	0.62	1.78	2.10	2.41	2.66	2.74	3.19	3.18	2.70	3.86	3.39	3.31	4.71	5.54	6.38
Other Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.04	0.13	0.25	0.33	0.29	0.31	0.18	0.13

The biggest decrease in time period 1990 – 2006 was for liquid fuel consumption – 91.7% (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 till 2004. In the last years consumption of solid fuels is increasing that is explained with increase of coal consumption in mineral production sector.

Consumption of biomass fuel increased in the time period 1990 – 2006. Since 2000, gaseous fuel consumption is increasing. 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.

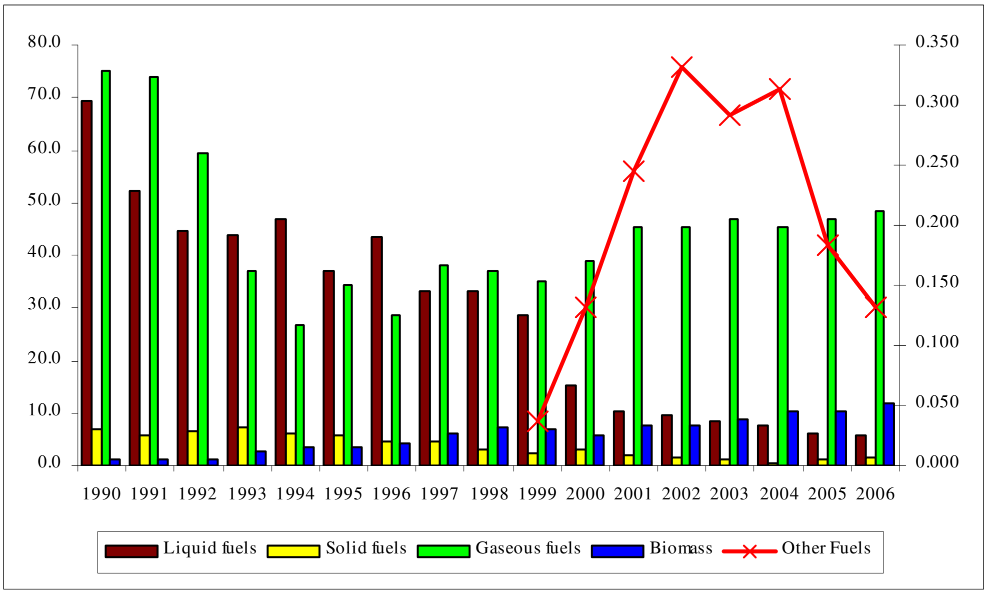


Figure 3.2.3 Total fuel consumption in Energy industries and Manufacture industries and Construction in 1990 – 2006 (PJ)

3.2.3 Uncertainties

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.1; CRF 1.A.2 is ±2% in 2006. 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 emission factor 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. CO_2 emission factor for biomass is assigned as 50% because emission factor is estimated by using default net calorific values still activity data is estimated by using net calorific values for specific wood products, wood types and moisture content of fuelwood.

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 – 2005. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

Changes occurred due to the updated statistical information, mistaken input data correction:

- CSB updated information of NCV for some liquid fuel types – other liquids and diesel oil, for wood and wood waste fuel. GCV/NCV ratio for natural gas was corrected for some years;
- Coke consumption in several industry sectors was included in emission estimation for submission 2008.

Difference for submission 2007 and submission 2008 in reported direct GHG emissions is insignificant for all years in time series 1990 – 2005 fluctuating from 0.1% to 1.23%.

3.2.5 Planned Improvements

CH_4 emissions from biomass stationary combustion are key source category so it is important to use Tier2 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;
- Domestic Navigation.

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 – 2006 by sub-categories (Gg CO_2 eqv.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Road Transport	2339,1	2178,5	1983,8	1959,8	1879,2	1773,7	1741,3	1723,6	1725,6	1729,2	1935,7	2319,3	2393,1	2511,2	2655,3	2791,4	3148,0
Civil Aviation	0,1	0,1	0,1	0,1	0,2	0,5	0,7	0,9	1,2	1,4	1,6	1,9	2,1	2,2	2,4	2,5	2,6
Domestic Navigation	19,5	22,8	35,1	45,9	48,9	51,1	52,6	49,9	49,7	52,0	54,2	54,3	52,5	51,9	49,5	50,5	52,0
Railway	589,9	576,1	467,8	289,8	254,8	265,3	265,3	279,2	254,8	219,9	226,9	233,9	244,4	279,2	286,2	286,3	251,3
Total Transport	**2948,6**	**2777,4**	**2486,8**	**2295,6**	**2183,1**	**2090,6**	**2059,9**	**2053,6**	**2031,3**	**2002,5**	**2218,5**	**2609,3**	**2692,0**	**2844,5**	**2993,3**	**3130,7**	**3453,9**

In 2006, Transport sector contributed 29.7% from total CO_2 eqv emissions, excluding LULUCF and 40.4% CO_2 eqv emissions from the total Energy sector. The biggest part of Transport GHG emissions contributes Road Transport (91.1%), then Railways (7.3%), Domestic Navigation (1.5%) and Civil Aviation, which contribute a very small part of transport emissions (0.08%).

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

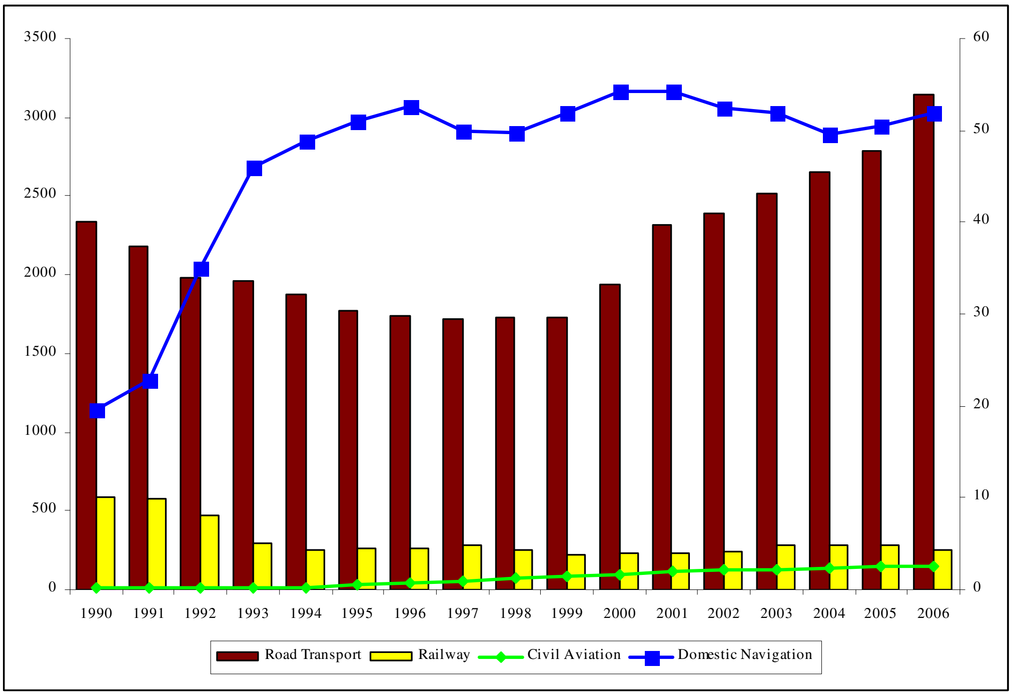


Figure 3.3.1 Emissions from the Transport sector in 1990 – 2006 by sub-sectors (Gg CO_2 eqv.)

(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 54.5% from national total NO_x emissions.

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.

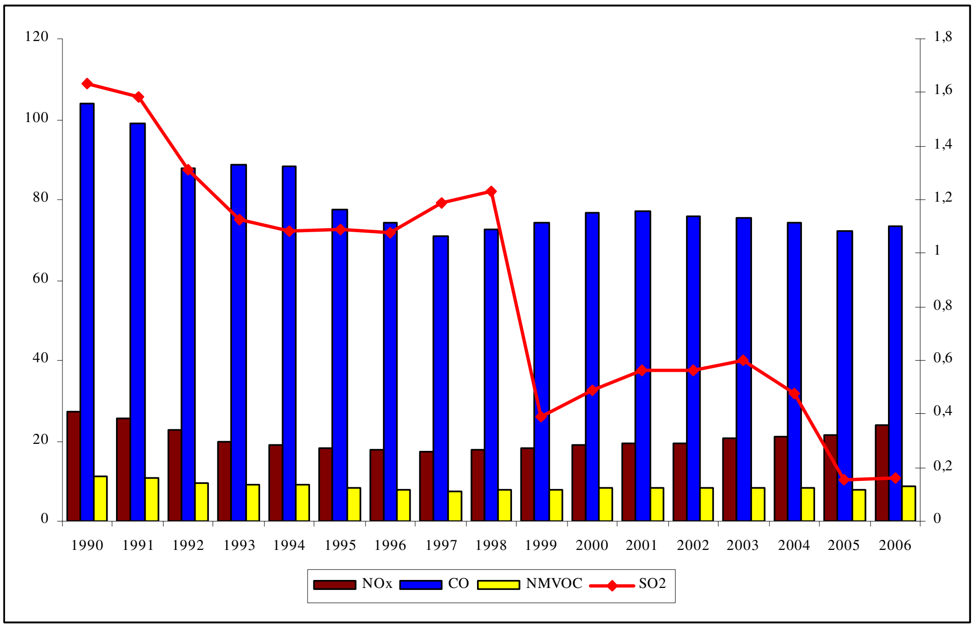


Figure 3.3.2 Indirect GHG emissions from Transport sector (Gg)
(SO_2 – secondary axis)

3.3.2 Methodological issues

Methods

Emission calculation from **Road transport** is 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 since 2005 also biofuels. Emissions are calculated for gasoline and diesel vehicles separately. Emissions from LPG and biofuels are calculated using Tier1 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 road transport activity data section. 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.

Exception in emission calculation by using COPERT III is made for CO2 emissions from gasoline use in road transport. During the In-Country visit in 21st – 26th May 2007 the ERT had prepared the recommendations of improvement of Latvia's Greenhouse Gas inventory – "Potential Problems and Further Questions from the ERT (2007) formulated in the course of the in-country review of Latvia's Initial Report under the Kyoto Protocol and 2006 Inventory Submission" [16].

As ERT (2007) found out following problem:

- The country-specific CO_2 emission factor was not inputted to the COPERT III model. The CORINAIR default emission factor is approximately 72 t/TJ, while the 2004 Latvia study is reported as 68.6 t/TJ in Table 3.3.2 of the submission 2006 NIR. Use of the higher EMEP/CORINAIR default CO_2 emission factor, rather than the country-specific CO_2 emission factor, appears to overestimate the base year estimates [16].

Latvia has recalculated CO_2 emissions from Gasoline use in 1.A.3.b with country-specific CO_2 emission factor as it was recommended by ERT (2007) that was assumed as Tier2 from IPCC 1996.

CO_2 emissions from diesel oil use in Transport sector are estimated by using default EMEP/CORINAIR emissions factors that are included in COPERT III model for Road Transport or default CO_2 emission factors from IPCC 1996 for other Transport sector sub-categories. Default CO_2 emission factors of diesel oil are used because country specific CO_2 emission factor for diesel oil reported in national expert research "Guidance manual for CO_2 emission estimations (developed in accordance with UNFCCC and IPCC recommendations and physical characteristics of fuels used in Latvia)" is determined as for stationary fuel combustion installations. CO_2 emission factors from Transport sector have to differ from ones used for emission estimations from stationary fuel combustion installations due to different combustion conditions.

To calculate emissions from **Railway, Civil Aviation and Domestic Navigation** are used the Tier1 method from IPCC 1996. The calculation includes CO_2, N_2O and CH_4 emissions and also indirect GHG emissions.

$$\boxed{\text{Emissions} = \text{Activity Data} \times \text{Emissions Factor}}$$

Emission factors and other parameters

Emission factors in **Road transport** are given as 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. 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 Diesel oil emission factors used for SO_2 emission calculation 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
2004-2006	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

Fuel consumption in road transport in 2006 was about 41.8% from total fuel consumption in Energy sector. In last years the consumption of gasoline in road transport becomes stable still gasoline consumption increased by approximately 10% in 2005 – 2006. The consumption of diesel oil since 2000 is increased more than 54% (Figure 3.3.5). In 2006, biofuels were included in energy balance for the first time. Biodiesel and biogasoline contributes very small part from total fuel used in road transport, just 0.3%, but amount of biofuels will grow in next years, because it is an environmental friendly fuel. According to national legislation in 2010 the amount of biofuels will contribute 5.75% from fuel used in Transport sector.

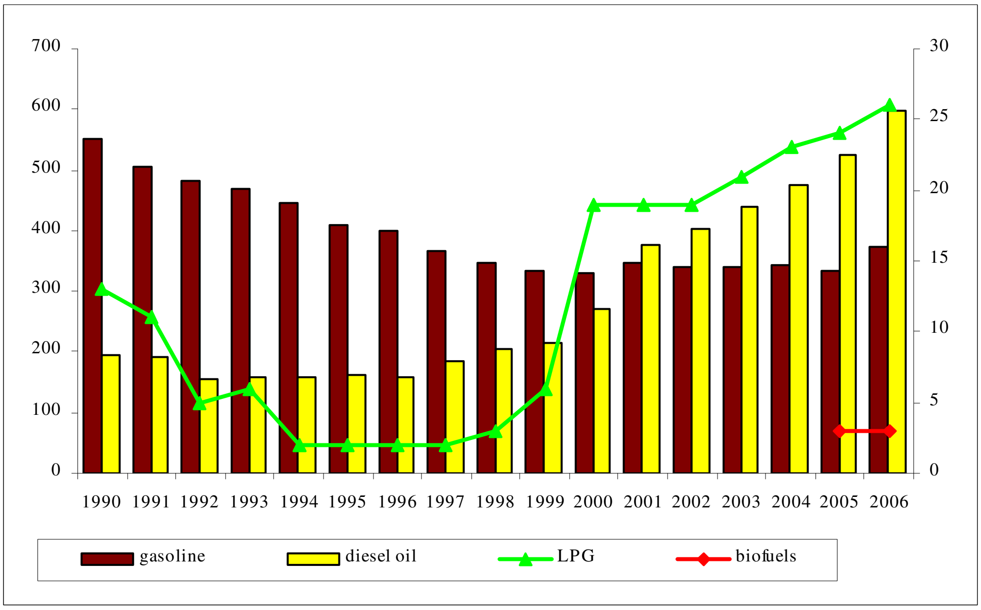


Figure 3.3.3 Fuel consumption in road transport in 1990 – 2006 (Gg)
(Biofuel and LPG - secondary axes)

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 3.3.7).

Table 3.3.7 Fuel consumption in railway transport (TJ) [3]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
diesel oil	7180.8	7010.9	5693.7	3526.7	3101.8	3229.2	3229.2	3399.2	3101.8	2676.9	2761.9	2846.8	2974.3	3399.2	3484.2	3484.2	3059.3

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.

In the end of 2005 a research "Research about fuel consumption in domestic navigation and aviation 1990-2004" was made [10]. This research performed very 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 and 2006 was calculated based on this research, but the assumption is that domestic aviation in 2006 is grown taking into account the last year tendencies. The fuel consumption and emissions from domestic aviation is still insignificant just 0.08% from total Transport fuel consumption (Table 3.3.8).

Table 3.3.8 Fuel consumption in civil aviation (TJ)[10]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
aviation gasoline	0.16	0.16	0.17	0.29	0.57	1.14	1.71	2.28	2.85	3.42	3.99	4.56	5.13	5.42	5.70	6.04	6.40
jet kerosene	0.76	0.78	0.81	1.34	2.68	5.35	8.04	10.72	13.40	16.07	18.76	21.44	23.73	25.46	26.80	28.41	29.81

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.

In the end of 2005 a research "Research about fuel consumption in domestic navigation and aviation 1990-2004" was made [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 3.3.9). Data for 2005 and 2006 was calculated based on this research, but the assumption is that domestic navigation in 2006 is grown taking into account the last year tendencies. Fuel consumption from domestic navigation is insignificant, just 1.7% from total Transport fuel consumption.

To get the fuel consumption from maritime navigation was easier. 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 3.3.9). Data for 2005 and 2006 was calculated based on this research, but the assumption is that domestic navigation in 2006 is grown taking into account the last year tendencies.

Fuel consumption from domestic navigation is insignificant, just 1.35% from total Transport fuel consumption.

Table 3.3.9 Fuel consumption in domestic navigation, TJ [10]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
diesel oil	212.5	251.0	398.4	527.7	562.4	588.3	605.9	571.8	568.9	595.1	621.7	621.7	598.9	590.4	560.8	572.0	589.2
gasoline	24.9	25.7	26.5	27.3	28.1	29	29.9	30.8	31.8	32.8	33.8	34.8	35.9	37	38.2	39.3	40.5

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 2007 the uncertainty was very small, just 2%, but in submission 2008 data for 2006 are calculated based on made assumptions, 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

Latvia has recalculated CO_2 emissions from 1.A.3.b – Gasoline with country-specific CO_2 emission factor as it was recommended by ERT. For Submission 2007, the CO_2 emissions factor was used default IPCC 1996 emission factor that was built in COPERT III emission calculation model.
For recalculation the country-specific CO_2 gasoline emissions factor is taken from national study "Guidance manual for CO_2 emission estimations" [13] (see Annex 4). The country-specific CO_2 emission factor is 68.6 kg/GJ, IPCC 1996 default CO_2 emission factor is 72.03 kg/GJ, respectively the CO_2 emissions after recalculation decreased. (Table 3.3.10)

Table 3.3.10 CO_2 emissions from 1.A.3.b - Gasoline (Gg)

	Submission 2007	Submission 2008	Difference (%)
1990	1 743.21	1 660.12	4.77%
1991	1 597.42	1 521.27	4.77%
1992	1 530.86	1 457.89	4.77%
1993	1 486.49	1 415.63	4.77%
1994	1 413.59	1 346.21	4.77%
1995	1 296.32	1 234.53	4.77%
1996	1 267.79	1 207.36	4.77%
1997	1 166.37	1 110.77	4.77%
1998	1 096.64	1 044.37	4.77%
1999	1 058.61	1 008.15	4.77%
2000	1 045.93	996.07	4.77%
2001	1 099.81	1 047.38	4.77%
2002	1 077.62	1 026.26	4.77%
2003	1 077.62	1 025.56	4.83%
2004	1 083.96	1 031.59	4.83%
2005	1061.78	1 010.47	4.83%

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.

It is planned to concretize statistical data about fuel consumption in transport sector that Central Statistical Bureau reports as combusted in others (not-specified) transport sectors as well as statistical data that is reported as autoproducers of transport sector. It could be combusted in stationary combustion installations of transport sector enterprises so this fuel consumption has to be reported in CRF 1A4a Commercial / Institutional sector.

It is planned to concretize statistical data of natural gas used in road transport sector. It could be compressed natural gas used in road transport so this consumption has to be reported in road transport sector or natural gas combusted in stationary combustion installations of transport sector enterprises so this fuel consumption has to be reported in CRF 1A4a Commercial / Institutional sector.

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.

Table 3.4.1 Emissions from Other Sectors in 1990 – 2006 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1.A.4 Other sectors																	
CO_2,	5629.55	5742.72	4083.08	3363.14	2369.08	1580.60	1600.87	1349.50	1165.56	1144.01	1056.13	1212.65	1179.96	1269.09	1324.46	1301.29	1375.86
CH_4	11.19	12.71	11.50	12.15	12.04	12.56	12.92	12.22	11.36	11.15	10.47	11.55	11.31	11.87	12.22	12.25	11.89
N_2O	0.16	0.18	0.17	0.17	0.16	0.17	0.18	0.17	0.16	0.15	0.14	0.16	0.15	0.16	0.17	0.17	0.16

Since 1990 – 1991, decrease 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). Still methane emissions from Other sectors had increased for 6.2% in time period 1990 – 2006 that is explained with increase of wood and wood waste consumption.

As it can be seen in Figure 3.4.1 emissions from 1.A.4 Other Sectors are increasing starting 2000 by 21.2%. It can be explained with development of this sector but mostly with development of Commercial/Institutional and Residential sector in second place. Decrease of central heating system role in residential households increase emissions from 1.A.4.b sector.

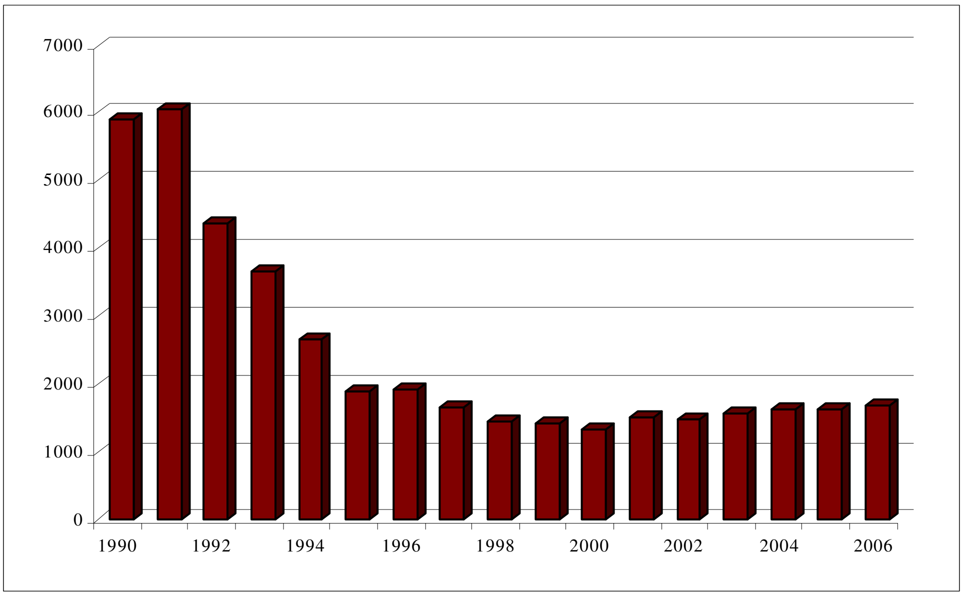


Figure 3.4.1 Total direct GHG emissions from 1.A.4 Other Sectors in 1990 – 2006 (Gg CO_2 eqv.)

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 – 2006. 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.

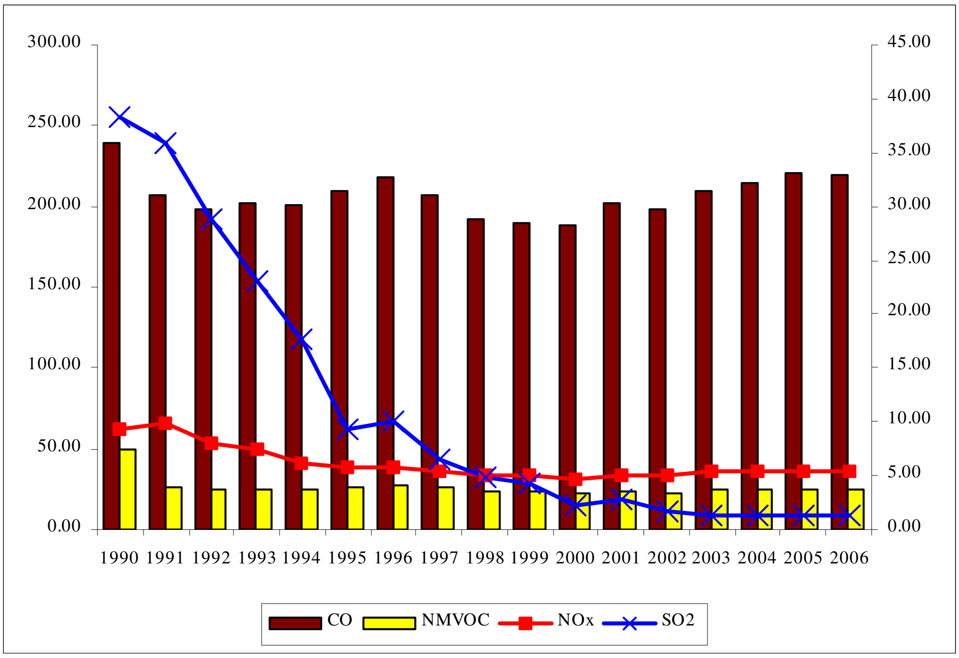


Figure 3.4.2 Total indirect GHG emissions of 1.A.4 Other Sectors in 1990 – 2006 (Gg)

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 Emission factors for 1.A.4 Other Sectors (Gg/PJ)

Sectors	CH_4	N_2O	NOx	CO	NMVOC
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
Biogas	0.3	0.004	0.1	5.0	0.6
Wood	0.005	0.0001	0.05	0.05	0.005
1.A.4.b 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
Biogas	0.3	0.004	0.1	5.0	0.6
Wood	0.005	0.0001	0.05	0.05	0.005
1.A.5.b Other					
Jet fuel	0.0005	0.002	0.25	0.1	0.05

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.

Table 3.4.3 Fuel consumption in 1.A.4 Other Sectors in 1990 – 2006 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1.A.4 Other Sectors																	
Liquid fuels	29.45	34.04	25.65	21.85	14.54	9.14	9.08	8.00	7.15	7.55	6.97	7.48	7.02	7.95	8.08	7.84	8.66
Solid fuels	23.53	20.77	16.88	13.96	9.88	5.57	6.03	5.00	3.60	2.88	2.20	3.00	2.39	2.21	2.15	2.07	2.01
Gaseous fuels	23.27	23.61	11.37	8.50	7.03	7.18	6.83	5.51	5.75	5.95	6.27	7.08	8.12	8.82	9.75	9.79	10.15
Biomass	26.45	31.06	30.87	33.30	33.83	38.73	39.83	38.07	36.35	35.99	33.90	36.63	36.37	38.38	39.64	39.59	38.41

For submission 2008, jet fuel (previously reported as consumed in 1.A.4.a Commercial/Institutional sector) was reported in 1A5b Other sector because it is consumed in military aircrafts. Also emissions from autoproducers of transport sector were reported in 1.A.4.a Commercial/Institutional due it is consumed in stationary combustion installation in transport sector enterprises.

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 in 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.

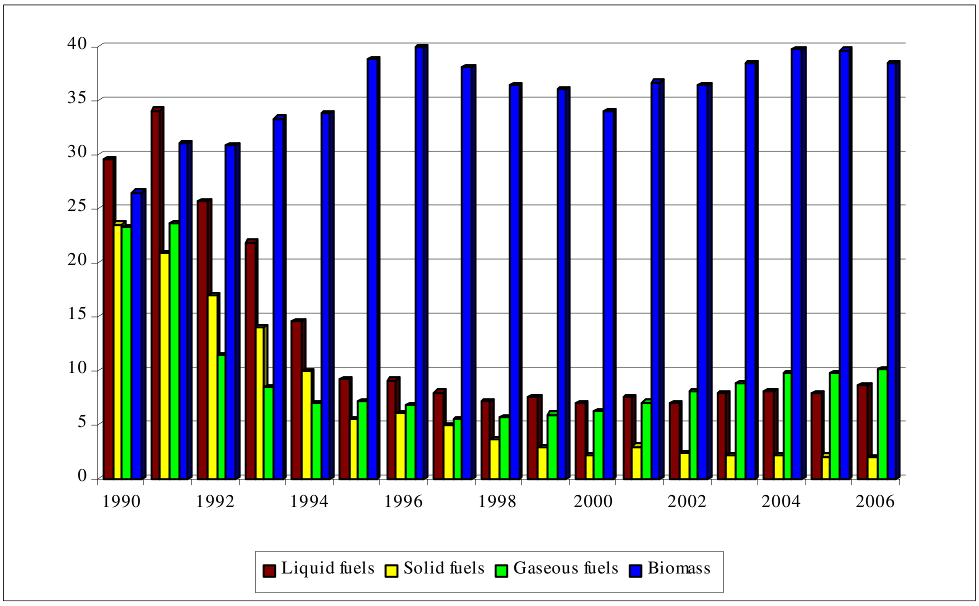


Figure 3.4.3 Fuel consumption for time period 1990 – 2006 for 1.A.4 Other Sectors (PJ)

3.4.3 Uncertainties

Uncertainty in activity data of fuel combustion in sectors 1.A.4 Other Sectors is ±2% in 2006. 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 emission factor 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. CO_2 emission factor for biomass is assigned as 50% because emission factor is estimated by using default net calorific values still activity data is estimated by using net calorific values for specific wood products, wood types and moisture content of fuelwood.

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 – 2005. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

Changes occurred due to the updated statistical information, mistaken input data correction and fuel consumption data division in IPCC categories:

- CSB updated information of NCV for some liquid fuel types – other liquids and diesel oil, for wood and wood waste fuel. GCV/NCV ratio for natural gas was corrected for some years;
- Jet fuel consumption was excluded from 1A4a sector and included in 1A5b sector because jet fuel is consumed in military aircrafts.

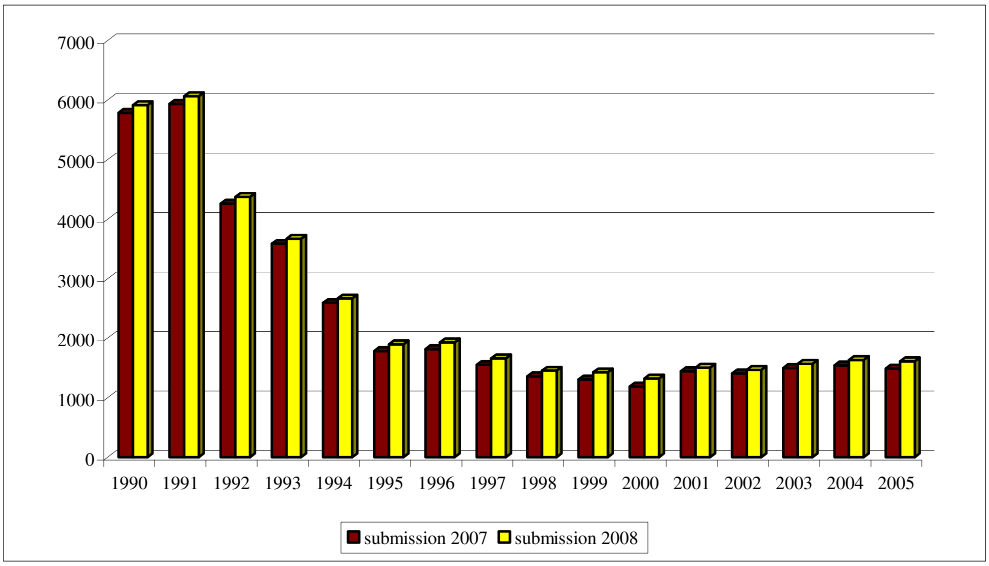


Figure 3.4.4 Direct GHG emissions difference in Other sectors for submissions 2007 and 2008 (CO_2 eqv. Gg)

Difference in reported direct GHG emissions for submission 2007 and submissions 2008 is quite significant for all years and fluctuates from 2.1% in 1991 to 10% in 2000.

3.4.5 Planned Improvements

CH_4 emissions from biomass stationary combustion are key source category so it is important to use Tier2 method from IPCC Guidelines in emission estimations. Therefore country specific emission factors are needed.

It is planned to concretize statistical data about fuel consumption in transport sector that Central Statistical Bureau reports as combusted in others (not-specified) transport sectors as well as statistical data that is reported as autoproducers of transport sector. It could be combusted in stationary combustion installations of transport sector enterprises so this fuel consumption has to be reported in CRF 1A4a Commercial / Institutional sector.

It is planned to concretize statistical data of natural gas used in road transport sector. It could be compressed natural gas used in road transport so this consumption has to be reported in road transport sector or natural gas combusted in stationary combustion installations of transport sector enterprises so this fuel consumption has to be reported in CRF 1A4a Commercial / Institutional sector.

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 sheets stock changes, statistical differences and distribution losses are reported for certain fuels, whereas in the RA table only stock changes are possible to input. Data from theme EB sheets are taken account and input in stock changes cells of CRF Reporter RA tables for better comparison. Also EB include "Interproduct transfers" category, data from this category is included in stock change category of 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. Total difference for fuel consumption didn't exceed 1% with average 0.59%. Total difference of CO_2 emissions also reach 1% only in year 2000 but have average difference 0.45%.

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	2006
Fuel consumption - Liquid fuels																	
Reference approach (PJ)	144.0	125.9	105.1	98.2	92.7	76.0	82.0	71.2	70.6	66.0	56.4	55.2	56.0	57.6	58.9	59.6	64.5
Sectoral approach (PJ)	139.4	124.1	104.3	97.4	91.6	74.9	80.8	69.5	68.3	63.7	52.7	53.3	53.3	54.9	56.2	56.1	61.1
Difference (%)	0.9	0.1	-0.3	-0.5	-0.6	-0.9	-0.9	-1.3	-1.3	-1.8	1.0	-1.3	-0.9	-1.2	-1.2	-1.2	-1.9
CO_2 emissions - Liquid fuels																	
Reference approach (Gg)	10367.8	9145.3	7648.0	7112.6	6727.2	5468.5	5923.1	5048.5	4958.5	4602.5	3873.5	3813.3	3837.0	3948.9	4054.0	4041.2	4338.1
Sectoral approach (Gg)	10278.3	9135.7	7668.4	7159.5	6765.7	5515.4	5971.4	5106.9	5016.7	4669.4	3815.0	3845.6	3851.6	3956.1	4049.6	4046.3	4396.2
Difference (%)	0.9	0.1	-0.3	-0.7	-0.6	-0.8	-0.8	-1.1	-1.2	-1.4	1.5	-0.8	-0.4	-0.2	0.1	-0.1	-1.3
Fuel consumption - Solid fuels																	
Reference approach (PJ)	30.4	26.5	23.5	21.3	16.0	11.6	10.9	9.7	7.1	5.4	5.5	5.2	4.2	3.5	2.8	3.4	3.6
Sectoral approach (PJ)	30.3	26.4	23.4	21.2	15.9	11.4	10.8	9.4	6.8	5.1	5.2	4.9	3.9	3.3	2.6	3.3	3.5
Difference (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 emissions - Solid fuels																	
Reference approach (Gg)	2836.3	2434.3	2168.6	1966.3	1490.8	1095.4	1032.2	921.2	670.1	503.9	526.0	485.0	392.5	324.4	259.8	311.8	331.6
Sectoral approach (Gg)	2835.4	2476.5	2201.8	1995.7	1501.7	1100.8	1036.2	911.4	655.5	485.2	508.2	466.5	374.4	316.4	245.3	300.8	323.9
Difference (%)	0.0	-1.7	-1.5	-1.5	-0.7	-0.5	-0.4	1.1	2.2	3.9	3.5	4.0	4.8	2.5	5.9	3.7	2.4
Fuel consumption - Gaseous fuels																	
Reference approach (PJ)	99.5	98.8	71.5	46.5	33.6	41.3	35.6	43.6	42.6	40.9	45.1	52.3	53.6	55.8	55.3	56.8	58.7
Sectoral approach (PJ)	98.1	97.6	70.7	45.4	33.6	41.3	35.5	43.5	42.6	40.8	45.0	52.2	53.5	55.7	55.3	56.7	58.6
Difference (%)	1.4	1.3	1.0	2.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
CO_2 emissions - Gaseous fuels																	
Reference approach (Gg)	5555.0	5517.3	3988.5	2593.7	1876.7	2306.0	1986.1	2431.0	2380.6	2281.5	2514.8	2922.1	2991.1	3113.0	3087.9	3168.5	3277.3
Sectoral approach (Gg)	5477.3	5447.3	3948.9	2535.5	1873.0	2304.7	1984.3	2429.1	2378.8	2279.6	2511.1	2916.4	2987.3	3109.3	3084.2	3164.8	3273.5
Difference (%)	1.4	1.3	1.0	2.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Fuel consumption - Other fuels																	
Reference approach (PJ)	-	-	-	-	-	-	-	-	-	0.0	0.1	0.2	0.3	0.3	0.3	0.2	0.1
Sectoral approach (PJ)	-	-	-	-	-	-	-	-	-	0.0	0.1	0.2	0.3	0.3	0.3	0.2	0.1
Difference (%)	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CO_2 emissions - Other fuels																	
Reference approach (Gg)	-	-	-	-	-	-	-	-	-	3.0	10.8	20.3	27.5	24.1	26.0	15.1	10.8
Sectoral approach (Gg)	-	-	-	-	-	-	-	-	-	3.0	10.8	20.3	27.5	24.1	26.0	15.1	10.8
Difference (%)	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel consumption – Total																	
Reference approach (PJ)	273.9	251.3	200.0	165.9	142.3	128.9	128.5	124.4	120.3	112.3	107.0	113.0	114.1	117.1	117.4	119.9	126.9
Sectoral approach (PJ)	267.9	248.2	198.4	164.0	141.0	127.6	127.1	122.4	117.7	109.7	103.0	110.6	111.1	114.2	114.4	116.3	123.4
Difference (%)	1.0	0.6	0.2	0.3	-0.4	-0.5	-0.6	-0.7	-0.8	-1.0	0.6	-0.5	-0.4	-0.5	-0.5	-0.5	-0.9
CO_2 emissions – Total																	
Reference approach (Gg)	18759.0	17096.9	13805.1	11672.6	10094.6	8869.9	8941.3	8400.6	8009.2	7390.9	6925.2	7240.6	7248.0	7410.4	7427.8	7536.7	7957.8
Sectoral approach (Gg)	18591.1	17059.5	13819.1	11690.8	10140.4	8920.8	8991.9	8447.4	8051.0	7437.2	6845.2	7248.8	7240.7	7405.9	7405.0	7527.0	8004.5
Difference (%)	0.9	0.2	-0.1	-0.2	-0.5	-0.6	-0.6	-0.6	-0.5	-0.7	1.0	-0.4	-0.3	-0.3	0.0	-0.1	-0.7

3.5.2 Methodological issues

Methods

The IPCC 1996 Tier1 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.B 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

Coke that is used as feedstock in Iron & Steel sector 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. Coke consumption is reported under this sector still 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 in 1D – 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 CO_2 emissions estimated with Reference approach and Sectoral approach are significant. It is also could be seen when fuel consumption difference for all years is about 0% but estimated CO_2 emission difference reach 6% in 2004 with average 1.63%.

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 for activity data and estimated CO_2 emissions between Reference approach and Sectoral approach is within 1.4% for all years.

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 consuming 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 Energy sector for all years in time period 1990 – 2005. Changes occurred due to changes of NCV of fuel wood reported by CSB for all years, changes of NCV of other liquid products for 2005, changes of activity data of diesel oil for all years, mistaken input data correction as well as previously not reported data were included in estimations, for example, jet fuel used for military purposes, fuel used as autoproducers in transport sector and coke consumption in machinery industry. Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

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, White Spirits and Coke is reported in 1.D tables for all years in time series 1990 – 2005. Paraffin Waxes, White Spirits and Coke 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 Tier1 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.D. 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, Lubricants and Coke 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 in EUROSTAT Annual Questionnaire formats were used (Table 3.6.1).

Table 3.6.1 Activity data for 1.D Feedstocks and non-energy use of fuels in 1990 – 2006 (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	3097.64
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	1088.36	1088.36
Paraffin Wax	-	-	-	-	-	-	-	-	-	125.58	125.58	167.44	167.44	167.44	251.16	334.88	251.16
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	125.58
Coke	52.74	105.48	131.85	105.48	184.59	158.22	158.22	263.7	263.7	263.7	263.7	263.7	241.11	133.95	187.53	160.74	133.95

3.6.3 Uncertainties

Uncertainty in activity data of fuel combustion is ±2% in 2006. 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

Data of fuel consumption from IEA/AIE – EUROSTAT – UNECE *Annual questionnaires* were used.

Only data of lubricants used as feedstocks changed for 2005 due to changes of NCV reported by CSB.

Activity data of Coke are reported in 1.D tables under Other Fuels category for the first time for all years in time series 1990 – 2006.

3.6.5 Planned Improvements

It is necessary to assign country specific carbon emission factors to correct estimate CO_2 not emitted emissions amount. Detailed information of activity data for fuel consumption that is not combusted but used as feedstock or for non-energy use is necessary. 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 Reporter 1.B and 1.D tables so data of Paraffin Wax, White Spirit and Coke 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 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. CH4 emission increase in 2005 is explained with transmission pipeline accident in Valmieras district in April 2005 when significant amount of natural gas leaked.

Table 3.7.1 Fugitive emissions from natural gas 1990 – 2006 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	5.035
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 – 2006 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	0,07

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.

There are lasting peat mining and manufacturing traditions in Latvia. It would be possible to estimate leaking CH4 emissions from peatbog manufacturing. Still, since there are no methodology and emission factors for estimations, these emissions are not estimated.

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 – 2006. 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.

Gas distribution systems and gas transport pipeline systems

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 - 2006
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	2006
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	15.13	16.8

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

Activity data for gasoline consumption changed for 2005 due to small corrections in NCV

3.7.5. Planned Improvements

Latvia could report emissions from underground and surface peat mining and handling as well as fugitive emissions from peat manufacturing. But due to lack of methodological issues it was not possible to report emissions from peat mining in GHG submission 2008. These emission data will be reported in further submissions if official methodology of estimations will be available.

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.

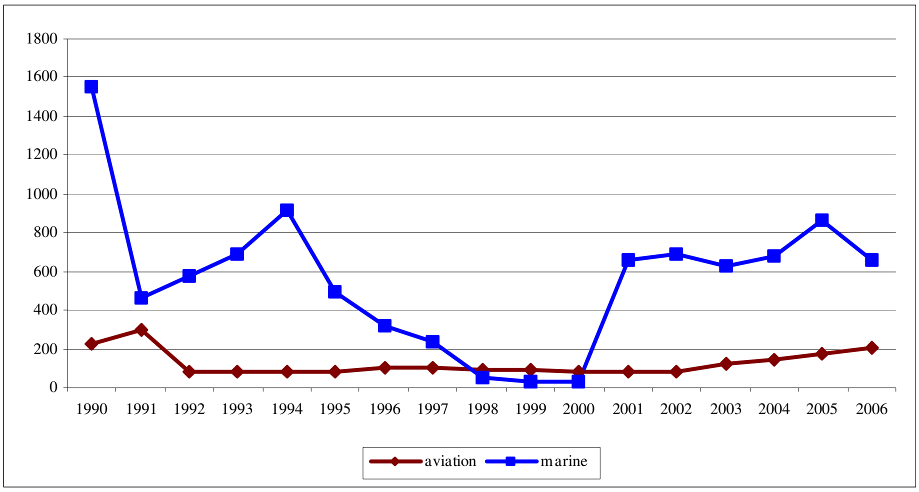


Figure 3.8.1 Emissions from International Bunkers, CO_2-eq (Gg)

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 [3]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Aviation																	
jet kerosene	3067.2	4147.2	1166.4	1166.4	1080.0	1080.0	1382.4	1382.4	1252.8	1252.8	1123.2	1123.2	1166.4	1685.2	2030.9	2463.0	2765.4
Navigation																	
diesel oil	5013.8	807.3	637.4	1402.2	2974.3	1104.7	934.8	849.8	552.4	424.9	339.9	4249.0	3611.7	3101.8	3186.8	3824.1	2761.9
RFO	14737.8	5075.0	6820.8	7429.8	8688.4	5156.2	3126.2	2111.2	81.2	NO	NO	3938.2	4993.8	4750.2	5278.0	7064.4	5481.0

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
2004-2006	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
2000-2006	0,2	40,6	0,097

4. INDUSTRIAL PROCESSES (CRF 2)

4.1 Overview of sector

Output growth of manufacturing in the last 7 years (1999 – 2005) equalled to approximately 5.9% annually. 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).

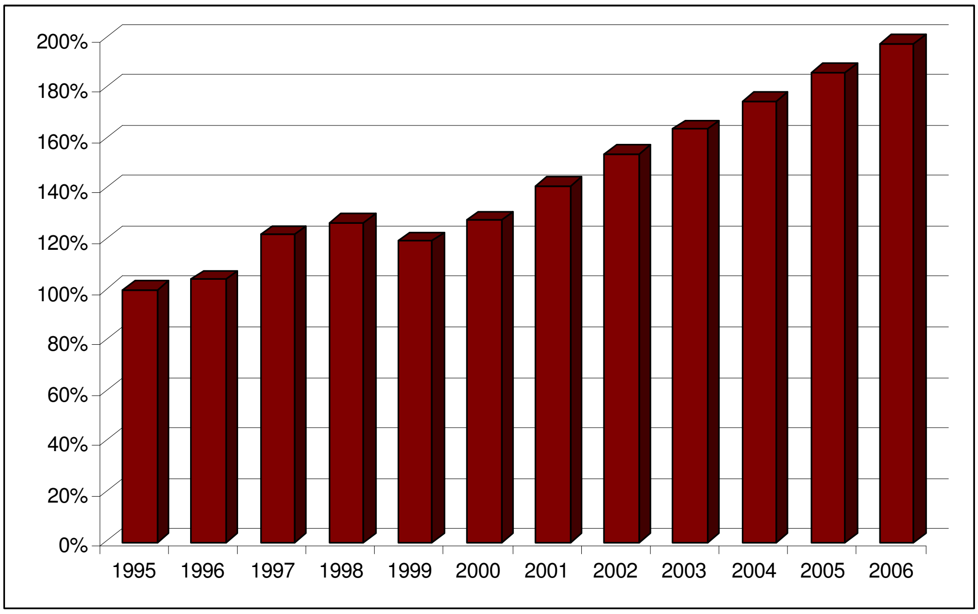


Figure 4.1.1 Manufacturing output, (1995 = 100% in 2000 prices)

In the last five years stable growth of manufacturing output is observed and average annual growth rates are reaching 7% (Table 4.1.1).

Table 4.1.1 Key indicators of manufacturing industries

	2000	2004	2005	2006
Share of only manufacturing industries in GDP (% in actual prices)	13.7	13.2	12.6	11.8
Share of industrial sector in GDP (% in actual prices)	23.5	22.3	21.5	21.4
Share in total employment (%)*	18.1	16.1	14.9	15.6
Share in foreign direct investment stock (%)	21.8	17.8	18.0	14.3

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

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 2006 was only 11.8% and it decreases constantly from 2000. 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.

Industrial greenhouse gas emissions contribute 2.15% of the total anthropogenic GHG emissions in Latvia in 2006 (Table 4.1.2). The most important emission source of the Industrial Processes in 2006 is CO_2 emissions from Mineral products with the 1.44%, CO_2 emissions from Metal production with 0.11 %. F-gases contribute 0.37% of the total GHG emissions.

Sources of emissions from Industrial Processes are:

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

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 – 2006 (Gg CO_2 eqv)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Industrial Processes	**510.41**	**430.54**	**189.48**	**46.37**	**132.45**	**144.55**	**145.12**	**152.78**	**158.24**	**191.17**	**148.83**	**166.60**	**183.00**	**198.96**	**209.07**	**230.47**	**249.94**
2.A Mineral Products	497.51	421.78	183.72	39.32	125.86	139.54	139.99	141.76	144.36	175.65	130.48	146.71	160.13	169.37	174.48	191.46	194.74
2.C Metal Production	12.90	8.76	5.76	7.04	6.59	4.47	3.52	8.05	8.56	7.77	8.48	8.10	7.66	12.23	12.98	12.42	12.65
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	19.06	35.43
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	7.12

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.

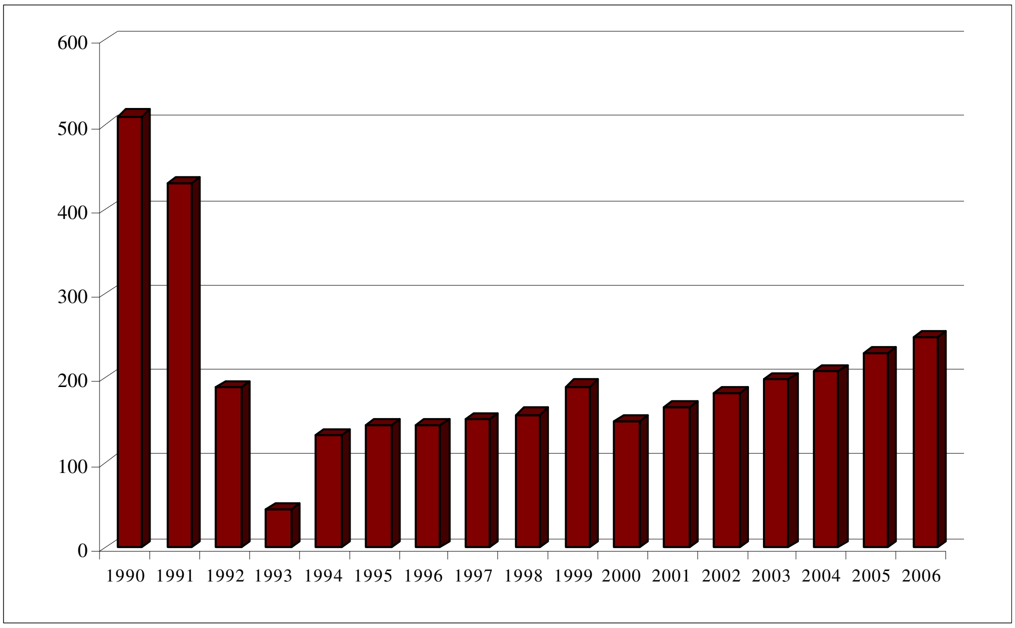


Figure 4.1.2 Total GHG emissions from Industrial Processes in 1990 – 2006 (Gg CO_2 eqv)

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 with 77.91% from total Industrial Processes sector GHG emissions.

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 77.9% from all GHG emissions in Industrial Processes sector in 2006.

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 4.2.1). 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.

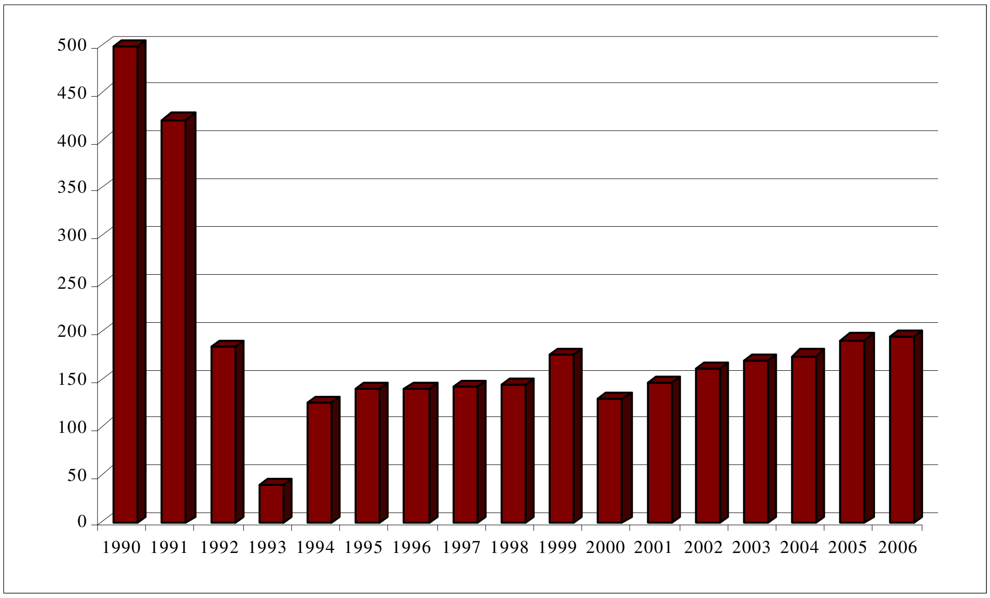


Figure 4.2.1 CO_2 emissions from 2.A Mineral Products in 1990 – 2005 (Gg)

4.2.2 Methodological issues

Methods

IPCC 1996, IPCC GPG 2000 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.

During the In-Country visit in 21st – 26th May 2007 the ERT had prepared the recommendations of improvement of Latvia's Greenhouse Gas inventory – "Potential Problems and Further Questions from the ERT (2007) formulated in the course of the in-country review of Latvia's Initial Report under the Kyoto Protocol and 2006 Inventory Submission" [16].

As ERT (2007) suggested the revised estimates contain the following:

- Relevant background information and a descriptive summary of the revisions made by Latvia in its 2006 inventory submission, in particular with respect to the sectors of Energy, Industrial Processes, and Agriculture [16].

Tier1 method from IPCC GPG 2000 was used to estimate clinker production data from final cement production amount when clinker / cement ratio for different types of cement is known. It is not a good practice still activity data calculation for submission 2008 estimations are based on final cement production data (imported cement amount is not taken into account) due to unavailability of statistics of produced clinker amount.

For submission 2008, it is possible to estimate activity data by using Tier1 method from IPCC GPG but for CO_2 emission factor as well as emission estimations Tier2 method is used.

CO_2 emissions from Lime production are calculated based on data of dolomite use in lime production. According to ERT (2007) expert's recommendations (2007) purity factor from IPCC GPG 2000 was taken into account in CO_2 emission calculation. 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.

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.

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 4.2.4).

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;
- IPCC GPG 2000;
- EMEP/CORINAIR Emission Inventory Guidebook 2006.

<u>CO_2 Emission factor for Clinker Production (IPCC GPG 2000 Tier2 method)</u>

For submission 2007 CO_2 emission estimations default emission factor of EU ETS Guidelines was used. This emission factor were reported as plant specific because cement producer reported it as suitable for technologies used in facility therefore it was assumed that specific CO_2 emission factor reflect plant specific production. As default emission factor is used it is assumed that Tier1 emission factor was used

ERT (2007) reported that Latvia used an emission factor of 0.525 based on the EU-ETS guidelines that is equivalent to using the Tier2 default method of IPCC GPG 2000 with 3% cement kiln dust (CKD). Information provided during the In-country review clearly indicates that Latvia also reported additional CKD emissions in the base year. That's why recalculation of CO_2 emission factor has to be done and CKD correction factor have to be excluded from emission factor.

For better estimations CO_2 emission factor has to be calculated for all years in time series 1990 – 2006 according to CaO content in used limestone that is measured in laboratory of cement production facility (Table 4.2.1). LEGMA is able to use all laboratory measurements data from cement production plant even it is not accredited and certified as requested in EU ETS Guidelines so CaO content in limestone is available to estimate CO_2 emission factor for clinker.

These emission factors will correspond to Tier2 emission factor estimations from IPCC GPG 2000 as CO_2 emissions from Cement Production sector.

CO_2 emission factors were recalculated using following equation from IPCC GPG 2000 [7].

$$EF_{clinker} = 0.785 \times \text{CaO Content (Weight Fraction) in Clinker}$$

Table 4.2.1 Average CaO content in used limestone in 1990 – 2006 (%) and average CO_2 emission factor in 1990 – 2006 (t CO_2 / t clinker)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Average CaO content	64.60	64.65	63.77	64.19	63.78	64.06	57.51	57.51	57.51	57.51	57.51	57.51	57.51	57.51	57.51	57.51	50.95
CO_2 EF without CKD factor	0.507	0.508	0.501	0.504	0.501	0.503	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.451	0.4
CO_2 EF with CKD factor	0.548	0.530	0.537	0.544	0.541	0.543	0.486	0.485	0.486	0.477	0.478	0.488	0.481	0.487	0.477	0.4540	0.4035

For year 1996 – 2005 average CaO content data of years 1995 and 2006 were used in emissions recalculation since data for average CaO content in produced clinker for years 1996 – 2003 were not available in facility. Also answer from facility as well as from experts of Industrial Processes sector of ERT (2007) that average CaO content of years where data is available could be used was received.

CO_2 emission from produced cement kiln dust were excluded from reported total CO_2 emissions from Cement Production sector to avoid double counting because it is assumed by ERT (2007) that CKD correction factor is already taken into account in default CO_2 emission factor 0,525 (t CO_2 / t production) from EU ETS Guidelines.

As it can be seen in Table 4.2.2 the plant specific data resulted in a higher CKD ratio (26.25%) in 1990, while the CKD in 2006 is much lower (0.87%). In addition to the changes to the CKD ratio, the lime content in clinker had decreased considerably from 64.6% (1990) to 50.95% (2006). The EF (without the CKD) changed from 0.51 to 0.4 representing 21% decrease from 1990 – 2006. Still to ensure comparability, as required by the IPCC GPG 2000 and also reflect the national circumstances of Latvia, the ERT (2007) recommended that Latvia use the maximum permissible good practice guidance limit of CKD – 6-8% where the plant specific data exceeds 8% for the calculation of CO_2 emissions from cement production. CKD ratio was changed to 8% that is maximum permissible good practice guidance limit of CKD (6% – 8%) although official statistical data resulted in different CKD ratio.

Table 4.2.2 CKD correction factor in 1990 – 2006*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Produced clinker	668.5	617.6	278.0	30.8	150.0	175.7	198.0	201.7	195.7	C	C	C	C	C	C	C	C
Produced cement kiln dust (CKD)	175.5	27.0	20.0	5.0	15.0	15.0	15.0	15.0	15.0	C	C	C	C	C	C	C	C
CKD / clinker ratio (%)	26.25	4.37	7.19	16.26	10.0	8.54	7.57	7.44	7.67	5.70	5.98	8.94	6.61	7.9	5.77	0.58	0.87
Corrected CKD / clinker ratio (%)	8%	4.4%	7.2%	8%	8%	8%	7.6%	7.4%	7.7%	5.7%	6.0%	8%	6.6%	7.9%	5.8%	0.6%	0.9%
CKD correction factor	1.08	1.04	1.07	1.08	1.08	1.08	1.08	1.07	1.08	1.06	1.06	1.08	1.07	1.08	1.06	1.01	1.01

* data for 1999 – 2006 are confidential

<u>CO_2 Emission factor for Lime Production (IPCC GPG 2000 Tier 2 method)</u>

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.

According to ERT (2007) Industrial Processes sector expert Latvia has to take into account correction factor for the proportion of hydrated lime for comparability. IPCC GPG 2000 provides default correction factor – 0.97.

$$CO_2\ EF_{lime\ production} = 309.51\ _{kg\ CO2} \times 0.97 = 0.3002247\ \text{tonne}\ CO_2\ /\ \text{tonne dolomite}$$

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 4.2.3.

Table 4.2.3 CO_2 emission factors for particular raw materials used in Mineral Industry (t CO_2 / t product or raw material)

	1990 – 2006
Limestone (used)	0.44
Dolomite (used)	0.477
Production of lime in Iron and Steel plant	0.785
Soda use	0.415
Fluorspar use	0.0017
Potash use	0.32
Use of clay for production of tiles	0.08

Estimation of CO_2 emission from bricks production

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 4.2.4 are estimated as average for amount of used raw materials – bricks.

1. plant (Table 4.2.4):

- 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
S_1 – content of magnesia in clay (%)
S_2 – 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 submission 2008, plant specific CO_2 emission factor is used.

2., 3., 4. and 5. plant (Table 4.2.4):

- 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:

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

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

- For submission 2008, emission factors are:
  - $CaCO_3$ – 0,44 and $MgCO_3$ – 0,522;
  - CaO – 0,785 and MgO – 1,092.

Table 4.2.4 CO_2 emission factors of bricks production in 1990 – 2006 (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	2006
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	0.112
2. plant	-	-	-	-	-	-	-	-	-	0.066	0.066	0.066	0.066	0.066	0.066	0.115	0.108
3. plant	-	-	-	-	-	-	-	-	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.112	0.112
4. plant	-	-	-	-	-	-	-	-	-	-	0.051	0.051	0.051	0.051	0.051	0.098	0.064
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	0.020

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. 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".

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.

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. All previously mentioned mineral producers participate in EU ETS and will participate in International ETS. It is possible to obtain more accurate and complete activity data and emission factors from enterprises, which are involved in the emission trading system.

Still after the Initial Review week it was necessary to require additional information of clinker production amount, cement kiln dust amount and CaO content laboratory measurements from enterprises or CSB for all years in time series 1990 – 2006. If statistical data of used raw materials and total produced amounts were possible to obtain then CaO content laboratory measurements were available only for years 1990 – 1995 and 2006. Data were lost or these measurements weren't done due to significant changes in enterprise.

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.

The activity data to calculate NMVOC emissions from road paving and asphalt roofing are from the CSB (Table 4.2.5).

Table 4.2.5 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
2006	74.00	42.18	18.98	31.82

* data from the CSB

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 lime production and bricks and tiles production. CO_2 emissions for cement production are estimated with IPCC GPG Tier2 method by using plant specific data so uncertainty is determined in 2% according to IPCC GPG 2000. 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

The ERT (2007) recommended that Latvia revise its estimations using IPCC GPG 2000 Tier2 method with correct emission factor based on plant-specific conditions, avoiding the separate calculation of additional emissions from CKD in the base year. For previous submission data reported by EU ETS enterprises were used to report CO_2 emissions from Mineral Production. Main problems occurred with Cement Production sector. The activity data for clinker was based on clinker ratios in various types of cement produced, making the approach a Tier1 method. Latvia used an emission factor of 0.525 based on the EU-ETS guidelines. As ERT (2007) expert of Industrial Processes stated, this emission factor is equivalent to using the IPCC GPG 2000 Tier2 default method with 3% cement kiln dust (CKD).

For submission 2007, estimated and reported CO_2 emissions from cement producer plant within EU ETS frame were reported, for submission 2008 CO_2 emissions were recalculated according to IPCC GPG 2000 and recommendation of ERT (2007) IP expert (Table 4.2.6).

Table 4.2.6 CO_2 emissions from cement production reported in submissions 2007 and 2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Submission 2007	345.91	250.81	120.05	18.77	123.60	95.73	111.84	114.85	109.75	150.11	95.50	116.46	123.71	132.94	144.38	140.14
Submission 2008	366.12	327.14	149.18	16.74	81.11	95.42	96.16	97.82	95.09	125.48	79.98	99.08	106.37	117.44	124.14	120.49
Difference (%)	5.52	23.33	19.52	10.84	34.38	0.32	14.02	14.83	13.36	16.40	16.25	14.92	14.02	11.66	14.02	14.02

For submission 2007, CO_2 emission reported by only lime production plant within EU ETS frame were reported under UNFCCC, but for submission 2008 purity factor of hydrated lime were taken account according to ERT (2007) IP expert's recommendations and CO_2 emission data reported by enterprise was recalculated by using purity factor (Table 4.2.7).

Table 4.2.7 CO_2 emissions from lime production reported in submission 2007 and 2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Submission 2007	125.17	93.89	34.71	17.04	14.36	11.00	9.39	6.29	7.05	4.68	4.52	3.89	3.87	3.19	3.04	1.95
Submission 2008	121.42	91.07	33.67	16.53	13.93	10.67	9.11	6.10	6.84	4.54	4.38	3.77	3.75	3.09	2.94	1.89
Difference (%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

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 use data of laboratory measurements even if laboratory is not accredited because laboratory accreditation is obliged only for EU ETS but is not requested within UNFCCC submissions.

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 14.2% from all emissions in Industrial Processes sector. CO_2 emissions from crude iron as input material in iron and steel production in open-heart furnaces as well as crude iron used in electric arc furnaces are included in the inventory and crude iron used according to IPCC GPG 2000 excluding scrap metal use in crude steel production.

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

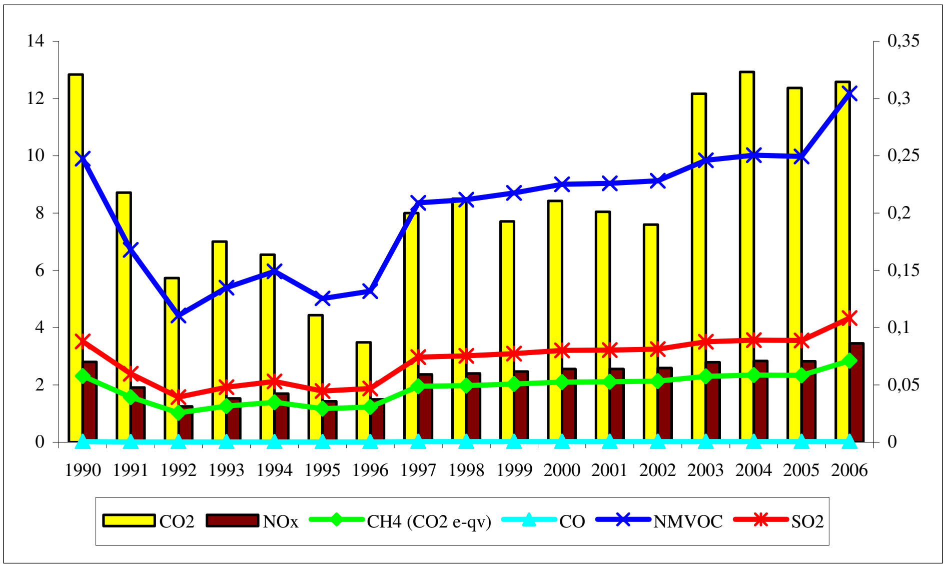


Figure 4.4.1 Direct and indirect GHG emissions from 2.C Metal Production in 1990 – 2006 (Gg)

Biggest decrease occurred in time period 1990 – 1991 due to crisis in Latvia's national economy. Decrease of CO_2 emissions in 1990 – 1996 occurred due to decrease of used crude iron in open-hear furnaces due to CO_2 emissions are estimated only from crude iron use excluding used scrap metal part. It is explained with modification of production process when biggest part of primary and final steel products is produced by smelting of scrap metal. CO2 emission increased almost twice in 2002 – 2003 when amount of used crude iron increased but amount of used scrap metal remains in same level. Final amount of steel products produced in only metal industry facility fluctuates in small range in latest years.

4.4.2 Methodological issues

Methods

IPCC 1996, IPCC GPG 2000 Tier2 and EMEP/CORINAIR are used to calculate direct and indirect 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 emission estimations from crude steel production

During the In-Country visit in 21st – 26th May 2007 the ERT had reviewed emission estimations from Iron & Steel sector and came out with recommendation to recalculate CO2 emissions from crude steel production because methodology used by steel producer plant that is taken from EU ETS Guidelines is not suitable for steel production technology used in plant. Industrial Processes reviewer made a conclusion that Tier1 method from IPCC GPG 2000 is used to estimate emission from steel production by using raw material data – amount of used coke and crude iron separately are multiplied with default emission factor taken from EU ETS Guidelines. So it was recommended to use IPCC GPG Tier2 method according loses of carbon during technological processes within open – heart furnaces as well as carbon emitted from electric arc furnaces have to be taken into account.

Following equation from IPCC GPG 2000 were used to recalculate CO_2 emissions from steel production:

$$\begin{aligned} Emissions_{\text{crude steel}} = {} & (\text{Mass of Carbon in the Crude Iron used for Crude Steel Production} - \\ & \text{Mass of Carbon in the Crude Steel}) \times 44/12 + \\ & \text{Emission factor}_{\text{EAF}} \times \text{Mass of Steel Produced in EAF} \end{aligned}$$

According to information reported by steel producer:

- Average carbon content of crude iron using in steel production is 3 – 4%;
- Average carbon content of produced steel is 0.1 – 0.4%.

In the beginning it was necessary to divide amount of crude steel produced in open-heart furnaces and in electric arc furnaces. Since official statistical information is not available and steel producer plant could not provide relevant information, it was decided to estimate these amounts by using amount of raw materials used in open-heart furnaces and electric arc furnaces (used raw materials in different furnaces related to total used raw materials) and relate the same percentage to amount of produced steel. Accordingly amount of steel produced in open-heart furnaces and in electric arc furnaces were divided from total produced crude steel.

Still since large amount of scrap metals are used in crude steel production it is necessary to exclude this amount from total crude steel amount and to estimate amount of crude steel in what production crude iron was involved. It was estimated by using crude iron / scrap metal ratio since amounts of used scrap metal in open-heart furnaces and used crude iron in the same furnaces are known. Then this ratio number was multiplied with amount of steel produced in open-heart furnaces to estimate amount of crude steel produced directly from crude iron.

Coke in crude steel production process is used as reducing agent for decrease of carbon content in final produced crude steel. Carbon content in final steel can't exceed 1% still average carbon content in used pig iron and crude iron is 3.5%.

IPCC GPG 2000 Tier2 method is based on estimation of carbon losses through the production processes when remaining carbon is emitted to air.

Carbon emitted from consumed electrodes in electric arc furnaces has to be taken into account. These emissions are estimated by multiplying emission factor with mass of steel produced in electric arc furnaces. Default emission factor – 1.5 kg carbon per tonne of steel was used because plant reported emission factor – 6 kg carbon per tonne of steel, was considered as unreliable high by reviewer of Industrial Processes sector.

Data for CO_2 emission estimations are given in Table 4.4.2 below.

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;
- IPCC GPG 2000;
- EMEP/CORINAIR Guidebook.

Emission factors of methane and indirect GHG emissions were taken from IPCC Guidelines (Table 4.4.1).

Table 4.4.1 Emission factors of metal production (t/t)

	CH_4	NO_x	CO	NMVOC	SO_2
1. Iron and Steel Production					
Steel	0,000005	0,0051	0,000001	0,00045	0,00016

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 enterprise. 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. 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".

To get the necessary information, permission from the enterprise should be asked to use its 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. Latvia has simpler situation in activity data of Metal production sector because only one plant operates in this sector.

Still after the Initial Review week it was necessary to require additional information of carbon content in crude iron and carbon content in crude steel, other information was provided by CSB and steel producer plant.

Table 4.4.2 Activity data for estimation of CO_2 emissions from steel production (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998
crude steel production	**550000**	**373492**	**245834**	**300393**	**331955**	**279326**	**293167**	**464529**	**470835**
mass of steel produced in OHF (%)	98.741%	98.741%	98.741%	98.741%	98.858%	98.719%	98.904%	99.451%	99.478%
mass of steel produced in OHF	**543074.4**	**368789.0**	**242738.5**	**296610.5**	**328163.6**	**275747.1**	**289954.5**	**461977.5**	**468374.9**
used scrap metal in open heart furnaces	537227.4	364818.4	240125.0	293417.0	317658.0	285015.0	307261.0	469205.0	470302.0
crude iron used in open heart furnaces	**107732.2**	**73158.4**	**48153.2**	**58840.0**	**55116.0**	**37086.0**	**29099.0**	**67039.0**	**71341.0**
crude iron/scrap metal ratio	20.05%	20.05%	20.05%	20.05%	17.35%	13.01%	9.47%	14.29%	15.17%
amount of crude steel from crude iron	**108904.7**	**73954.6**	**48677.2**	**59480.4**	**56938.8**	**35880.1**	**27460.0**	**66006.3**	**71048.7**
mass of steel produced in EAF (%)	1.26%	1.26%	1.26%	1.26%	1.14%	1.28%	1.10%	0.55%	0.52%
mass of steel produced in EAF	**6925.6**	**4703.0**	**3095.5**	**3782.5**	**3791.4**	**3578.9**	**3212.5**	**2551.5**	**2460.1**
EF for electric arc furnaces (t/t)	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015
carbon content in crude iron (%)	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%
carbon content in crude steel (%)	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
conversion factor	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67

* data for 1999 – 2006 are confidential

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 5%.

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

4.4.4 Recalculations

The ERT (2007) recommended that Latvia revise its estimations using IPCC GPG 2000 Tier2 method based on plant-specific conditions. For previous submission data reported by EU ETS enterprises were used to report CO_2 emissions from Metal Production. ERT (2007) Industrial Processes expert assumed that Tier1 method was used for previous estimations when emission factor was multiplied with coke consumption data and used crude iron data. For submission 2008 more complicated emission estimation IPCC GPG Tier2 method is used based on carbon capture and carbon leakage during crude steel production from crude iron, pig iron and scrap metals.

For submission 2007, estimated and reported CO_2 emissions from steel producer plant within EU ETS frame were reported. For submission 2008, CO_2 emissions were recalculated according to IPCC GPG 2000 and recommendations of ERT (2007) IP expert (Table 4.4.3).

Table 4.4.3 CO_2 emissions from steel production reported in submission 2007 and 2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Submission 2007	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
Submission 2008	12.84	8.72	5.74	7.01	6.56	4.44	3.49	8.00	8.51	7.72	8.43	8.05	7.61	12.17	12.92	12.37
Difference (%)	70.95	37.53	67.11	68.98	79.92	83.64	86.40	81.95	81.26	83.14	81.46	81.91	82.69	72.46	66.80	68.18

4.4.5 Planned improvements

Information reported for the first time under EU ETS are planned to use in further submissions so data will be more precise and accurate. It is planned to use data of laboratory measurements even if laboratory is not accredited because laboratory accreditation is obliged only for EU ETS but is not requested within UNFCCC submissions.

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 2005 from food and drink industries were recalculated due to obtaining more reliable statistical data.

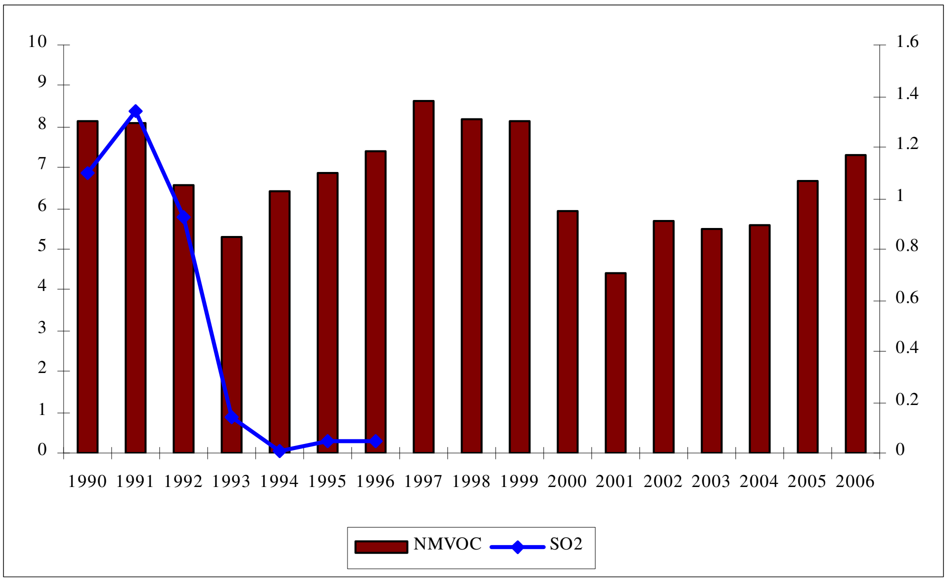


Figure 4.5.1 Total emissions from 2.D Other Production in 1990 – 2006 (Gg)

Biggest fluctuations occurred in time period 1991 – 1993 due to changes in economical situation in country (Figure 4.5.1). Decrease in time period 1999 – 2001 is explained with economical crisis in neighbourhood Russia with whom Latvia has stable economical linkage. For last years in time period 2002 – 2004 NMVOC emissions were stable. Since 2004, 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 IPCC 1996 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	2006
1. Pulp and Paper	t	36.6	44.7	30.8	4.7	0.2	1.5	1.5	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Food and Drink		**1212.28**	**1239.88**	**912.50**	**703.70**	**578.29**	**611.65**	**619.02**	**668.39**	**653.00**	**675.64**	**722.04**	**769.63**	**855.57**	**862.97**	**871.37**	**876.09**	**926.37**
Wine	hl	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	77.1
Beer	hl	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	1383.0
Spirits	hl	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	360.6
Met, fish, poultry	t	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	288.4
Sugar	t	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	59.9
Cakes, biscuits, breakfast cereals	t	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	41.8	45.0
Bread	t	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	106.8
Animal forage	t	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	244.2

4.5.3 Uncertainty

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

4.5.4 Recalculations

In submission 2008 data of 2005 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 SF6 (CRF 2.E)

Halocarbons and SF_6 are not produced in Latvia.

4.7 Consumption of Halocarbons and SF6 (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 [16].

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.

Continuing 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.

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. For submission 2007 these data are available for LEGMA to estimate actual emissions of F – gases. For the submission 2007 not all enterprises operated with f-gases reported necessary data since new rule of legislation weren't posted to all enterprises so not all of them knew their new obligations. Only 8 enterprises reported their operations with f-gases. All necessary data for year 2005 were obtained from the biggest importers of f-gases. For submission 2008, 83 enterprises reported data of their operation with f-gases.

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 eq. Gg) in 1995 and 42.55 Gg. in 2006 (Table 4.7.1 – Table 4.7.9, 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.

Table 4.7.1 Actual emissions of SF_6

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2.F.8	10.51	12.02	21.26	29.69	40.89	53.35	82.71	141.50	184.66	224.67	315.07	298.07
GWP (CO_2 e-qv Gg)	0.251	0.287	0.508	0.710	0.977	1.275	1.977	3.382	4.413	5.370	7.530	7.124

Table 4.7.2 Actual emissions of HFC – 134a

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2.IIA.F.1.1	0.0673	0.0912	0.1032	0.115	0.1393	0.1634	0.1872	0.2229	0.2707	0.3305	0.381	0.421
2.IIA.F.1.2				0.010	0.019	0.030	0.073	0.098	0.137	0.199	0.218	2.347
2.IIA.F.1.3					0.003	0.008	0.024	0.022	0.026	0.038	0.047	0.045
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	17.549
2.F.4				0.240	0.734	0.995	0.996	1.536	1.164	0.742	0.733	0.886
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	0.035
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	21.284
GWP (CO_2 e-qv Gg)	0.191	1.301	2.419	4.439	6.776	8.577	9.765	11.770	12.740	15.853	18.881	27.670

Table 4.7.3 Actual emissions of HFC – 23

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	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	NO

Table 4.7.4 Actual emissions of HFC – 32

Source	2004	2005	2006
2.IIA.F.1.2	0.0401	0.0016	0.129875
GWP (CO_2 e-qv Gg)	0.0261	0.0010	0.0844

Table 4.7.5 Actual emissions of HFC – 125

Source	2004	2005	2006
2.IIA.F.1.2	0.0518	0.0095	1.10204
2.IIA.F.1.3	0.0028	NO	0.02717
Total emissions (t)	0.0546	0.0095	1.1292
GWP (CO_2 e-qv Gg)	0.1530	0.0266	3.1618

Table 4.7.6 Actual emissions of HFC – 143a

Source	2004	2005	2006
2.IIA.F.1.2	0.0072	0.0091	1.1304
GWP (CO_2 e-qv Gg)	0.0274	0.0346	4.2954

Table 4.7.7 Actual emissions of HFC – 227ea

Source	2001	2002	2003	2004	2005	2006
2.F.3	0.0122	0.0122	0.0304	0.0616	0.0397	0.0739
GWP (CO_2 e-qv Gg)	0.0353	0.0353	0.0882	0.1786	0.1150	0.2143

Table 4.7.8 Actual emissions of HFC – 152a

Source	2006
2.IIA.F.1.2	0,0026
GWP (CO_2 e-qv Gg)	0,00036

Table 4.7.9 Total emissions of HFCs (CO_2 e-qv Gg)

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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**	**34.0132**
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	0.5479
2.IIA.F.1.2				0.0134	0.0250	0.0389	0.0943	0.1279	0.1781	0.4566	0.3459	10.5175
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	0.1348
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	22.8134
2.F.3							0.0353	0.0353	0.0882	0.1786	0.1150	0.2143
2.F.4				0.3121	0.9541	1.2939	1.2946	1.9967	1.5132	0.9651	0.9523	1.1522
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	0.0458
total HFCs (CO_2 e-qv Gg)	**0.2878**	**1.3246**	**2.4681**	**4.6130**	**6.7764**	**8.5863**	**9.8099**	**11.8257**	**12.9456**	**16.2376**	**19.0584**	**35.4258**

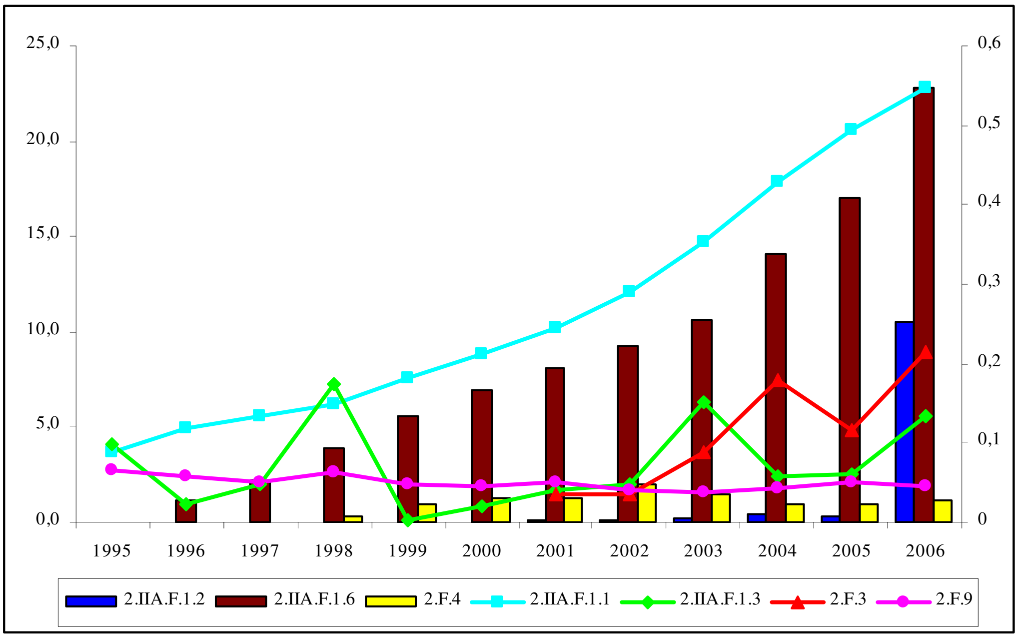


Figure 4.7.1 HFCs emissions from 2.F Consumption of Halocarbons and SF_6 sector in 1990 – 2006 (GWP Gg CO_2 eq.)

As it can be seen in Figure 4.7.1 all f-gases emissions have increasing tendency. Emissions from other sectors are stable or have decreasing tendency. Only HFC-134a from imported shoes and SF_6 emissions from electric equipment have decreased in last years.

Increase of f-gases emissions is explained mainly with improvement of data collection system when biggest part of f-gases consumers reported their operations with f-gases within national legislation rules. It is assumed that f-gases consumption in practice has decreased in last years. 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. Since 1992, it consumes small amount of SF_6 in electrical equipment, but since 1995 used amount radical increase.

Tier3a equation given in IPCC 1996:

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

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 Tier2b was chosen to estimate SF_6 emissions:

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

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

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

Emissions from Metered Dose Inhalers

Emissions are possible to estimate only from gases usage in medicine. Amount of inhalers contained HFC – 134a were clarified. It was presumed that 100 % of HFC – 134a from medicine inhalers used mainly by asthma patient is emitted. 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 1996 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 1996 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 1996 as well as research and assumptions of Danish experts (Table 4.7.10).

Table 4.7.10 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. Enterprises operated with f-gases reports their operations within rules of national legislation to LEGMA Chemicals Register. Data of imported and exported f-gases from Register were used to estimate F – gases potential emissions.

4.7.3 Uncertainties

Activity data for this sub-sector were obtained from reports of enterprises operated with f-gases therefore it is assumed that uncertainty could arise to 50%.

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

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. It is planned to continue to use data reported within rules of these regulations. It is believable that these data will be more precise for next submissions as more enterprises operated with f-gases will report of their operations.

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 – 2006 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 four biggest enterprises that imported F – gases are reported to the Chemicals Registry and these data are used in estimations of potential emissions.

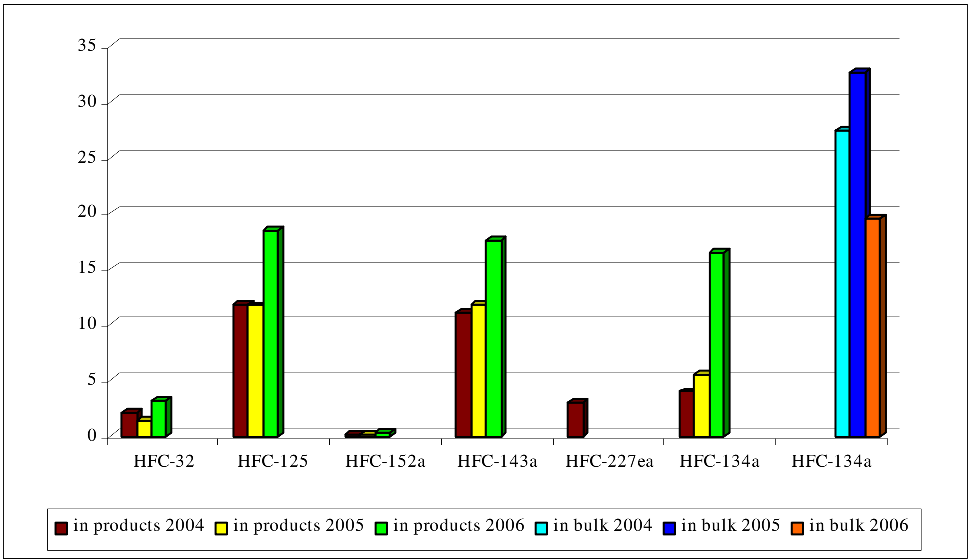


Figure 4.8.1 Total potential emissions in 2004 – 2006 (tonnes)

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 – 2006

Chemicals, products	2004	2005	2006
R 410a	1.5	-	1.36
R 407c	6.1	5.9	10.5
R 404a	19.8	21.9	33.8
R 507	1.5	0.7	-
R 134a	27.3	32.6	19.5
SUVA MP 39	0.5	1.2	
SUVA HP 80	-	0.1	0.27
SUVA HP 81	-	0.4	
Tecfoam SP-27-B5/365/245	2.9	-	2.5
ISCEON 49 (R 413 a)	-	0.5	1.3
FIXER MEGAPRO 65	-	-	15.7
R 422a			0.22

Table 4.8.2 Percentage amounts of chemicals in imported products 2004 – 2006

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

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.

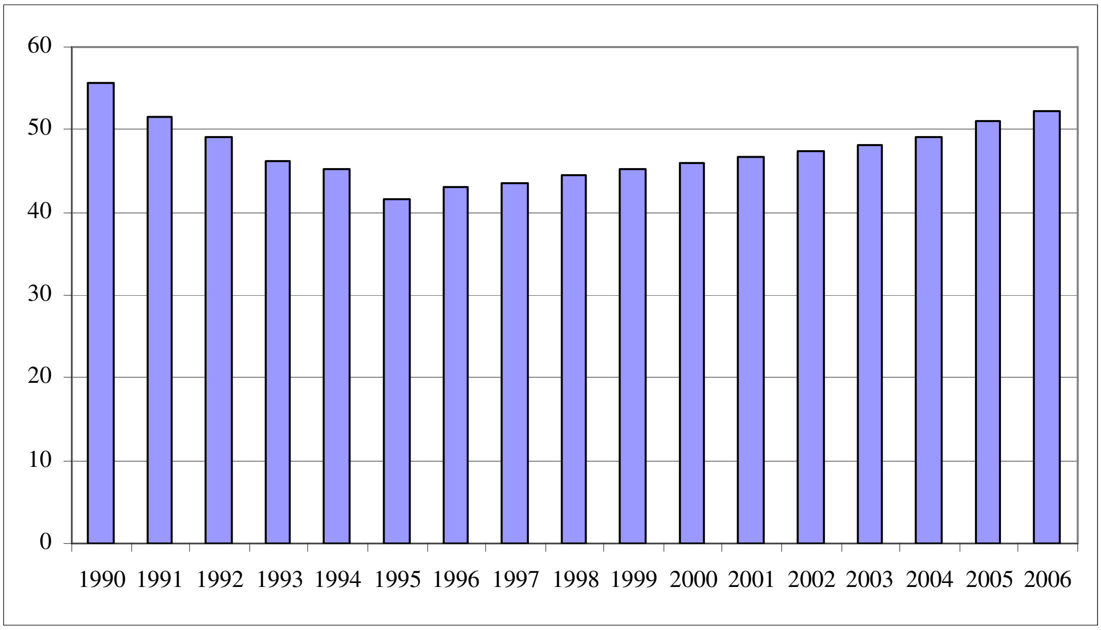
5. SOLVENT AND OTHER PRODUCT USE (CRF 3)

5.1 Overview of sector

Solvent and Other Product Use sector emissions contribute only about 0.55% 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 CO_2 eq.)

The NMVOC emissions from productions of pharmaceuticals are included under Chemical Products, Manufacture and Processing for 1997-2006. 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 [25], and consequently NMVOC emissions for degreasing and dry cleaning and other decreased also.

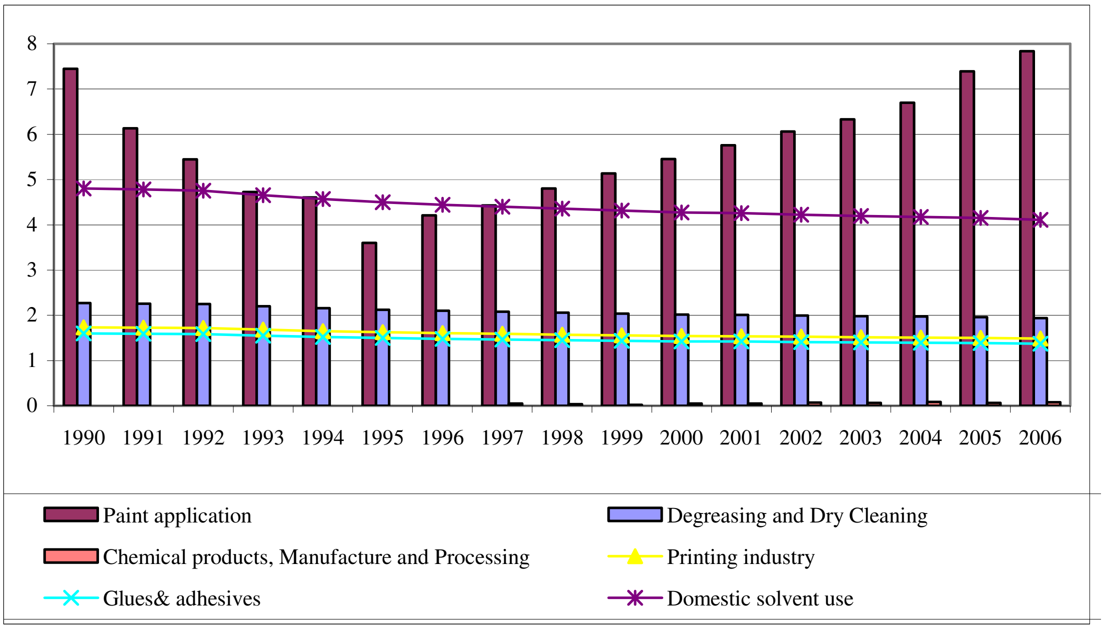


Figure 5.2 NMVOC emissions 1990-2006 (Gg)

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 0.8% from total N_2O emissions (Figure 5.3).

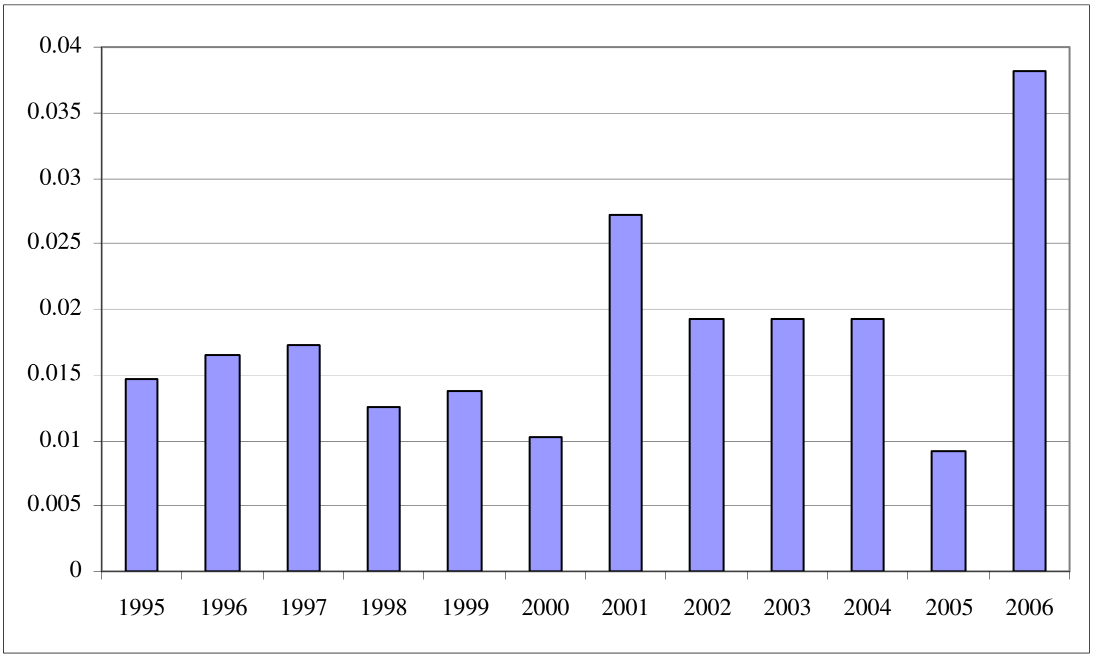


Figure 5.3 N_2O emissions 1995 – 2006 (Gg)

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.

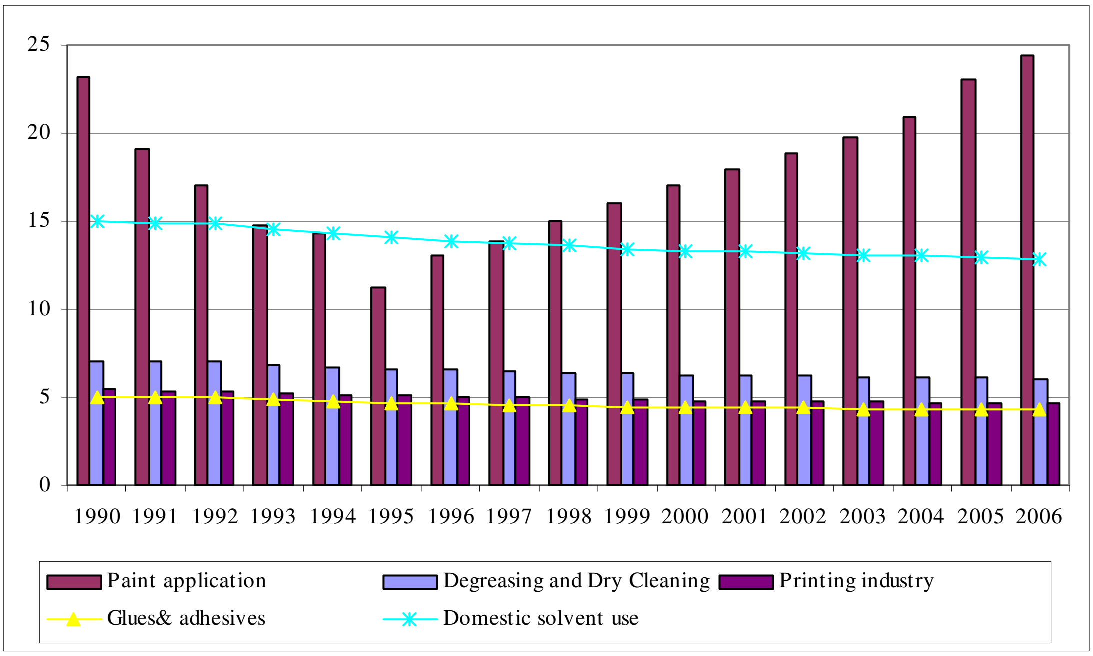


Figure 5.4 CO_2 emissions 1990-2006 (Gg)

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 [4]. 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. Latvia's agricultural income increased significantly by 15% in 2006, which is even slightly higher than the average figure of the European Union Member States.

Concerning the weather conditions the 2006 for the farmers was not successful, because the year started with losses to winter crops caused by black frost and then more intensified late and dry spring, which was followed by even more dry summer in such way reducing the productivity of the main crops and the total yield, including the forage base in cattle-breeding.

Taking a look over the structure of agricultural end products in 2006 the crop farming comprised 52.8%, but cattle-breeding – 47.2%[1].

The emissions of greenhouse gases from the Agriculture sector include emissions of CH_4 from Enteric Fermentation, 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 isn't observed. Emissions from previous grass burning are included under LULUCF sub sector Grassland.

In 2006, the Agriculture sector contributes 17% from total national emissions. Total GHG emissions from agriculture have declined approximately 66% over the period of 1990 – 2006 (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.

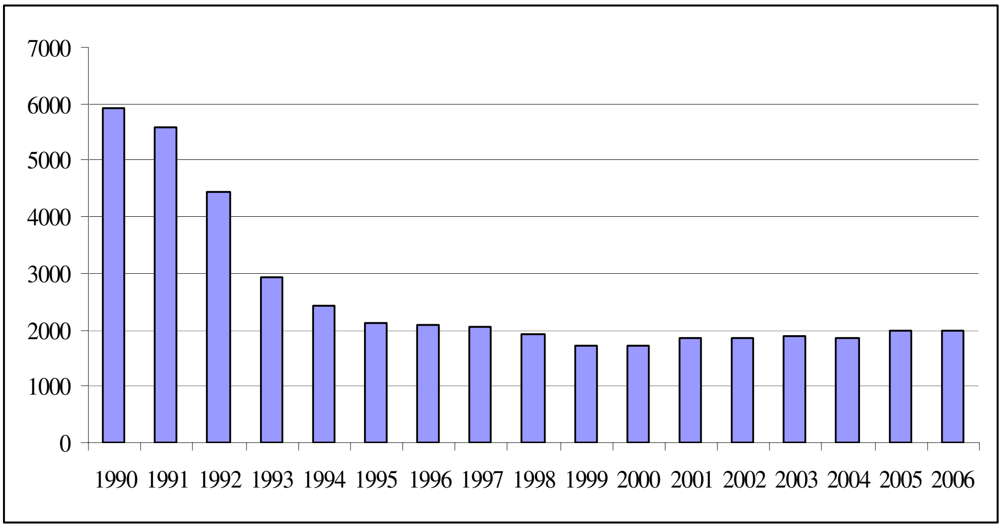


Figure 6.1 Trend in agricultural emissions in 1990 – 2006 (Gg CO_2 eq.)

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 sown area and area of cultivated organic soils.

Table 6.1 Agricultural greenhouse gas emissions by source and gas in 1990 – 2006

	CH_4 (Gg)			N_2O (Gg)		
	Total	Enteric Fermentation	Manure management	Total	Manure management	Agricultural Soils
1990	111.27	97.96	13.31	11.59	1.78	9.81
1991	107.11	94.64	12.47	10.74	1.71	9.03
1992	88.77	79.27	9.5	8.27	1.37	6.90
1993	54.6	48.88	5.72	5.71	0.85	4.86
1994	45.79	40.61	5.17	4.7	0.73	3.97
1995	44.63	39.31	5.32	3.80	0.7	3.09
1996	41.79	37.02	4.77	3.89	0.67	3.22
1997	39.19	34.72	4.47	3.92	0.63	3.29
1998	35.86	31.67	4.19	3.74	0.58	3.16
1999	31.35	27.52	3.83	3.41	0.51	2.90
2000	30.6	26.88	3.73	3.46	0.5	2.96
2001	32.07	28.08	3.99	3.81	0.53	3.28
2002	32.31	28.2	4.11	3.78	0.54	3.25
2003	31.21	27.2	4.01	3.98	0.52	3.46
2004	30.7	26.75	3.95	3.91	0.51	3.40
2005	31.47	27.5	3.97	4.26	0.52	3.74
2006	30.86	26.9	3.92	4.36	0.51	3.85

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.

In 2006, methane emissions from Enteric Fermentation of domestic livestock comprised 87 % of total agricultural emission, expressed in CO_2 equivalents. CH_4 emissions were 26.9 Gg and decreased 73% since 1990 due to decreasing number of cattle (Figure 6.2).

CH_4 emissions from enteric fermentation are key source accordingly level and trend assessment (including LULUCF) and contribute 2% and 4% respectively.

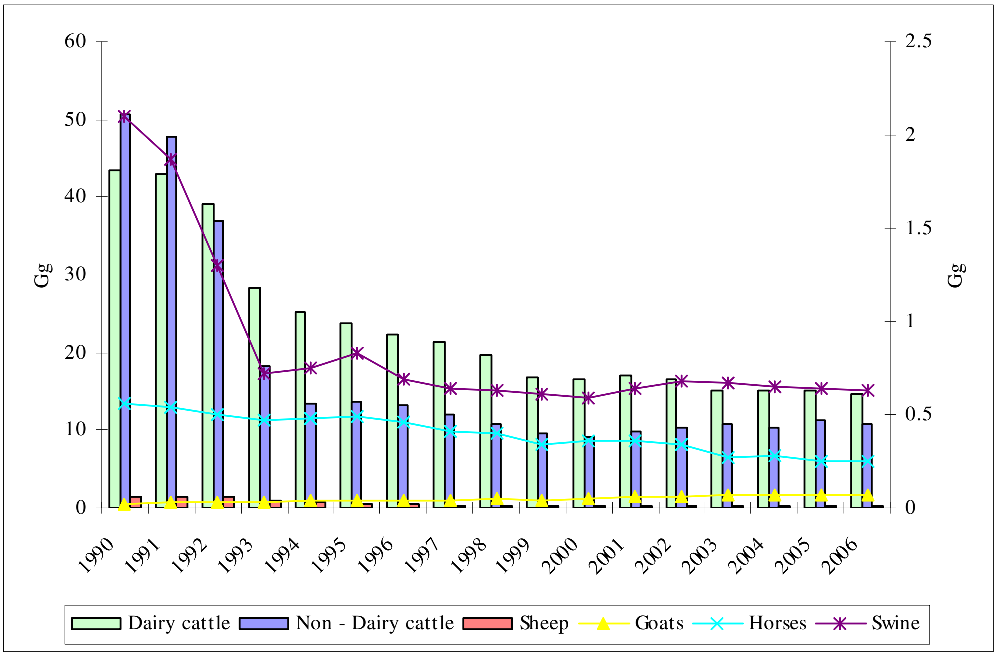


Figure 6.2 Methane emissions from Enteric Fermentation in 1990 – 2006 (Gg)

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 CRF Reporter.

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) [2].

Table 6.3 Number of livestock for 1990 -2006 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	275	234	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	204	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
2006	182	195	41	14	14	417	4488

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 survey was first launched in 1995 and since then it is conducted twice a year. The sample for 2006 covers 15.0 thsd. farms selected by economic size and specialisation [2].

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 2006.

According trend assessment N_2O emissions from Manure Management is a key source and contributes 1%.

Methane emissions from Manure Management were 3.92 Gg. CH_4 emissions from Manure Management have decreased 71 % during the time period 1990 - 2006 (Figure 6.3).

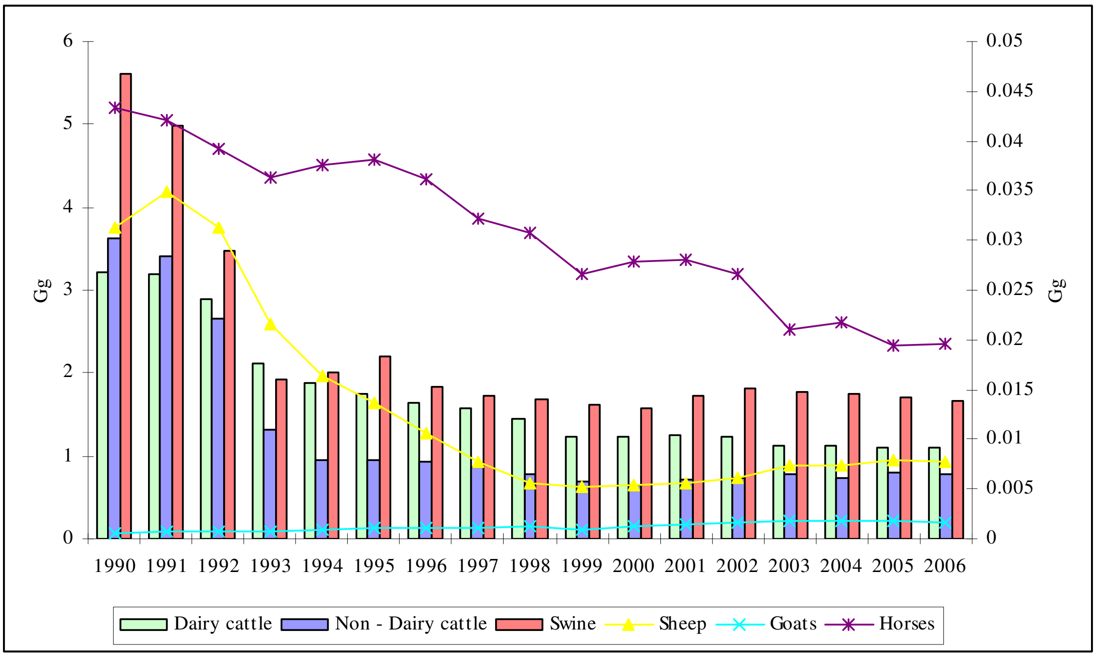


Figure 6.3 CH_4 emissions from Manure Management in 1990 – 2006 by livestock type (Gg)

In 2006, nitrous oxide emissions from Manure Management were 0.51 Gg. It is observed, that emissions from Manure Management have decreased 71% from 1990 to 2006 (Figure 6.4).

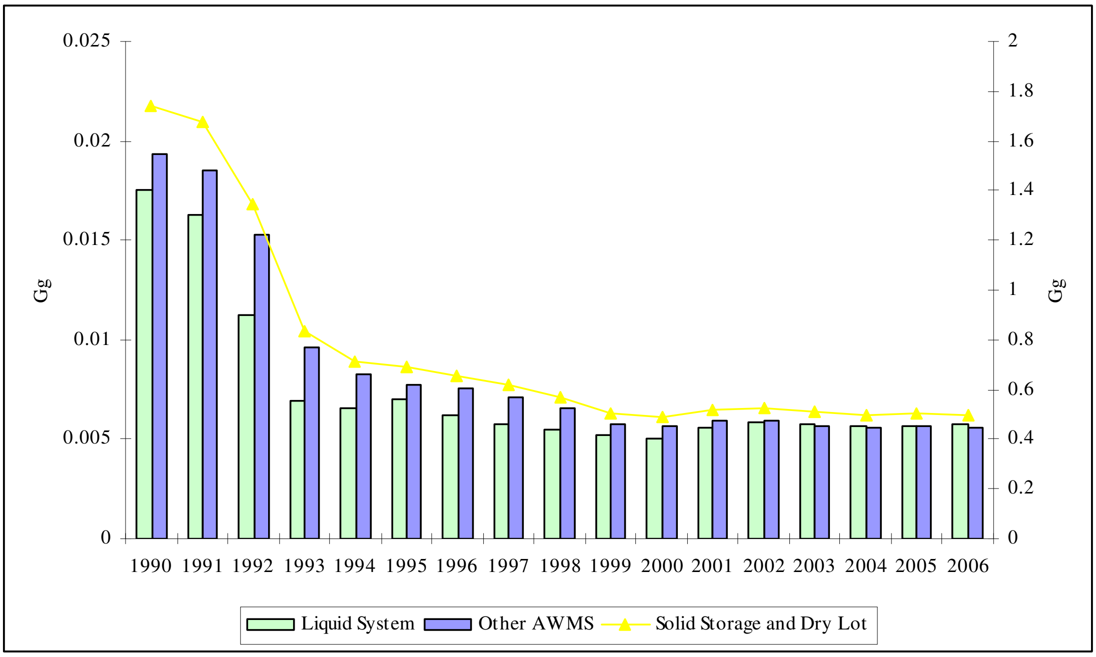


Figure 6.4 Nitrous oxide emissions from Manure Management in 1990 – 2006 by manure management system (Gg)

The fluctuations in emissions (Figure 6.3. and Figure 6.4) 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 CRF Reporter.

Emission factors and other parameters

To calculate CH4 emissions from Manure Management were used IPCC default emission factors (Table 6.4). Emission factors as for *cool* climate region were chosen because annual temperature in Latvia is 6.0 ºC (reference period 1971-2000).

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; 6.7 and 6.8 [8, 11, 21].

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		

Table 6.8 Distribution of different manure management systems for 2006

	Liquid system, %	Solid storage and dry lot, %	Pasture range and paddock, %	other, %
Dairy cattle	3.6	52.4	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	37	63		

Data about annual N excretion per animal (Table 6.9) obtained from Research made by LSIAE (2005) [8, 21]. 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 (Annex 5).

Table 6.9 Average N excretions per head of animal [8]

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

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

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 2006 direct N_2O emissions from agricultural soils consist 3% and 1% respectively, but indirect N_2O emissions from agricultural soils consist 1% and 2%.

N_2O emissions from Agricultural Soils contribute 60 % of total agricultural emissions (expressed in CO_2 equivalents) in 2006. Nitrous oxide emissions from Agricultural Soils were 3.85Gg in 2006.

Emissions have decreased and fluctuated over the period 1990 – 2006 (Figure 6.5). 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.

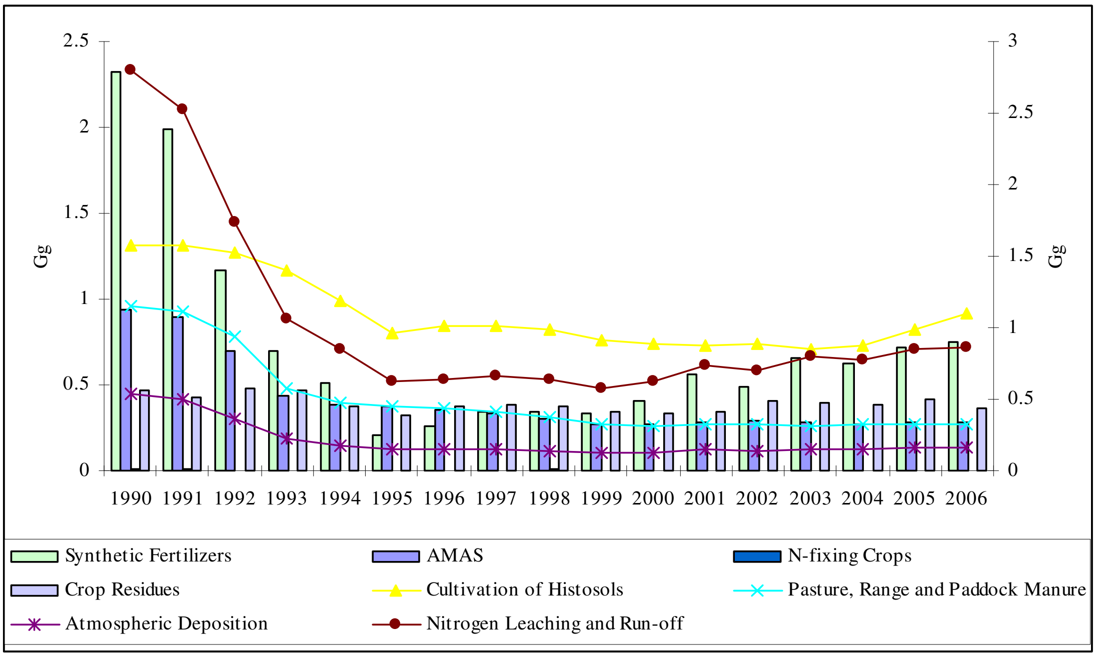


Figure 6.5 Direct and indirect N_2O emissions from Agricultural Soils by source category

6.5.2 Methodological issues

Methods

Nitrogen inputs to soils from all sources were calculated using IPCC Tier 1a. Direct N_2O emissions from agricultural soils are estimated as follows (GPG, equation 4.20):

$$N_2O_{DIRECT} - N = [(F_{SN} + F_{AW} + F_{BN} + F_{CR}) * EF_1] + F_{OS} * EF_2$$

$N_2O = N_2O\text{-}N * 44/28$

Nitrogen input through application of mineral fertilizers

The method applied for calculation of emissions is IPCC Tier 1a (GPG, Equation 4.22):

$$F_{SN} = N_{FERT} * (1\text{-}Frac_{GASF})$$

F_{SN}	Annual amount of synthetic fertilizer nitrogen applied to soils
N_{FERT}	Annual amount of nitrogen in synthetic fertilizers applied to soils (thsd.t) – see Table 6.14
$Frac_{GASF}$	Fraction of nitrogen lost through gaseous emissions of NH_3 and NOx - 0.1kg (IPCC 1996, Table 4-19)

Nitrogen input through application of animal manure

For emission calculation is used equation from IPCC 1996:

$$F_{AW} = (Nex * 1-(Frac_{Fuel} + Frac_{GRAZ} + Frac_{GASM}))$$

Nex	Amount of nitrogen excreted by the livestock, see Table 6.9
$Frac_{Fuel}$	Such activities not occurred
$Frac_{GRAZ}$	Fraction of livestock nitrogen excreted and deposited onto soil during grazing
$Frac_{GASM}$	Fraction of livestock nitrogen excretion that volatilises as NH3 and NOx – 0.2 kg (IPCC 1996, Table 4-19)

N fixed by Crops (F_{BN})

The method applied for calculation of emissions is IPCC Tier 1a (GPG, Equation 4.25):

$$F_{BN} = 2*Crop_{BF}*Frac_{NCRBF}$$

$Crop_{BF}$	Seed yield of pulses, Table 6.15
$Frac_{NCRBF}$	Fraction of nitrogen in N-fixing crop (crop kg N/kg of dry biomass) , GPG Table – 4.16

Nitrogen input from crop residues

The method applied for calculation of emissions is IPCC Tier 1a (GPG, Equation 4.28):

$$F_{CR} = 2*(Crop_o * Frac_{NCRO} + Crop_{BF} * Frac_{NCRBF}) * (1 – Frac_R) * (1- Frac_{BURN})$$

$Crop_o$	Production of all other (non-N fixing) crops in country, Table 6.15
$Frac_{NCRO}$	Fraction of nitrogen in non-N fixing crop - 0.015 kg N/kg of dry biomass (IPCC 1996; Table 4-19)
$Frac_{NCRBF}$	Fraction of nitrogen in N-fixing crop (crop kg N/kg of dry biomass) , GPG Table – 4.16
$Frac_R$	Fraction of crop residue that is removed from the field as crop – 0.45 kg N/kg crop – N biomass (IPCC 1996; Table 4-19)
$Frac_{BURN}$	In Latvia such activities not occurred

Area of cultivated organic soils (histosols- F_{OS})

The IPCC 2000 defines F_{OS} as the area of organic soils cultivated annually. During the In country review (May of 2007) ERT recommended that for calculation of Histosols consistent data source is necessary, therefore:

- sown area, which is collected by CSB and has consistent time series is used instead of previously used area of arable land;
- area of permanent crops was extrapolated for 1990 – 1995 by CSB.

For assessing approximate area of Histosols were used materials from Ministry of Agriculture, Central Statistical Bureau, scientists publications. Detailed information about assessing area of Histosols is in the Annex 5.

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 -2006 is shown in the Table 6.10. An assumption was made using CSB surveys.

Table 6.10 Proportion of cultivated meadows and pastures in the histosols for period 1990-2006

Years	%
1990 - 2002	18.6
2003	15.8
2004	13
2005-2006	17.2

According to national research Histosols is calculated as 7% from cultivated agricultural area (Annex 5). From national expert, who was prepared previously mentioned research, was received answer that it is possible to use sown area instead of arable land for Histosols calculation. Received answers from CSB and national expert were documented in separate folder developed by national inventory compiler. Reassessed areas of approximate cultivated Histosols are shown in the Table 6.11.

Table 6.11 Assessed area of Histosols 1990 – 2006 [12]

	Sown area*, thsd, ha	Permanent crops*, thsd.ha	Meadows and pastures*, thsd.ha	0f which cultivated	Cultivated area, thsd. ha	Histosols, 7% from cultivated area, thsd.ha
1990	1627	11.4	844.2	157.02	1795.43	**125.680**
1991	1621	11.6	843.4	156.87	1789.48	**125.26**
1992	1572	8.4	825.1	153.47	1733.85	**121.37**
1993	1426	8.4	803.4	149.43	1583.82	**110.87**
1994	1195	8.6	803.4	149.43	1353.04	**94.71**
1995	930	10.6	800.5	148.89	1089.47	**76.26**
1996	986	16.2	798.1	148.45	1150.65	**80.55**
1997	1003	15.1	677.9	126.09	1144.19	**80.09**
1998	983	12.1	677.9	126.09	1121.19	**78.48**
1999	912	11.7	617.7	114.89	1038.59	**72.70**
2000	881	11.5	605.7	112.66	1005.16	**70.36**
2001	870	12.1	611.3	113.70	995.80	**69.71**
2002	878	12.2	610.3	113.52	1003.72	**70.26**
2003	851	12.0	613.1	96.87	959.87	**67.19**
2004	899	12.4	620.9	80.72	992.12	**69.45**
2005	1000	12.8	628.9	108.171	1120.97	**78.47**
2006	1123	13.2	636.8	109.530	1245.73	**87.20**

* Data source: CSB [20]

To calculate indirect emissions from Atmospheric Deposition (NH_3 and NOx) and Leaching were used calculation steps according to IPCC Workbook.

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 6.12 and 6.13.

Table 6.12 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 6.13 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

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 6.14) and productions of crops (Table 6.15). Other data sources are LSIAE [8] (distribution of different manure management systems are shown in the Table 6.6, 6.7 and 6.8 and researches made by local experts (area of cultivated organic soils) [12; 18].

Table 6.14 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
2006	43

Table 6.15 Productions of crops (thsd.t)

Year	Wheat and oth.	Barley	Oats	Rye	Rape	Potatoes	Sugar beet	Vegetables	Pulses
1990	402.5	697	176.1	323.6	3.8	1016.1	439.1	169.4	22.7
1991	190.2	761.9	177.2	145.8	0.9	944	377.9	209.2	20.7
1992	332.4	426.3	60	295	1.4	1167.4	462.6	250.8	8.6
1993	338.3	445.8	73.7	340.7	2.5	1271.7	298	284.8	4.3
1994	199.4	476.8	88.9	113.4	1.8	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	110.7	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
2006	598.3	307	91.6	116.8	120.6	550.9	473.9	174.4	1.4

The nitrogen excreted per animal is the same used for calculating nitrous oxide emissions from manure management (Table 6.9).

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 isn't observed in Latvia and the emissions from this source aren't estimated.

6.8 Recalculations

For submission 2008, following recalculations were done:

1. Under category 4B, subcategory Non - Dairy Cattle for 1995 CH_4 emissions was corrected because of previously mistaken data input;

2. Area used for Histosol calculation were reassessed according to recommendations by ERT during In-country review of Latvia's Initial Report under Kyoto Protocol and 2006 Inventory Submission (May 2007);

3. N_2O emissions from manure Management were reassessed based on a time consistent N excretion values from swine for 2004 and 2005 according to recommendations by ERT during In-country review of Latvia's Initial Report under Kyoto Protocol and 2006 Inventory Submission (May 2007);

4. As field burning of agricultural residues isn‘t occurred in Latvia, the calculation of nitrogen input from crop residues was corrected.

6.9 Planned Improvements

The following improvements are necessary:

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. According Forest State Register data total forestland area was 2958 thsd. ha in 2006 and it covers 45% of total land area of Latvia.

In submission 2008, 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.

At the moment Latvia works on changes of regulations that will determine that Latvian State Forest Research Institute (LSFRI) "Silava" will estimate removals and emissions calculations regarding LULUCF sector by using data from national forest inventory (NFI). LSFRI "Silava" is the main centre of forest science in Latvia that performs research on forest ecosystems and their components and works out the recommendations for sustainable forest management and a rational and effective utilisation of forest resources and forest products. The information of new methodology that will be applied is reported in the Annex 6.

In submission 2008, 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 submission 2008, 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.

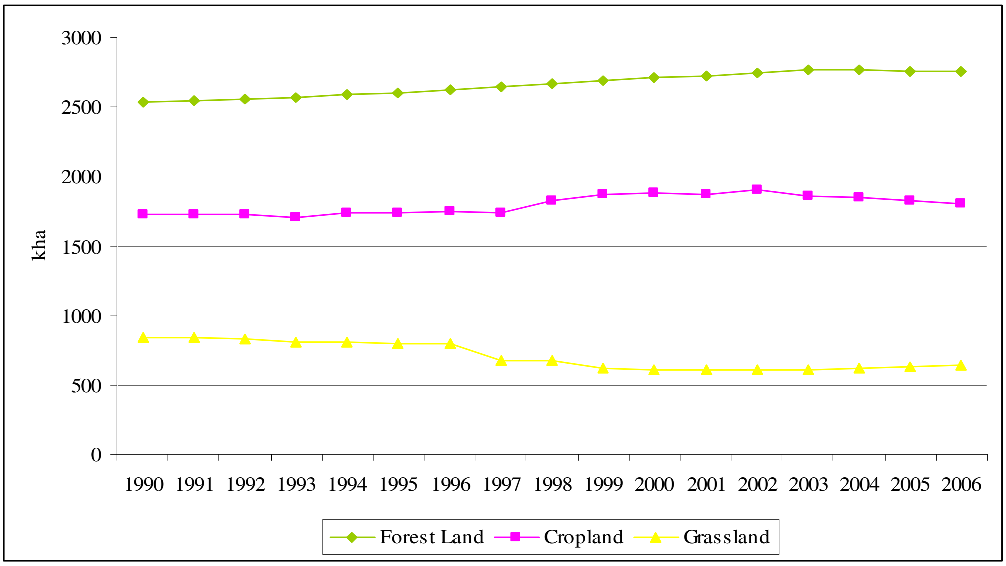


Figure 7.1 Dynamics of Forest land, Cropland and Grassland (thsd.ha)

In 2006, 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 1990-2006

	Forest land	Cropland	Grassland	Total
1990	-20666	153	-195	**-20708**
1991	-21236	151	-195	**-21279**
1992	-21663	239	-195	**-21619**
1993	-20812	186	-195	**-20821**
1994	-19847	80	-195	**-19961**
1995	-17469	5	-244	**-17708**
1996	-18678	18	-264	**-18924**
1997	-16431	28	-277	**-16680**
1998	-15254	23	-295	**-15526**
1999	-14404	13	-314	**-14705**
2000	-13875	8	-328	**-14195**
2001	-14615	-0.4	-355	**-14970**
2002	-13799	16	-360	**-14144**
2003	-13402	20	-353	**-13734**
2004	-14365	10	-375	**-14730**
2005	-14141	35	-387	**14493**
2006	-17609	64	-307	**-17852**

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

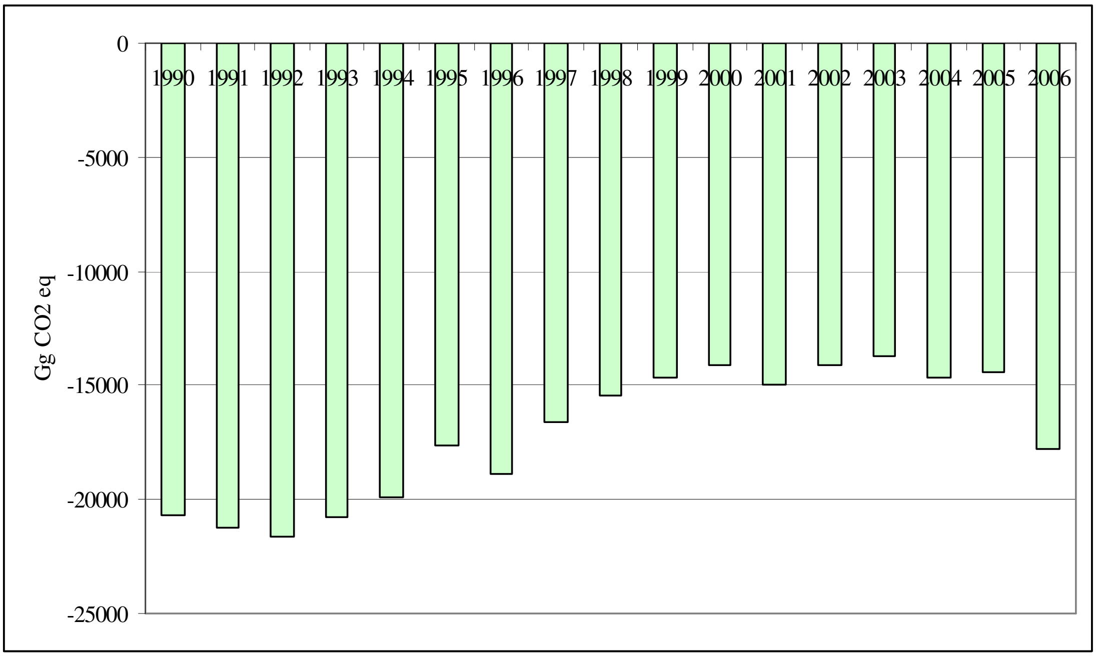


Figure 7.2 Total GHG removals from LULUCF (Gg CO_2 eqv)
(negative figures – GHG removals)

If compared CO_2 removal changes from 1990 and 2007 then CO_2 removals was decreased approximately by 14%.

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 and strict protected zones in national parks. This land area is 14.6 thsd.ha.

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 2006 with 59%, 25% 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 that 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	13,7	2950
2006	175.7	2753.3	14.6	2958

Table 7.2.4 Timber Harvesting Volume (mio. m^3)

1990	5,0
1991	4,4
1992	4,0
1993	4,8
1994	5,7
1995	6,9
1996	6,8
1997	8,9
1998	10,0
1999	10,8
2000	11,0
2001	10,5
2002	11,3
2003	11,7
2004	10,8
2005	11,3
2006	9,8

7.2.1.3 Uncertainties

Uncertainty for used activity data is +/-10%, but for CO_2 removals and emissions calculation - approximately 30%.

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 61.3 Gg C in 2007. CO_2 emissions are released from agricultural soils during different management practices and liming of agricultural soils. In submission 2008, are include emissions only from organic soils witch were 79 Gg C in 2006. CO_2 emissions from agricultural liming were 0.6 Gg in 2006.

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 were obtained from State Land Service and information from MoA. For CO_2 emission calculation CSB data about sown area was used according to UNFCCC ERT recommendations (Table 7.3.2).

Table 7.3.2 Areas of cropland, sown and orchards, thsd.ha

	Cropland area	Sown area	Area of orchards
1990	1723	1627	35,0
1991	1723	1621	35
1992	1724	1572	22
1993	1710	1426	24
1994	1735	1195	30
1995	1740	930	31
1996	1744	986	31
1997	1743	1003	30
1998	1830	983	30
1999	1870	912	29
2000	1880.12	881	28.9
2001	1873.64	870	29.1
2002	1900.05	878	29.1
2003	1861.29	851	28.8
2004	1850.03	899	28.8
2005	1822.63	1000	29
2006	1807.4288	1123	29.2

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 (t/ha)

90-95	3.5
1996	3.1
1997	1.2
1998	1.9
1999	2
2000	3.3
2001	6.1
2002	10.2
2003	13.9
2004	2.9
2005	3.5
2006	1.5

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 tenth key source regarding level (1%) and 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 307 Gg in 2006.

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	21
1994	98
1995	526
1996	1224
1997	576
1998	1255
1999	2685
2000	2262
2001	4800
2002	11547
2003	14335
2004	6717
2005	2089
2006	25806

7.5 Recalculations

Activity data to estimate the area of cropland for the whole time series was corrected due to recommendations in the report of the review of the initial report of Latvia.

Activity data of timber harvesting volume is updated.

7.6 Planned Improvements

Latvia currently uses forest definition parameters as defined by their Forestry Law. This forestry definition under this law is not fully consistent with the definition for forest given in the Annex to Decision 16 /CMP.1; however it has been used for reporting. Latvia will use the forest definition given in the Annex to Decision 16 /CMP.1 for reporting in future.

Latvia will also implement and document the new method of National Forest Inventory for LULUCF sector starting from year 2008. As well as higher-tier method and new documentation on the identification of land areas will be provided.

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 five 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. Till the end of 2007 - 8 regional waste management plans have been accepted in Cabinet of Ministers, remainder 4 regional plans must be accepted in nearest time.

Main activity data sources for GHG emissions calculations in Waste sector are databases "3-Wastes", "2-Water" [24] and data from CSB [25].

Data on hazardous waste in Latvia have been collected and compiled by LEGMA since 1997, but data on municipal (non-hazardous) 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 2006, total emissions were about 12 % higher than in 1990. Emissions from the Waste sector were 764,42 CO_2 equivalents Gg in 2006; it contributes about 6,57 % of total GHG emissions in 2006 (excluding LULUCF). Total emissions from Waste sector are shown in Figure 8.1.

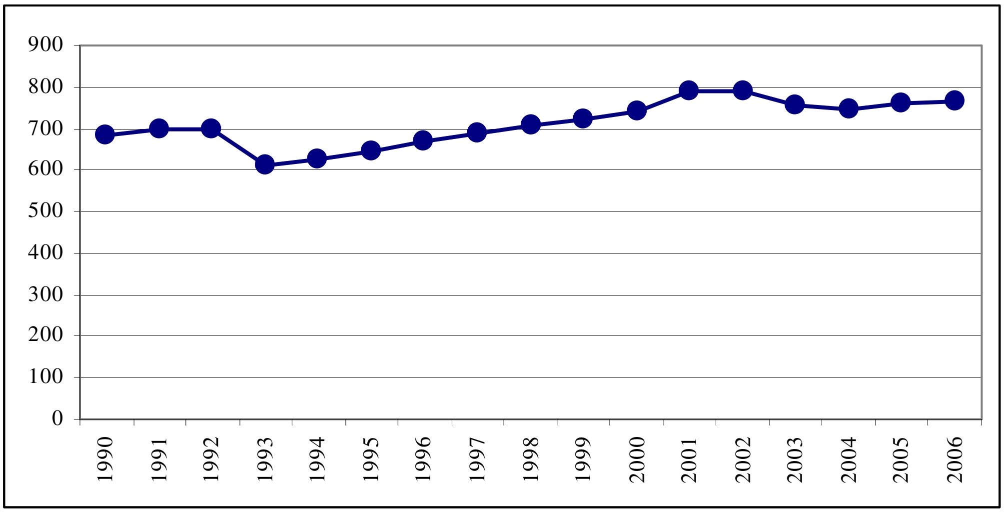


Figure 8.1 Total emissions from Waste sector in CO_2 equivalent (Gg)

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.

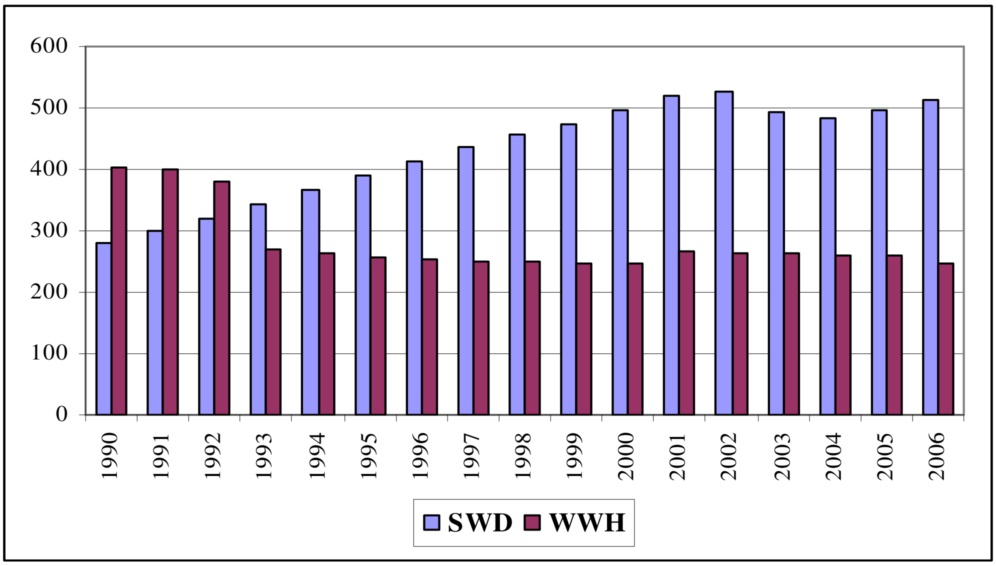


Figure 8.2 Emissions from SWD and WWH sectors in CO_2 equivalent (Gg)

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).

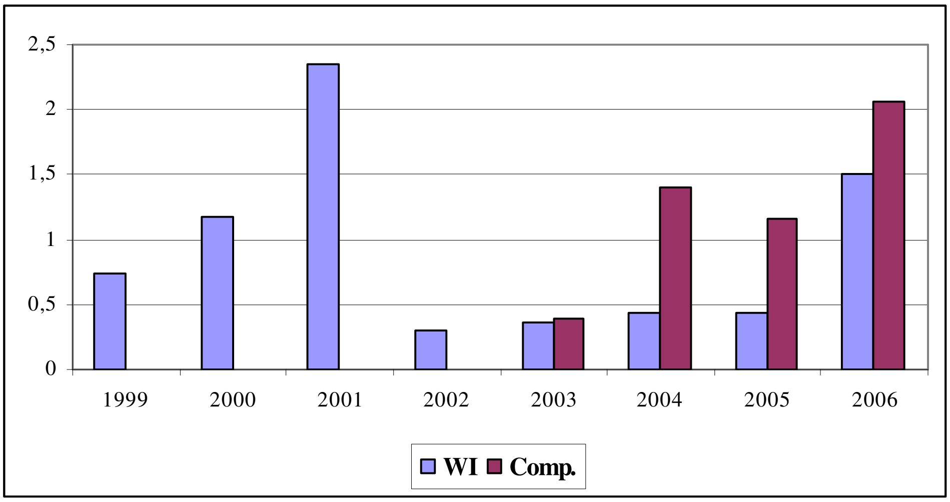


Figure 8.3 Emissions from WI and Comp. sectors in CO_2 equivalent (Gg)

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
2002	821,24	72,26	**893,5**
2003	982,07	25,77	**1007,84**
2004	1136,70	27,49	**1164,19**
2005	1230,62	27,93	**1258,55**
2006	1420,46	45,05	**1465,51**

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 2006, when LULUCF not included, CH_4 emissions from solid waste disposal on land contributes about 4% of emissions, when LULUCF is included – 2%. According to trend assessment in 2006, when LULUCF not included, CH_4 emissions from solid waste disposal on land contributes about 5% of emissions, if LULUCF is included – 2%.

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 99 in 2006. Data about waste disposal on land for 2001 - 2006 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.

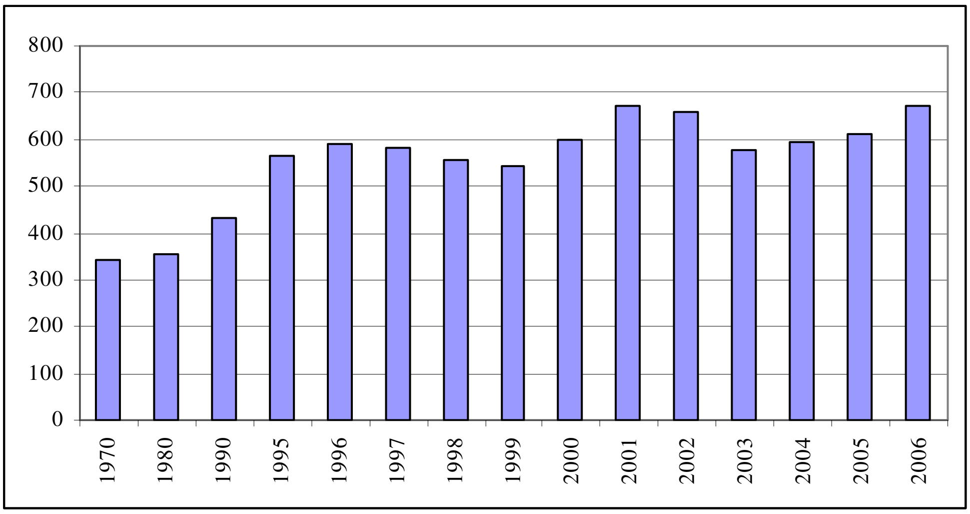


Figure 8.4 Disposed waste amounts in Latvia (Gg)

Since October 2002 CH_4 recovery from landfills are in progress. For 2006 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 4,758 Gg of CH_4 was collected and recovered. Recovered methane amount is presented in Figure 8.5.

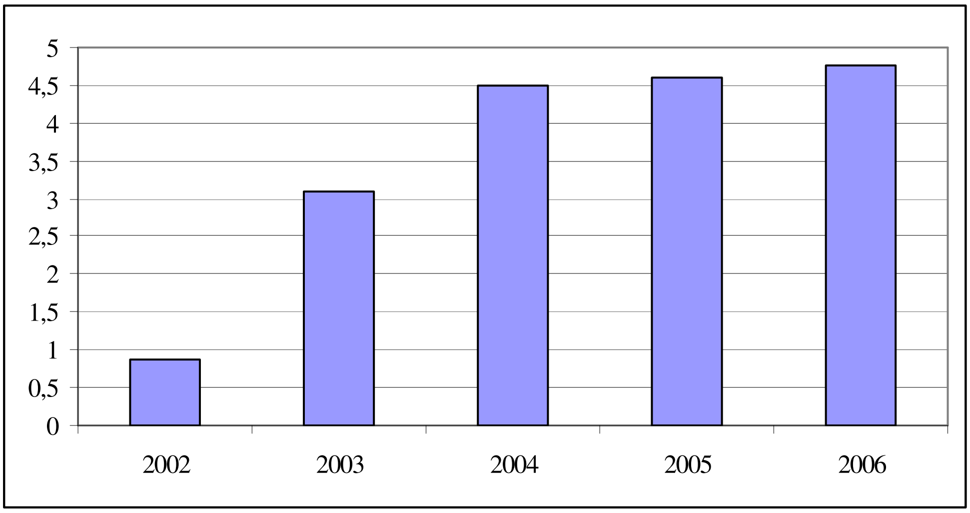


Figure 8.5 Recovered CH_4 from waste landfills (Gg)

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 8.6.

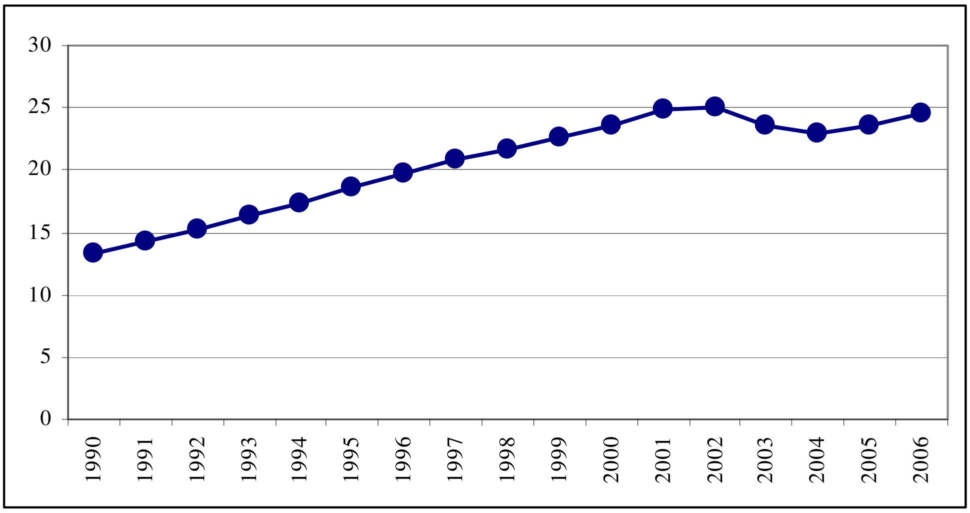


Figure 8.6 CH_4 emissions from waste landfilling (Gg)

8.2.2 Methodological issues

IPCC GPG 2000 (Tier 2) method is used for CH_4 emissions calculation and is based on equations:

$$\boldsymbol{L_o\, CH_4}\ _{\text{potential emission}} = MSW_L * MCF * DOC * DOC_F * F * 16/12$$

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

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

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 1996 guidelines, because Latvia hasn't national emission factors.

8.2.3 Uncertainties

Emission factors uncertainty is estimated as 15 %. It is calculate from IPCC 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

LEGMA data show that 196 million m³ of wastewater in 2006 was released, from which 126 million m³ were treated by different wastewater treatment plants, ~73% from which were biological plants.

CH_4 emissions from Wastewater Handling are key source contributing 2% according to Level Assessment in 2006 when LULUCF is not included. CH_4 emissions are not key source according to Trend Assessment in 2006.

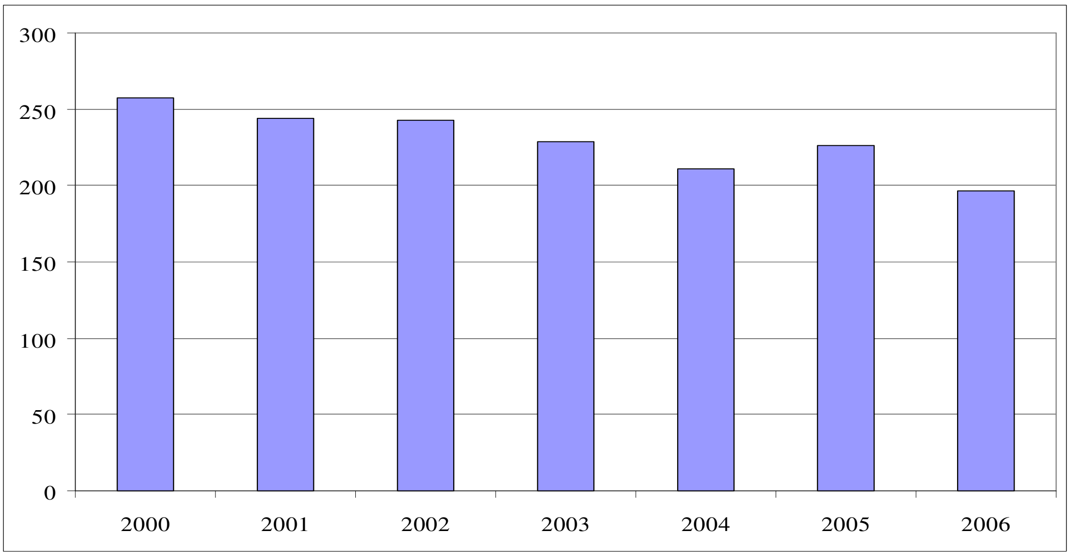


Figure 8.7 Amount of discharged wastewater in last six years (mio m^3)

In most cases urban wastewaters are treated in aerobe systems in Latvia. However, the accurate breakdown of amount aerobic and anaerobic processes during treatment of municipal waste water is unknown; therefore assumption that all the municipal waste water is treated in anaerobic plants. Such assumption can make the emissions from municipal waste water handling sector overestimated what most likely is so. Only one waste water treatment plant in Latvia (UWWTP "Daugavgriva" in Riga – capital of Latvia) has methane tanks for recovery of methane produced during the treatment process; therefore there is assumption the all methane, generated by population served with waste water collection and treatment service by UWWTP "Daugavgriva", is recovered.

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 [14].

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 ~8 % (2006) from total CH_4 emission from Wastewater Handling sector.

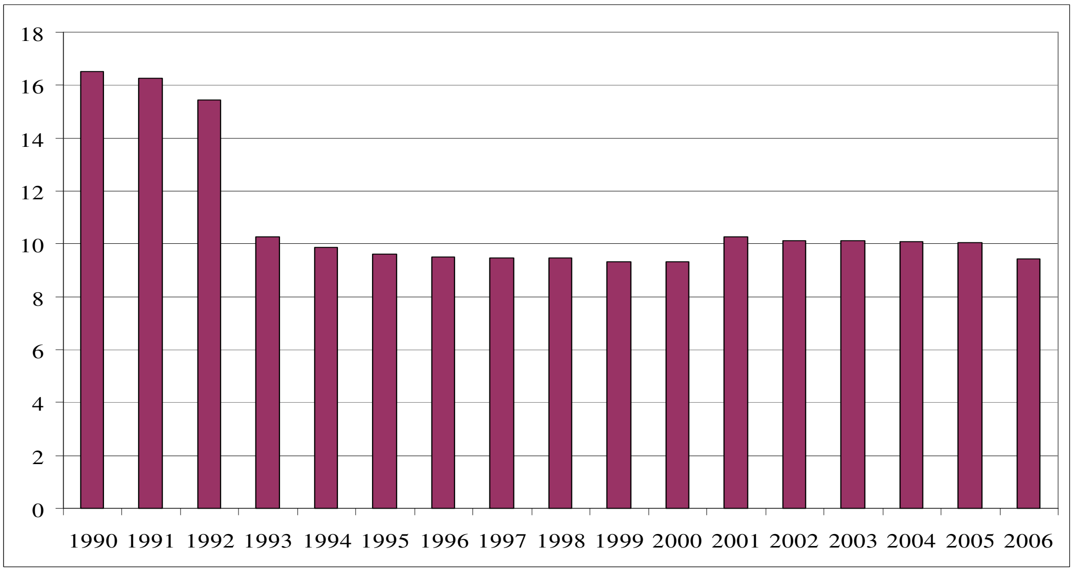


Figure 8.8 Emissions of methane from wastewater handling (total), Gg

The calculations regarding industrial wastewater in this report take into account amount of all the waste water that is produced as result of food industry when ether it is treated in local treatment plants of factory or is transferred to public waste water treatment plant.

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 = 2,282 million;
D – organic load (BOD); D = 60 g BOD/person;
SBF – easy 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.

$$WM = 2{,}282 \times 10^{6} \times 60 \times 0{,}5 \times 0{,}6 \times 0{,}8 \times 365 \times 10^{-12} = 0{,}0120 \text{ (Tg)}$$

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 0,633 mio inhabitants connected to treatment plant [24]), and thus:

$$WM = 0{,}0120 - 0{,}633 \times 10^{6} \times 60 \times 0{,}5 \times 0{,}6 \times 0{,}8 \times 365 \times 10^{-12} = 0{,}0087 \text{ (Tg)}$$

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 [21].

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 Gg 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 [14].

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. In 2006 incinerated amount of waste increase due to hazardous waste incineration facility works on almost full capacity. CO_2 emissions from Waste Incineration are presented in Figure 8.9.

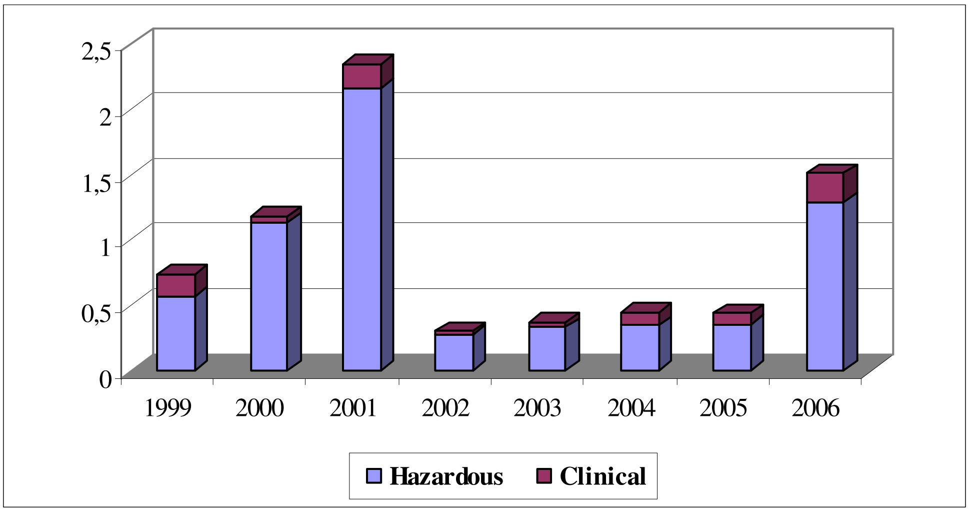


Figure 8.9 CO_2 emissions from Waste Incineration by waste type (Gg)

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 GPG 2000 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. 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 without energy recovery

Year	Hazardous waste (Gg)	Clinical waste (Gg)	Total (Gg)
1999	0,347210	0,201420	0,548630
2000	0,690280	0,056410	0,746690
2001	1,319270	0,213310	1,532580
2002	0,165643	0,032247	0,197890
2003	0,201813	0,040607	0,242420
2004	0,210125	0,112325	0,322450
2005	0,215127	0,102127	0,317254
2006	0,786160	0,261890	1,048050

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

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 [28].

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 - 2006 in Riga crematorium is available (assumed to be 1750), therefore emissions are identical for these years:

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

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

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

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

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.

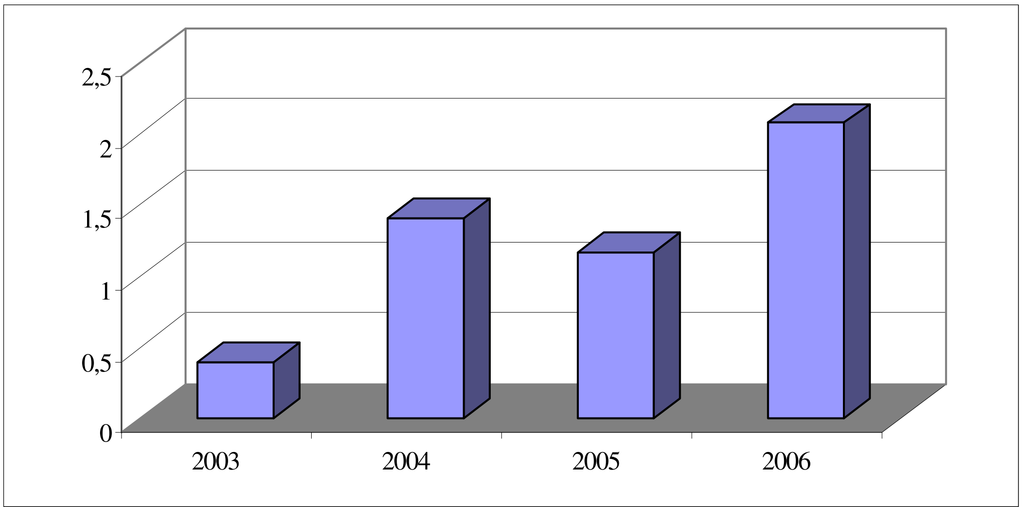


Figure 8.10 Total emissions from waste composting in CO_2 equivalent (Gg)

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. Not all amounts, which classified under recovery as R3, are composted. To determine composted amount, each enterprise, which reports with recovery operations R3, working profile must be taken in account.

Default emission factors for composting were used from IPCC Guidelines 2006:

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	0,031620	0,0023715
2005	6,564	0,026256	0,0019692
2006	11,698	0,046792	0,0035094

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 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. Generally recalculations was made according to recommendations by ERT during In – country visit on May 2007, when was reviewed initial report of Latvia. Short improvement plan for 2008 inventory was prepared based on these recommendations (Annex 7), but many of recommendations will be include in the GHG improvement plan for inventory 2009, due to short time for realising many of recommendations.

Detailed information about planed improvements is described in the sectoral chapters.

10. INFORMATION ON NATIONAL REGISTRY

The description for the national registry for initial report under the Kyoto Protocol has been provided to UNFCCC secretariat as part of Latvia's initial report under the Kyoto Protocol.

According to national legislation Latvian Environment, Geology and Meteorology Agency is responsible for establishing and maintaining Emission Trading Registry.

Latvian Emission Trading Scheme Registry is developed with full consistency to "Data Exchange Standards for Registry Systems under the Kyoto Protocol by registry developers from UK DEFRA (GRETA Registry system). Latvian registry software had passed Annex H testing in October 31 – November 1 2007.

According to "Independent Assessment Report of the National Registry of Latvia" the registry has fulfilled all of its obligations regarding conformity with the Data Exchange Standards. These obligations include having adequate transaction procedures; adequate security measures to prevent and resolve unauthorized manipulations; and adequate measures for data storage and registry recovery. The registry is therefore deemed fully compliant with the registry requirements defined in decisions 13/CMP.1 and 5/CMP.1, noting that registries do not have obligations regarding Operational Performance or Public Availability of Information prior to the operational phase. Latvia had completed all Registry Readiness documentation by autumn 2007 and documentation is scored 80% (max. 100) and it means that no significant concerns about the state of registry readiness are identified.

In the end of 2007 LEGMA received "Registry Initialization Recommendation" according to whom another package of documents were prepared and sent to UNFCCC on January 23, 2008 – Disaster recovery plan, Test plan, Application logging documentation and Version change management plan were prepared. Still there is no new information about this document package from UNFCCC.

Latvia is ready to do ETS go – live procedure and connect to ITL in live regime in time that would fit to Latvia and ITL. Still Latvia had decided to wait for the CITL – ITL Annex H testing finalization and do the ETS go – live procedure together with other GRETA Registry system parties. In March 27, 2008 information that CITL has passed necessary testing with ITL and is connected to ITL Registry Test Environment was received. LEGMA will do all necessary steps and performs test cycle with CITL in short time and will perform "Go-Live with ITL" after that.

No operations in Latvian ETR (within Kyoto Protocol) have been performed because Emission Trading Scheme within Kyoto Protocol started in 1st January 2008.

Latvia had fulfilled all the recommendations and requirements prepared by ERT (2007) of assigned amount units calculation. Latvia received the pre-web version of the Initial Review Report for Latvia in 12th December 2007. It was published officially on the official Internet page of the UNFCCC on 14th December 2007.

There are planned some Joint Implementation projects being on the different phases of development. So there is no official information of the legal entities authorized by Latvia to hold assigned amount units, removal units, emission reduction units and certified emission reductions.

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ANNEX 1 KEY SOURCE ANALYSES

Table 1 Key sources - Level Assessment in 1990 without LULUCF

	IPCC Source Categories	GHG	Base year 1990	LA, %	Cumulative, %
1	CO2 Emissions from Stationary Combustion-oil	CO2	7421.580019	0.2843802	0.2843802
2	CO2 Emissions from Stationary Combustion-gas	CO2	5477.335703	0.209880621	0.4942608
3	CO2 Emissions from Stationary Combustion-coal	CO2	2835.416432	0.108647524	0.6029083
4	Mobile Combustion: Road Vehicles	CO2	2313.569299	0.088651379	0.6915597
5	Emissions from Enteric fermentation in Domestic Livestock	CH4	2057.2335	0.0788291	0.7703888
6	Emissions from Agricultural Soils	direct-N2O	1649.849415	0.063218951	0.8336078
7	Emissions from Nitrogen Used in Agriculture	indirect-N2O	1033.872639	0.039615945	0.8732237
8	Emissions from Manure Management	N2O	551.629279	0.021137338	0.8943611
9	Mobile Combustion: Railways	CO2	525.635292	0.0201413	0.9145024
10	Emissions from Cement Production	CO2	366.1232778	0.014029117	0.9285315
11	Emissions from Wastewater Handling	CH4	346.9986206	0.013296298	0.9418278
12	Emissions from Manure Management	CH4	279.518148	0.01071058	0.9525384

Table 2 Key sources - Level Assessment in 1990 with LULUCF

	IPCC Source Categories	GHG	Base year 1990	LA, %	Cumulative, %
1	Removals from Forest Land	CO2	20666.28	0.44	0.44
2	CO2 Emissions from Stationary Combustion-oil	CO2	7421.58	0.16	0.60
3	CO2 Emissions from Stationary Combustion-gas	CO2	5477.34	0.12	0.71
4	CO2 Emissions from Stationary Combustion-coal	CO2	2835.42	0.06	0.77
5	Mobile Combustion: Road Vehicles	CO2	2313.57	0.05	0.82
6	Emissions from Enteric fermentation in Domestic Livestock	CH4	2057.23	0.04	0.87
7	Emissions from Agricultural Soils	direct-N2O	1649.85	0.04	0.90
8	Emissions from Nitrogen Used in Agriculture	indirect-N2O	1033.87	0.02	0.92
9	Emissions from Manure Management	N2O	551.63	0.01	0.93
10	Mobile Combustion: Railways	CO2	525.64	0.01	0.94
11	Emissions from Cement Production	CO2	366.12	0.01	0.95

Table 3 Key sources - Level Assessment in 2006 without LULUCF

IPCC Source Categories	GHG	2006	LA, %	Cumulative, %
CO_2 Emissions from Stationary Combustion-gas	CO_2	3267.89	0.28	0.28
Mobile Combustion: Road Vehicles	CO_2	3069.05	0.27	0.55
CO2 Emissions from Stationary Combustion-oil	CO_2	1051.08	0.09	0.64
Emissions from Agricultural Soils	direct-N_2O	773.74	0.07	0.71
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	565.69	0.05	0.76
Emissions from Solid Waste Disposal Sites	CH_4	514.00	0.04	0.80
CO_2 Emissions from Stationary Combustion-coal	CO_2	323.91	0.03	0.83
Emissions from Nitrogen Used in Agriculture	indirect-N_2O	318.00	0.03	0.86
Non-CO_2 Emissions from Stationary Combustion-biomass	CH_4	247.43	0.02	0.88
Mobile Combustion: Railways	CO_2	223.94	0.02	0.90
Emissions from Wastewater Handling	CH_4	198.15	0.02	0.92
Emissions from Manure Management	N_2O	157.86	0.01	0.93
Emissions from Cement Production	CO_2	133.40	0.01	0.94
Fugitive Emissions from Oil and Gas Operations	CH_4	105.74	0.01	0.95

Table 4 Key sources - Trend assessment in 2006 without LULUCF

IPCC Source Categories (LULUCF isn't t included)	Direct Greenhouse Gas	Base year 1990, CO_2 eqv.Gg	2006, CO_2 eqv. Gg	Level Assessment, %	Trend Assessment %	Contribution to Trend, %	Cumulative, %
CO_2 Emissions from Stationary Combustion-oil	CO_2	7421.58	1051.08	0.09	0.44	0.29	0.29
Mobile Combustion: Road Vehicles	CO_2	2313.57	3069.05	0.27	0.40	0.26	0.55
CO_2 Emissions from Stationary Combustion-coal	CO_2	2835.42	323.91	0.03	0.18	0.12	0.67
CO_2 Emissions from Stationary Combustion-gas	CO_2	5477.34	3267.89	0.28	0.17	0.11	0.78
Emissions from Solid Waste Disposal Sites	CH_4	278.79	514.00	0.04	0.08	0.05	0.83
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057.23	565.69	0.05	0.07	0.04	0.87
Non-CO_2 Emissions from Stationary Combustion-biomass	CH_4	167.29	247.43	0.02	0.03	0.02	0.90
Emissions from Nitrogen Used in Agriculture	indirect-N_2O	1033.87	318.00	0.03	0.03	0.02	0.91
Emissions from Manure Management	N_2O	551.63	157.86	0.01	0.02	0.01	0.92
Mobile Combustion: Road Vehicles	N_2O	15.90	66.32	0.01	0.01	0.01	0.93
Emissions from Lime Production	CO_2	121.42	1.34	0.00	0.01	0.01	0.94
Emissions from Agricultural Soils	direct-N_2O	1649.85	773.74	0.07	0.01	0.01	0.94
Non-CO_2 Emissions from Stationary Combustion-biomass	N_2O	34.10	61.65	0.01	0.01	0.01	0.95

ANNEX 2 UNCERTAINTIES

Table 1 The uncertainties in CO_2 emissions

IPCC Source Categories (LUCF not included)	Base Year (1990) Estimate,	Current Year (2006) 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 CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%
CO2 Emissions from Stationary Combustion-oil	7421.580	1051.084	2%	5%	5%	1%	-11%	5%	-1%	0%	1%
CO2 Emissions from Stationary Combustion-coal	2835.416	323.910	2%	5%	5%	0%	-5%	2%	0%	0%	0%
CO2 Emissions from Stationary Combustion-gas	5477.336	3 267.89	2%	5%	5%	2%	5%	17%	0%	0%	1%
Mobile Combustion: Road Vehicles	2313.569	3069.046	5%	5%	7%	3%	11%	16%	1%	1%	1%
Mobile Combustion: Waterborne Navigation	17.463	46.423	50%	5%	50%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Aircraft	0.066	2.599	20%	5%	21%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Railways	525.635	223.939	2%	5%	5%	0%	0%	1%	0%	0%	0%
Emissions from Cement Production	366.123	133.400	2%	2%	3%	0%	0%	1%	0%	0%	0%
Emissions from Lime Production	121.424	1.337	2%	2%	3%	0%	0%	0%	0%	0%	0%
Emissions from Limestone and Dolomite use	0.352	31.208	2%	10%	10%	0%	0%	0%	0%	0%	0%
Emissions from Soda Ash Production and Use	0.000	0.361	2%	10%	10%	0%	0%	0%	0%	0%	0%
Emissions from Asphalt Roofing	0.008	0.015	70%	70%	99%	0%	0%	0%	0%	0%	0%
Emissions from Road Paving with Asphalt	9.603	18.222	70%	70%	99%	0%	0%	0%	0%	0%	0%
Emissions from other mineral products	0.000	10.193	2%	10%	10%	0%	0%	0%	0%	0%	0%
Emissions from the Iron and Steel Industry	12.838	12.582	2%	2%	3%	0%	0%	0%	0%	0%	0%
Emissions from Solvent and other product use	55.698	52.204	25%	50%	56%	0%	0%	0%	0%	0%	0%
Emissions from Waste Incineration	0.000	1.510	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 CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%
Non-CO2 Emissions from Stationary Combustion-oil	13.269	2.893	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO2 Emissions from Stationary Combustion-coal	59.628	6.243	2%	50%	50%	0%	-1%	0%	0%	0%	0%
Non-CO2 Emissions from Stationary Combustion-gas	6.185	3.19	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO2 Emissions from Stationary Combustion-biomass	167.286	247.435	10%	50%	51%	7%	5%	7%	2%	1%	3%
Mobile Combustion: Road Vehicles	9.603	12.605	5%	40%	40%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Waterborne Navigation	0.038	0.083	50%	10%	51%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Aircraft	0.000	0.000	20%	10%	22%	0%	0%	0%	0%	0%	0%
Mobile Combustion: Railways	0.626	0.267	2%	10%	10%	0%	0%	0%	0%	0%	0%
Fugitive Emissions from Oil and Gas Operations	274.050	105.735	2%	2%	3%	0%	-1%	3%	0%	0%	0%
Emissions from the Iron and Steel Industry	0.058	0.071	2%	5%	5%	0%	0%	0%	0%	0%	0%
Emissions from Enteric fermentation in Domestic Livestock's	2057.234	565.688	2%	40%	40%	13%	-13%	16%	-5%	0%	5%
Emissions from Manure Management	279.518	82.302	2%	30%	30%	1%	-2%	2%	0%	0%	0%
Emissions from Solid Waste Disposal Sites	278.786	513.996	20%	15%	25%	7%	11%	15%	2%	4%	4%
Emissions from Wastewater Handling	346.999	198.146	2%	10%	10%	1%	1%	6%	0%	0%	0%
Emissions from Compost production	0.000	0.983	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 CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%
Non-CO2 Emissions from Stationary Combustion-oil	19.50	2.88	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO2 Emissions from Stationary Combustion-coal	16.46	1.58	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO2 Emissions from Stationary Combustion-gas	3.04	1.81	2%	50%	50%	0%	0%	0%	0%	0%	0%
Non-CO2 Emissions from Stationary Combustion-biomass	34.10	61.65	10%	50%	51%	2%	1%	2%	1%	0%	1%
Mobile Combustion: Road Vehicles	15.90	66.32	5%	50%	50%	2%	2%	2%	1%	0%	1%
Mobile Combustion: Waterborne Navigation	1.99	5.50	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	27.12	2%	10%	10%	0%	0%	1%	0%	0%	0%
Emissions from Manure Management	551.63	157.86	40%	30%	50%	5%	-2%	5%	-1%	3%	3%
Emissions from Agricultural Soils	1649.85	773.74	40%	25%	47%	25%	2%	22%	1%	13%	13%
Emissions from Nitrogen Used in Agriculture	1033.87	318.00	30%	40%	50%	11%	-4%	9%	-1%	4%	4%
Emissions from Wastewater Handling	56.98	48.70	2%	10%	10%	0%	1%	1%	0%	0%	0%
Emissions from Compost production	0.00	1.09	20%	90%	92%	0%	0%	0%	0%	0%	0%

ANNEX 3 DIRECT GHG EMISSION TRENDS 1990-2006

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	2006
	(Gg)																
1. Energy	**18 591.07**	**17 059.54**	**13 819.12**	**11 690.78**	**10 140.36**	**8 920.85**	**8 991.94**	**8 447.41**	**8 051.01**	**7 437.17**	**6 845.16**	**7 248.82**	**7 240.72**	**7 405.90**	**7 405.02**	**7 526.99**	**7 998.85**
A. Fuel Combustion (Sectoral Approach)	18 591.07	17 059.54	13 819.12	11 690.78	10 140.36	8 920.85	8 991.94	8 447.41	8 051.01	7 437.17	6 845.16	7 248.82	7 240.72	7 405.90	7 405.02	7 526.99	7 998.85
1. Energy Industries	6 332.17	5 805.70	4 955.13	3 990.00	3 748.76	3 440.44	3 565.90	3 327.26	3 368.30	2 944.78	2 490.22	2 442.60	2 335.07	2 269.73	2 077.39	2 067.76	2 091.23
2. Manufacturing Industries and Construction	3 772.61	2 824.39	2 373.72	2 103.01	1 897.51	1 862.44	1 822.77	1 766.83	1 545.06	1 398.01	1 147.18	1 054.65	1 108.99	1 107.79	1 105.35	1 126.61	1 187.61
3. Transport	2 856.73	2 686.74	2 407.19	2 234.63	2 125.01	2 031.14	1 999.29	1 991.36	1 968.98	1 941.02	2 151.63	2 538.91	2 616.70	2 759.29	2 894.70	3 031.34	3 342.01
4. Other Sectors	5 629.55	5 742.72	4 083.08	3 363.14	2 369.08	1 580.60	1 600.87	1 349.50	1 165.56	1 144.01	1 056.13	1 212.65	1 179.96	1 269.09	1 324.46	1 301.29	1 374.89
5. Other	NA	NA	NA	NA	NA	6.23	3.11	12.46	3.11	9.34	NA	NA	NA	NA	3.12	NA	3.12
B. Fugitive Emissions from Fuels	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
1. Solid Fuels	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
2. Oil and Natural Gas	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
2. Industrial Processes	**510.35**	**430.50**	**189.46**	**46.33**	**132.42**	**143.98**	**143.47**	**149.76**	**152.86**	**183.37**	**138.92**	**154.76**	**167.74**	**181.54**	**187.41**	**203.83**	**207.32**
A. Mineral Products	497.51	421.78	183.72	39.32	125.86	139.54	139.99	141.76	144.36	175.65	130.48	146.71	160.13	169.37	174.48	191.46	194.74
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	12.84	8.72	5.74	7.01	6.56	4.44	3.49	8.00	8.51	7.72	8.43	8.05	7.61	12.17	12.92	12.37	12.58
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
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	52.20
5. Land Use, Land-Use Change and Forestry(2)	**-20 708.09**	**-21 279.49**	**-21 619.44**	**-20 820.87**	**-19 961.11**	**-17 708.05**	**-18 924.26**	**-16 680.14**	**-15 526.19**	**-14 705.03**	**-14 194.67**	**-14 970.47**	**-14 144.41**	**-13 733.73**	**-14 729.68**	**-14 493.01**	**-17 852.23**
A. Forest Land	-20 666.28	-21 236.15	-21 663.19	-20 811.56	-19 846.56	-17 468.95	-18 677.73	-16 430.53	-15 254.28	-14 404.33	-13 874.87	-14 614.63	-13 799.48	-13 401.66	-14 365.12	-14 140.54	-17 608.85
B. Cropland	152.72	151.18	238.70	185.83	80.34	4.62	17.81	27.76	23.37	12.94	8.39	-0.38	15.53	20.49	9.95	34.60	64.04
C. Grassland	-194.53	-194.52	-194.95	-195.14	-194.89	-243.72	-264.34	-277.37	-295.28	-313.63	-328.20	-355.46	-360.47	-352.56	-374.51	-387.07	-307.41
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
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**	**1.51**
A. Solid Waste Disposal on Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
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	1.51
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Gg)																
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total CO2 emissions including net CO2 from LULUCF	**-1 550.98**	**-3 737.99**	**-7 561.71**	**-9 037.58**	**-9 643.07**	**-8 601.58**	**-9 745.69**	**-8 039.43**	**-7 277.90**	**-7 038.56**	**-7 163.50**	**-7 517.83**	**-6 688.20**	**-6 097.80**	**-7 087.70**	**-6 710.63**	**-9 592.34**
Total CO2 emissions excluding net CO2 from LULUCF	**19 157.11**	**17 541.51**	**14 057.72**	**11 783.30**	**10 318.04**	**9 106.47**	**9 178.57**	**8 640.71**	**8 248.29**	**7 666.47**	**7 031.17**	**7 452.65**	**7 456.22**	**7 635.93**	**7 641.98**	**7 782.39**	**8 259.89**
Memo Items:																	
International Bunkers	**1 721.08**	**747.50**	**653.73**	**756.98**	**963.50**	**554.58**	**408.31**	**324.27**	**137.42**	**121.77**	**106.14**	**697.07**	**733.88**	**714.90**	**786.54**	**1 001.70**	**823.61**
Aviation	221.15	299.01	84.10	84.10	77.87	77.87	99.67	99.67	90.33	90.33	80.98	80.98	84.10	121.50	146.43	177.58	199.39
Marine	1 499.94	448.49	569.64	672.88	885.63	476.72	308.64	224.60	47.10	31.44	25.15	616.09	649.79	593.40	640.11	824.12	624.22
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO2 Emissions from Biomass	2 964.06	3 476.23	3 466.42	3 865.98	4 007.94	4 542.88	4 747.60	4 759.40	4 697.60	4 611.54	4 283.41	4 749.81	4 720.98	5 075.02	5 351.95	5 357.34	5 387.60

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	2006
	(Gg)																
1. Energy	25.27	26.21	23.81	23.94	23.56	23.77	23.77	22.43	21.21	20.55	19.23	20.10	20.19	19.06	19.45	20.20	18.02
A. Fuel Combustion (Sectoral Approach)	12.22	13.64	12.35	12.98	12.85	13.34	13.72	13.05	12.21	11.96	11.29	12.40	12.16	12.78	13.23	13.26	12.99
1. Energy Industries	0.27	0.26	0.25	0.24	0.24	0.23	0.25	0.29	0.28	0.23	0.22	0.20	0.20	0.23	0.21	0.18	0.20
2. Manufacturing Industries and Construction	0.26	0.19	0.17	0.18	0.17	0.16	0.17	0.17	0.18	0.17	0.15	0.19	0.18	0.18	0.22	0.25	0.28
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	0.62
4. Other Sectors	11.19	12.71	11.50	12.15	12.04	12.56	12.92	12.22	11.36	11.15	10.47	11.55	11.31	11.87	12.22	12.25	11.89
5. Other	NA	NA	NA	NA	NA	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	0.00	NA	0.00
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	5.04
1. Solid Fuels	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
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	5.04
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**	**0.00**
A. Mineral Products	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE,NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	0.00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Agriculture	**111.27**	**107.11**	**88.77**	**54.60**	**45.79**	**44.63**	**41.79**	**39.19**	**35.86**	**31.35**	**30.60**	**32.07**	**32.31**	**31.21**	**30.70**	**31.47**	**30.86**
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	26.94
B. Manure Management	13.31	12.47	9.50	5.72	5.17	5.32	4.77	4.47	4.19	3.83	3.73	3.99	4.11	4.01	3.95	3.97	3.92
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
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**	**1.55**	**1.69**	**1.76**	**1.59**	**1.65**	**1.53**
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	1.53	1.64	1.70	1.56	1.64	1.43
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
	(Gg)																
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	0.11
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
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**	**33.96**
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	24.48
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	9.44
C. Waste Incineration	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.03	0.03	0.05
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total CH4 emissions including CH4 from LULUCF	**167.24**	**164.90**	**144.22**	**106.26**	**98.02**	**98.23**	**96.41**	**94.03**	**90.71**	**86.42**	**85.43**	**88.78**	**89.31**	**85.71**	**84.82**	**87.07**	**84.37**
Total CH4 emissions excluding CH4 from LULUCF	**166.35**	**163.83**	**143.25**	**105.11**	**96.63**	**96.56**	**94.77**	**91.86**	**88.27**	**83.80**	**82.76**	**87.23**	**87.63**	**83.96**	**83.23**	**85.42**	**82.84**
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	0.04
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	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	0.04
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

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	2006
	(Gg)																
1. Energy	**0.50**	**0.50**	**0.45**	**0.40**	**0.38**	**0.39**	**0.41**	**0.40**	**0.39**	**0.38**	**0.38**	**0.40**	**0.41**	**0.45**	**0.50**	**0.50**	**0.54**
A. Fuel Combustion (Sectoral Approach)	0.50	0.50	0.45	0.40	0.38	0.39	0.41	0.40	0.39	0.38	0.38	0.40	0.41	0.45	0.50	0.50	0.54
1. Energy Industries	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03
2. Manufacturing Industries and Construction	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
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	0.32
4. Other Sectors	0.16	0.18	0.17	0.17	0.16	0.17	0.18	0.17	0.16	0.15	0.14	0.16	0.15	0.16	0.17	0.17	0.16
5. Other	NA	NA	NA	NA	NA	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	0.00	NA	0.00
B. Fugitive Emissions from Fuels	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO	IE,NE,NO
1. Solid Fuels	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
2. Oil and Natural Gas	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
2. Industrial Processes	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**
A. Mineral Products	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE,NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
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	0.04
4. Agriculture	**11.59**	**10.74**	**8.27**	**5.71**	**4.70**	**3.80**	**3.89**	**3.92**	**3.74**	**3.41**	**3.46**	**3.81**	**3.78**	**3.98**	**3.91**	**4.26**	**4.36**
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	0.51	0.51	0.51
D. Agricultural Soils	9.81	9.03	6.90	4.86	3.97	3.09	3.22	3.29	3.16	2.90	2.95	3.28	3.25	3.46	3.40	3.74	3.85
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
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**	**0.02**
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	0.01
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
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	0.01
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Gg)																
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**	**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	0.16
C. Waste Incineration	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00	0.00	0.00	0.00
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total N2O emissions including N2O from LULUCF	**12.28**	**11.43**	**8.91**	**6.29**	**5.26**	**4.39**	**4.50**	**4.53**	**4.33**	**3.99**	**4.02**	**4.41**	**4.39**	**4.63**	**4.60**	**4.94**	**5.11**
Total N2O emissions excluding N2O from LULUCF	**12.28**	**11.42**	**8.90**	**6.28**	**5.25**	**4.38**	**4.49**	**4.51**	**4.32**	**3.98**	**4.01**	**4.40**	**4.37**	**4.61**	**4.58**	**4.93**	**5.09**
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**	**0.10**
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	0.01
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	0.09
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

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	2006
	(Gg)											
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**0.288**	**1.325**	**2.468**	**4.613**	**6.776**	**8.586**	**9.810**	**11.826**	**12.946**	**16.238**	**19.058**	**35.425**
HFC-23	0.000	0.000	0.000	0.000	NA,NO	0.000	0.000	0.000	0.000	NA,NO	NA,NO	NA,NO
HFC-32	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.000	0.000	0.000
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
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	0.000	0.000	0.001
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.000	0.001	0.002	0.003	0.005	0.007	0.008	0.009	0.010	0.012	0.015	0.021
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
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	0.000	0.000	0.001
HFC-227ea	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.000	0.000	0.000	0.000	0.000	0.000
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs(4) - (Gg CO2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
CF4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C2F6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C 3F8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C4F10	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
c-C4F8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C5F12	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C6F14	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs(4) - (Gg CO2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6(3) - (Gg CO_2 equivalent)	**0.251**	**0.287**	**0.508**	**0.710**	**0.977**	**1.275**	**1.977**	**3.382**	**4.413**	**5.370**	**7.530**	**7.124**
SF6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ANNEX 4 BACKGROUND DATA AND INFORMATION OF ENERGY SECTOR

Table 1 SO_2 emission factors per fuel type

Type of fuel	Sulphur content													EF (Gg/PJ)											
	1990-1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	NCV	1990-1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Diesel	0.3	0.3	0.3	0.3	0.3	0.035	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	0.016
RFO	2	2	2	2	2	1	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	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	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	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	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	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	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	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	0.661	26.22	1.236	1.236	0.825	0.820	0.807	0.770	0.769	0.564	0.467	0.454	0.480	0.454
Coke	1.8	1.8	1.20	1.19	1.18	1.12	1.12	0.82	0.68	0.66	0.70	0.661	26.79	1.209	1.209	0.808	0.802	0.790	0.753	0.753	0.552	0.457	0.444	0.469	0.444
Shale oil	1	1	1	1	1	1	1	1	1	1	0.57	0.8	39.35	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.290	0.407
Peat	0.3	0.3	0.24	0.21	0.21	0.21	0.21	0.27	0.25	0.24	0.15	0.224	10.05	0.507	0.507	0.411	0.359	0.362	0.355	0.364	0.456	0.419	0.412	0.259	0.378

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

Table 2 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		24 887.020	5 672.130	NO	2 418.350	16 796.540	1.000	NCV	16 796.540	18.900	317.455	NA	317.455	0.990	1 152.360
		Jet Kerosene	TJ		2 808.650	NO	2 765.440	-43.210	86.420	1.000	NCV	86.420	19.500	1.685	NA	1.685	0.990	6.117
		Other Kerosene	TJ		259.200	43.200	NO	43.200	172.800	1.000	NCV	172.800	19.700	3.404	NA	3.404	0.990	12.357
		Shale Oil	TJ		865.700	NO		747.650	118.050	1.000	NCV	118.050	20.780	2.453	NA	2.453	0.990	8.905
		Gas / Diesel Oil	TJ		38 368.470	4 673.900	2 761.850	-5 523.700	36 456.420	1.000	NCV	36 456.420	20.300	740.065	NO	740.065	0.990	2 686.437
		Residual Fuel Oil	TJ		6 536.600	NO	5 481.000	-1 096.200	2 151.800	1.000	NCV	2 151.800	21.100	45.403	NA	45.403	0.990	164.813
		Liquefied Petroleum Gas (LPG)	TJ		3 142.260	728.640		-273.240	2 686.860	1.000	NCV	2 686.860	17.200	46.214	NO	46.214	1.000	169.451
		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		3 139.500	NO		41.860	3 097.640	1.000	NCV	3 097.640	22.000	68.148	68.148		0.990	
		Lubricants	TJ		1 506.960	460.460	NO	-41.860	1 088.360	1.000	NCV	1 088.360	20.000	21.767	21.767		0.990	
		Petroleum Coke	TJ		395.760	NO		230.860	164.900	1.000	NCV	164.900	27.500	4.535	NA	4.535	0.990	16.461
		Refinery Feedstocks	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other Oil	TJ		1 428.644	NO		77.224	1 351.420	1.000	NCV	1 351.420	20.000	27.028	NA	27.028	0.990	98.113
Other Liquid Fossil												376.740		8.037	NO	8.037		29.175
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	293.020	41.860	NO	NO	251.160	1.000	NCV	251.160	22.000	5.526	NO	5.526	0.990	20.058
Gasoline type jet fuel			TJ	NO	216.050	NO	NO	216.050		1.000	NCV		18.900		NO		0.990	
Liquid Fossil Totals												64 547.950		1 286.195	89.915	1 196.280		4 344.189

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)
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	4 195.200	NO	NO	786.600	3 408.600	1.000	NCV	3 408.600	25.100	85.556	NA	85.556	0.980	307.431
		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	140.700	NO	NO		70.350	70.350	1.000	NCV	70.350	28.320	1.992	NA	1.992	0.980	7.159
	Secondary Fuels	BKB[3] and Patent Fuel	TJ		IE	IE		IE	IE	IE	NCV	IE	IE	IE	IE	IE	IE	IE
		Coke Oven/Gas Coke	TJ		160.740	NO		NO	160.740	1.000	NCV	160.740	29.500	4.742	NO	4.742	0.980	17.039
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												3 639.690		92.290	IE,NA,NO	92.290		331.629
Gaseous Fossil		Natural Gas (Dry)	TJ	NO	64 042.084	NO		5 431.170	58 610.914	1.000	NCV	58 610.914	15.300	896.747	NO	896.747	0.995	3 271.632
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												58 610.914		896.747	NA,NO	896.747		3 271.632
Total												126 798.554		2 275.232	89.915	2 185.317		7 947.450
Biomass total												50 632.146		1 507.840	NA	1 507.814		NA
		Solid Biomass	TJ	66 602.000	645.000	17 094.000		425.000	49 728.000	1.000	NCV	49 728.000	30.000	1 491.840	NA	1 491.840	NA	NA
		Liquid Biomass	TJ	383.059	395.293	231.084		49.554	497.714	1.000	NCV	497.714	19.600	9.755	NA	9.755	NA	NA
		Gas Biomass	TJ	406.433	NO	NO		NO	406.433	1.000	NCV	406.433	15.300	6.218	NA	6.218	NA	NA

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)	64.548	59.985	4 344.189	61.070	4 396.207	-1.776	-1.183
Solid Fuels (excluding international bunkers) [(5)]	3.640	3.506	331.629	3.506	323.910		2.383
Gaseous Fuels	58.611	58.611	3 271.632	58.543	3 267.894	0.115	0.114
Other [(5)]	0.131	0.131	10.842	0.131	10.842		0.000
Total [(5)]	***126.930***	***122.233***	***7 958.292***	***123.250***	***7 998.853***	***-0.825***	***-0.643***

Table 4 Energobalance of Latvia in year 2006 (TJ)

sectors	**oil Products**	motor and aviation gasoline	kerosene	kerosene type jet fuel	gasoline type jet fuel	diesel oil	residual fuel oil	LPG	white spirit	paraffin waxes	petroleum coke	Used oils	other oil products	oil bitumen	lubricants	shale oil	**coal**	peat	coke oven coke	used tires	**natural gas**	fuelwood, wood wastes, other wood products	biogas	biodiesel	biogasoline
NCV		43,97	43,20	43,21	43,21	42,49	40,60	45,54	41,86	41,86	32,98	29,23	41,86	41,86	41,86	39,35	**26,22**	10,05	26,79	26,20	**33,53**			37,20	26,8
production of primary energy resources																		141				66392	336	250	133
primary product receipts	1575	220				297										787									
recycled products	205											205								131					
import	83259	24667	259	2809	216	38071	6537	3142	126	293	396	58	1172	3140	1507	866	4195		161		64056	645		1	
export	11620	5672	43			4674		729		42					460							16914		143	88
bunkering	8243					2762	5481																		
interproduct transfer	9		-43	-43	-216	127	853						-42		42	-669									
stock changes	-1985	-1891		86		-765	244	273			231		-42	-42		-79	-787	-70			-5164	-425		-23	-27
statistical differences	-4846	528				-6161										787								85	
gross energy - total	**67775**	**16797**	**173**	**2852**	**0**	**36456**	**2152**	**2687**	**126**	**251**	**627**	**263**	**1088**	**3098**	**1088**	**118**	**3409**	**70**	**161**	**131**	**58892**	**49698**	**336**	**0**	**18**
transformation sector	**1300**					**42**	**1218**									**39**	**210**	**60**			**36187**	**7369**	**248**		
public CHP	568						568														26193	661	107		
public heat plants	691					42	609									39	105	20			8049	3972			
autoproducer CHP																					705	8	141		
autoproducer heat plants	41						41										105	40			1241	2246			
autoproducer electricity plants																						0			
charcoal production plants																						482			
Energy sector*	253					212	41											10			939	108			18
Losses																					268	18			
Final consumption:	**66223**	**16797**	**173**	**2852**		**36201**	**893**	**2687**	**126**	**251**	**627**	**263**	**1088**	**3098**	**1088**	**79**	**3199**	**0**	**161**	**131**	**21498**	**42203**	**88**		
industry	**3896**	**44**				**892**	**447**	**137**	**126**	**251**	**627**	**205**	**1088**			**79**	**1311**		**161**	**131**	**11738**	**5766**			

sectors	oil Products	motor and aviation gasoline	kerosene	kerosene type jet fuel	gasoline type jet fuel	diesel oil	residual fuel oil	LPG	white spirit	paraffin waxes	petroleum coke	Used oils	other oil products	oil bitumen	lubricants	shale oil	coal	peat	coke oven coke	used tires	natural gas	fuelwood, wood wastes, other wood products	biogas	biodiesel	biogasoline
transport:	**49821**	**16357**		**2809**		**28383**		**1184**							**1088**						**68**				
air	2809			2809																					
road	43953	16357				25324		1184							1088						68				
railways	3059					3059																			
pipelines																									
other sectors:	**12507**	**396**	**173**	**43**		**6926**	**447**	**1366**				**58**		**3098**			**1888**				**9693**	**36437**	**88**		
agriculture / forestry / hunting	3783	44				3739											52				705	473			
fishery	763					722	41															7			
construction	3820	44				637	41							3098			26				402	255			
residential	1621	264				127		1230									813				4326	31165			
other consumers	2520	44	173	43		1700	365	137				58					996				4260	4537	88		

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

GUIDANCE MANUAL FOR CO_2 EMISSION ESTIMATIONS

(Developed in accordance with UNFCCC and IPCC recommendations and physical characteristics of fuels used in Latvia)

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Riga

2004

Annotation

The report is done in accordance with conditions of contract No. 15 of 17 May 2004. Guidance manual of CO_2 emissions from stationary fuel combustion installations estimations is developed in accordance to requirements from IPCC Guidelines. It means that according to developed guidance, CO_2 emissions from every object could be determined using physical characteristics of combusted fuel and amount of consumed fuel. In case such physical characteristics are not available, average estimated data for types of fuels used in Latvia could be used (Table 1).

Following additional information are given:

- capacity of combustion installations,
- particle content of fuel,
- concept of heat of combustion and use of it in estimations
- discretion in composition of thermal balance of combustion installation that provide better understanding of combustion installations operations and processes that generate CO_2 emissions.

The report is developed to help enterprises that operate with combustion installations, Regional Environmental Boards (REB) and environment experts calculate CO_2 emission from stationary fuel combustion.

Introduction

Guidance for practical determination of CO_2 emission factors in the case of:

1. combusted type of fuel and physical qualities of it;
2. combusted amount of fuel,

is developed for enterprises to fulfil the requirements of national legislation (Cabinet of Ministers Regulations "About taxes of natural resources" and Cabinet of Ministers Regulation No. 555).

Stationary combustion installations are divided in:

1. boiler units – generation of electricity and heat for public utilities;
2. technological equipment combustion installations that are divided in:

installations where flue gases directly do not collide with produced products (mainly food industry – bread baking, malt drying;

installations where flue gases directly collide with produced products (construction materials and metal production).

In point 1 and 2.1 mentioned installations emission thresholds of noxious products is determined and guidance of CO_2 emission estimations could be used. In other cases technological specific of production should be taken into account.

Mathematical expression of CO_2 emission determination given in first chapter is used in specified calculation using data from fuel certificates and combusted amount of fuels. In cases when data from fuel certificates are not available (carbon content and net calorific value of fuel), CO_2 emission factors (Table 1) that are estimated using mathematical expression, IPCC Guidelines and average values of physical qualities of fuels used in Latvia are used.

In CO2 emission determination it is assumed that all carbon stored in fuel transforms into CO2 in combustion process. Practically part of carbon (depends on type of fuel, type of furnaces, maintenance conditions of boiler units) doesn't burn fully and forms CO that transforms into CO_2 in length of time (approximately 48 h).

Consequently enterprise operating combustion installation and permit chemically incomplete combustion (q_3) has to consume bigger amount of fuel to obtain necessary amount if heat and therefore bigger amount of CO2 is generated.

Part of fuel did not participate in combustion processes. This part is composed by non-combusted fuel (carbon) that is discharged from combustion installation with ashes, slag and soot. Non-combusted part of fuel is accounted as mechanically incomplete combustion losses q_4 in thermal balance of combustion installation. These loses are rather big if solid fuels – coal, peat, are combusted (ashes, slag), smaller – if liquid fuels are combusted (soot) and minimal – if gaseous fuels are combusted. For gaseous fuels q_4 is technological losses (maintenance of installations and safe work requirements provision) that are gas-fittings leakage in units processes to avoid possible explosions. In leakage process other greenhouse effect gas – methane, is emitted to atmosphere.

Brief discretion in particle content of organic fuel, relevance between fuel working, dry and combusted volumes, gross and net calorific values and suggestions in what cases previously mentioned relevancies could be used in estimations are given in the report.

1. CO_2 emission estimations for combusted organic fuels (guidance manual)

In combustion of organic fuels process carbon (C) in fuel connects with air oxygen as a result carbon dioxide (CO_2) is made. In case of chemically incomplete combustion also carbon monoxide (CO) is made that in approximately 48 h time connects with air oxygen and transforms in CO_2.

To estimate CO_2 emissions, it is necessary to know:

1. combusted type of fuel;
2. amount of combusted fuel B_n;
3. carbon content (C^d %) in working mass of fuel;
4. net calorific values of working mass of fuel (Q_z^d, MJ/kg (m^3)).

Easier way to estimate CO_2 emissions is to calculate emission factor (E) and consumed amount of fuel (B_q) marked in heat amount units (MJ, GJ, TJ…. / time period). For E and B_q estimation necessary data is collected from fuel certificates (Quality note) or analyse data and accounting of combusted fuels.

For emission factor calculation following relevance is used:

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

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)
1000 – switching from MJ to GJ
100 – percentage determination

Heat amount generated into furnaces with fuel is estimated:

$$B_q = B_n \times Q_z^d$$

where:
Bn – consumption of fuel in natural units in time period, tn ($10^3 \times m^3$)

CO_2 emissions in time period are estimated:

$$CO_2 = E_{CO_2} \times B_q$$

where:
CO_2 – estimated emissions, kg (t)
E_{CO2} – calculated emission factor, kg/GJ (t/TJ);
B_q - heat amount generated into furnaces with fuel, GJ (TJ).

Practically all amount of fuel input in furnaces doesn't take part in combustion process. Part of non-combusted fuels is discharged from furnace with ashes, soot and slag. These are so-called mechanically incomplete combustion losses. That's why oxidation factor p has to be taken into account in CO2 emission estimations.

Oxidation factor:

$$p = \frac{100 - q_4}{100}$$

Practically CO_2 emissions:

$$E'_{CO_2} = E_{CO_2} \times p$$

If data from fuel certificates are not available, average data summarized in Table 1 could be used in CO_2 emission estimations. Data reported in table are estimated by using average data from fuel certificates of fuels used in Latvia and suggestions from IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

Table 1 Carbon content in organic fuels working masses, net calorific values and CO_2 emission factor

Type of fuel	Carbon content C^d %	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	67,32	26,22	94,08	0,98	**92,20**
Wood, W^d = 55%	20,11	6,70*	109,98	0,98	**107,78**
Peat, W^d = 40%	29,07	10,05	105,99	0,98**	**103,87**
Residual fuel oil	85,72	40,60	77,36	0,99	**76,59**
Diesel oil, liquid oven fuel	86,68	42,49	74,74	0,99	**74,00**
Motor gasoline (for off-roads****)	83,13	43,96	69,29	0,99	**68,60**
Natural gas	51,54	33,66***	56,10	0,995	**55,82**
LPG	77,99	45,54	62,75	0,995	**62,44**
Shale oil	82,82	39,35	76,19	0,99	**75,43**
Coke	63,87	26,37	88,75	0,98	**86,98**
Lubricants	83,77	41,86	73,33	0,99	**72,60**
Other kerosene	85,17	43,20	72,24	0,99	**71,52**
Jet fuel	85,18	43,60	71,58	0,99	**70,86**

* for wood – Q_z^d ir TJ/1000m^3
** for electricity production p = 0,99
*** natural gas – Q_z^d is MJ/m^3
**** off roads – vehicles not involved in traffic, for example, asphalt pavers, and other commercial and household technological equipment, for example, grass rollers

Emission factor values (E^n_{CO2}) that are determined for natural unit of consumed amount of fuel – t, (1000 m^3) could be used equally in CO_2 emission estimations. These values are reported in Table 2.

Table 2 CO_2 emission factors for natural units of organic fuel

Type of fuel	E^n_{CO2}, kg/t (1000 m^3)
Coal	2417
Wood, W^d = 55%	722
Peat, W^d = 40%	1044
Residual fuel oil	3110
Diesel oil, liquid oven fuel	3144
Motor gasoline (for off-roads)	3016
Natural gas	1879
LPG	2844
Shale oil	2968
Coke	2294
Lubricants	3039
Other kerosene	3090
Jet fuel	3089

Following relevance for very approximate (control) CO2 emission estimations could be used:

$$E_k \approx \frac{B_n \times C^d \times M_{CO_2}}{M_C \times 100} \approx B_n \times C^d \times 0{,}0366413$$

where:
B_n – consumed natural units amount of fuels, t (1000 m^3)
C^d – carbon content in working mass of fuel, %

Note: CO_2 emissions of renewable energy resources are not estimated. Emission factors given in Table 1.1 and Table 1.2 could be used as comparative values.

2. Installed capacity

Following concept of combustion installations (boiler units) capacity are used in practice:

1. capacity **N**;
2. installed capacity $\mathbf{N_{nom}}$;
3. with fuel input installed capacity $\mathbf{N_{th}}$;

N – momentary capacity of combustion installation (existing moment). Temporary it can exceed installed capacity. Mostly it is lower than installed capacity during operating time of combustion installations. As often as not average capacity of specific time period N_{vid} (h, day, and month) is used.

$\mathbf{N_{nom}}$ – capacity that could be used permanent without harmful influence on installation safety. For New installations installed capacity is equal to boiler unit installed capacity that is reported in technical documentation of installation – passport. For operating installations installed capacity could be determined by control (testing) institution – boiler unit inspection.

$\mathbf{N_{th}}$ – capacity input with fuels marked in MW to provide consummation of installed capacity.

$$N_{th} = \frac{N_{nom}}{\eta_{ka}}$$

where:
η_{ka} – boiler unit (boiler-house) efficiency factor with nominal load.

It means: to reach installed capacity, it is necessary to input in combustion installation more fuel than it is required for furnaces installed capacity (in capacity units) to cover all heat losses.

3. Organic fuels

Particle content off organic fuel:

$$C + H + N + O + S + A + W = 100 \text{ (\% mass content)}$$

where:
C – carbon content in solid or liquid fuels (%);
H – hydrogen content in solid or liquid fuels (%);
N – nitrogen content in solid or liquid fuels (%)
O – oxygen content in solid or liquid fuels (%)
S – sulphur content in solid or liquid fuels (%)
A – ash content in solid or liquid fuels (%)
W – moisture content in solid or liquid fuels (%)

For gaseous fuels usually it is declared hydrocarbons CnHm, hydrogen, nitrogen and CO2 (% volume units):

$$CH_4 + C_2H_6 + C_3H_8 + C_4H_{10} + C_5H_{12} + H_2 + N_2 + CO_2 = 100$$

According to mass content fuel is divided:

- working mass of fuels (marked with index **d**)

$$C^d + H^d + N^d + O^d + S^d + A^d + W^d = 100$$

- dry mass of fuels (marked with index **s**)

$$C^s + H^s + N^s + O^s + S^s + A^s = 100$$

- burning mass of fuels (marked with index **deg**)

$$C^{\deg} + H^{\deg} + N^{\deg} + O^{\deg} + S^{\deg} = 100$$

As it can be seem from these expressions for different masses particle percentage content is different. Mostly particle content of dry mass is given in fuel certificates, except moisture content – for working mass. In this case recalculations have to be done and all indices have to be determined as for working mass.

Coefficients for fuel content recalculations

Given mass content	**Needed mass content**		
	Working	**Dry**	**Burning**
Working	1	$\frac{100}{100 - W^d}$	$\frac{100}{100 - (A^d + W^d)}$
Dry	$\frac{100 - W^d}{100}$	1	$\frac{100}{100 - A^s}$
Burning	$\frac{100 - (A^d + W^d)}{100}$	$\frac{100 - A^s}{100}$	1

In practice gross and net calorific values of organic fuels working mass is used.

For solid and liquid fuels net calorific values are estimated with equations:

$$Q_z^d = 339C^d + 1031H^d - 109(O^d - S_g^d) - 25W^d \text{ (kJ/kg)}$$

(S_g – fugitive sulphur amount)

Relevance between net and gross calorific values:

$$Q_z^d = Q_a^d - 25(9H^d + W) \text{ (kJ/kg)}$$

As it can be seen from these expressions gross calorific values of fuels is always higher than net calorific values. That's because value of condensation heat from water vapour that contain flue gasses is used, respectively outgoing flue gases temperature is lower than condensation temperature of water vapour (dew-point). That kind of operations is allowable if fuel doesn't contain sulphur. Otherwise final heating surfaces, gas lines and smokestack have to be safeguarded from aggressive environment (acids) influence and condensate neutralization have to be done.

ANNEX 5 RELEVANT BACKGROUND INFORMATION – AGRICULTURE SECTOR

English translation of document, June 27, 2007

Extract from research on the amount of organic soils (Histosols) in Latvia from 1990 – 2004 according to IPCC Good Practice Guidance and uncertainty management for national greenhouse gas inventories

Published too by the Latvian State Institute of Agrarian Economics

(Working papers2 (16)/2006, pages 11-13)

Dr. oec. Ligita Melece

INTRODUCTION

To support global climate change mitigation through implementing United Nations Framework Convention on Climate Change and its Kyoto Protocol and requirements of European Union (hereinafter –EU) legislation Latvia had to elaborate Climate Change Mitigation Program. This program stipulates Governmental policy and measures. EU member states and EU Council have ratified Kyoto Protocol by accepting regulation 280/2004/EC on GHG and implementation requirements of Kyoto Protocol monitoring mechanism in EU.

In accordance with this regulation EU member states have to elaborate Climate Change Mitigation Program which contains information of Governmental policy and measures for GGH emission reduction and limitation, as well as increase sequestration of carbon dioxide, application of Kyoto Protocol mechanism, measures for implementation EU legislation and policy of climate changes, sequestration forecast of GHG and carbon dioxide until 2020.

Until now the most important policy planning documents stipulating climate change reduction in Latvia are:

- Climate Change Mitigation Policy Plan (1998);
- Latvian Sustainable Development Strategy (2002);
- Implementation concept of joint implementation projects for 2002 – 2012 (2202);
- Implementation strategy of joint implementation projects for 2002. -2012 (29.10.2002);
- National Environmental Policy plan for 2004 - 2008 (03.02.2004).

In accordance with the obligations of Convention and Kyoto Protocol, as well as Conference decisions of Convention Parties and EU legislation, Latvia should annually submit to Convention secretary and European Commission national inventory report with overview on GHG emissions and sequestration of carbon dioxide.

Climate Change Mitigation Programme was elaborated according to the Prime Minister Order No. 142 „On Climate Change Mitigation Programme" and content of the programme corresponds to the obligations of EU Parliament and Council regulation. This Programme covers goals and obligations of Kyoto Protocol to United Nations Framework Convention on Climate Change including obligation that in the time period from 2008 – to 2012 the total amount of anthropogenic GHG emissions in Latvia will not exceed 92% of 1990 level.

Greenhouse gas emissions arise also from agricultural activity. Amount of nitrous oxide emissions from managed soils is considerable.

When estimating greenhouse gas emissions, it is important to estimate nitrous oxide - N_2O emissions from the management or use of organic soils – histosols or histosol soils (hereinafter in the text histosols) in agriculture.

ASSIGNMENT

In accordance with the assignment during contract elaboration amount of organic soils – Histosols was estimated in Latvia from 1990 – 2004 according to IPCC Good Practice Guidance and Uncertainty Management in national greenhouse inventories.

SOURCES AND METHODS

Sources

In order to fulfil the assignment during the project elaboration following sources was used:

- Data from Ministry of Agriculture of the Republic of Latvia;
- Instructions, methods and data from international organizations and institutions;
- Published data and data base information of Central Statistics Bureau of the Republic of Latvia;
- Information and data of State agency „Latvian Environmental, geology and meteorology agency";
- Publications by foreign and Latvian scientists and specialists.

Methods

For the solution of assignments and estimates taking into account methods of international institutions (IPCC; EPAM/CORINAIR etc.) the most appropriate quantitative and qualitative economic research methods were applied:

- Grouping of data;
- Analysis and synthesis;
- Logically and abstractedly constructive;
- Interpolations of data;
- Experts etc.

RESULTS

Emissions from agricultural soils

Greenhouse gas emissions from agricultural soils differ according to the method agricultural land is managed with, which in its turn depend on the type of cultivated agriculture crop.

For easier emission estimate IPCC methodology distinguishes three types of the usage of agricultural lands. For cultivated plant sowings and plantations, as well as for intensively managed grasslands significant amounts of fertilizers are used, but for extensively managed grasslands fertilizers are not used at all or in very small amounts.

Because of this methane and nitrous oxide emissions from the territories of cultivated plants and intensively managed grasslands are considerably higher than emissions from extensively managed grasslands without the use of additional fertilizers.

Histosols

Histosols are formed of nitrogen rich organic substances. Depth of upper layer of these soils is more than 40 cm and content of organic substances is within 89% to 96%. Usually histosols form in places where atmospheric moisture is high, vaporization is low and drainage is limited which facilitates reinforced decomposition of the matters from plants and animals. Histosols is ecologically important because of the large quantities of organic substances they contain (Histosols, 2005).

Histosol soils theoretically can be divided into three groups:

First group histosols form in lowlands, mudflats, and mixed forests on wet peat soils or places where excessive moisture conditions in the upper layer of soil create anaerobic conditions;

Second group histosols form in flat topography where annual precipitation exceed amount of vaporization. Highland swamps and peatlands are typical to this group;

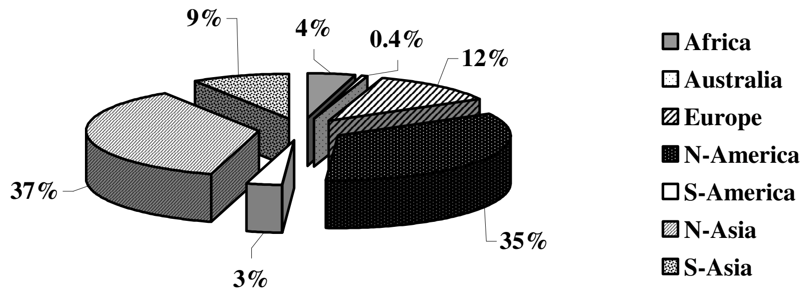
Third group histosols form in mountains where upper layer of soil is composed mainly from the remains of plants.

Taking into account the high content of organic substances, usage of histosol soils in agricultural production is limited.

Histosols possess specific characteristics – low mass density, colloidal character and specific thermal qualities. In order to ensure long-term use of histosols in agriculture, management of these soils should be particularly careful as histosol soils lose their structure when drying out quickly, mineralize and become trampled. If soil is not properly or timely managed then irreversible soil drying out processes take place and it becomes vulnerable to the wind erosion (Histosols, 2000).

Histosol soils of the first and second group mostly are met in North Europe and Baltic counties, including Latvia, and in the North America, but the third group soils – in South Asia.

Overall histosols take up 1,2% or 270 million hectares of the world land territory. Mainly histosols compose in boreal and mild climate regions. Looking at total areas occupied by histosols divided by continents we can see in the Picture 1 that the biggest territories occupied by histosols are in N-America (35%) and N-Asia (37%).



Picture 1 Histosol soils (%) by continents
Source: Histosols, 2000

In neighbouring countries of Latvia – in Estonia peatlands take up 22% or 9 000 km^2 from the total state territory (Global peat resources by country, 2001; Selge, 2002) or 23% (Reintman, 2001) and in Lithuania peat soils occupy 11% from the state territory (Land found and soil, 2004).

In Estonia histosol soils occupy 8.6% from arable land (*Kolli R., Ellermae O., 2003*), but there are no data on arable histosol soils in Lithuania.

In many European countries organic or histosol soils are not precisely defined, also experts from one country indicate different spread of these soils. Researchers Brito Soares and Ronco (Brito Soares F., Ronco R., 2005) while estimating greenhouse gas emissions under the Common agriculture policy in „old" 15 member states indicate how difficult it is to define arable histosol areas.

There is not unambiguous opinion of researchers regarding GHG emission from histosols management. For example, Swedish soil researchers (*Klemedtsoon et.al.,2005*) found that not always and not in all cases histosols are the sources of GHG, including nitrous oxide emissions.

Authors point out that in some cases nitrous oxide (N_2O) emissions from histosols are significant but in other cases nitrous oxide emissions are unimportant. This is why researchers suppose that in order to estimate total nitrous oxide emissions from histosols it is necessary to evaluate or map soil parameters that differ depending on emitting intensity of the place.

When analyzing annual measurement of N_2O emissions from histosol soils, Swedish researchers have concluded that there is close negative relation between N_2O emissions and soil C (carbon) and N (nitrogen) proportion - r^2_{adj}=0.96, where annual average N_2O emissions = $ae^{(-bCN\ proportions)}$).

Klemedtsoon and other authors for estimating N_2O emissions from histosols in certain territories stipulate that correlation between N_2O emissions and CN proportion should be used. However, if C and N proportions are low then it should be taken into account that such parameters as climate, pH and level of ground waters will significantly influence amounts of nitrous oxide emissions.

Histosols in Latvia

Latvia lacks accurate data as regarding histosols areas in its territory, so as regarding those histosols areas that are situated within arable land and also regarding proportion of managed histosols due to various reasons:

There is a lack of financing for the soil researches, international soil classification or taxonomy is not implemented in Latvia. In order to introduce international soil classification system more in-depth soil researches are needed, because the old and existing soil classification does not correspond with the international and it is not possible to adapt it in a simplified way without performing researches;

Inventory in Latvia of agricultural lands including managed meadows and pastures is incomplete.

It is necessary to define areas of histosols or organic soils in Latvia as EU and international experts have expressed their dissatisfaction with the data Latvia has previously reported on histosols proportion from arable lands – 1,5% and histosols areas which considerably differed from the data of other countries, including neighbouring countries.

Regardless of the above-mentioned reasons we can acquire approximate area of managed histosols if we evaluate publications and information by researchers from Latvia and other countries.

Many authors (Busmanis, 1999; Shvangiradze, 2000; Nikodemus, 2003; Āboliņa, 2003; and other experts) indicate that proportion of histosols could be **approximately 7 %** from the agricultural lands in Latvia.

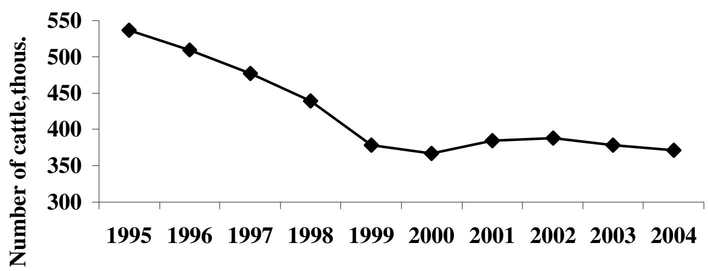
Comparing this proportion of histosols areas with the data of other countries we can agree with this assumption. In Denmark that is situated more to South from Latvia, areas occupied by histosols make 2377 km^2 or 5.5% from the state territory. In Denmark more than half of areas occupied by histosols or 184 000 hectares are used in agriculture.

Besides Danish researchers emphasize that 90% of these areas are used as grasslands and therefore do not emit nitrous oxide emissions. Remaining 10% from the total area occupied by histosols (18 400 hectares) during the year emit 0.14 kt N_2O emissions if emission factor is 5 kg N_2O-N/ha.

But the latest IPCC directions define new increased histosols emission factor - 8 kg N_2O-N/ha.

Soil researcher in Latvia Regīna Timbare (Timbare, 2002) in her report prepared in 2002 on histosols proportion in arable lands in Latvia observed that proportion of histosol soils is higher in fallow lands, i.e., not arable lands. Timbare concludes that in the last 10 years (after 1990) proportion of histosol soils in arable lands could not particularly change as practically there was no drainage of new areas (more or less only the management of existing drainages took place) or development of new lands, and in the result area of arable lands even in the last two years cannot significantly differ from the area defined in 1990. Also it should be taken into account that the area of arable land not used in agriculture increases.

Besides due to significant reduction of livestock, especially cattle (Picture 1), including dairy cows during the time period from 1990 – 2004, also the areas of managed meadows and grazing pastures reduced.



Picture 2 Dynamics of the number of cattle in Latvia, 1995 – 2004

Source: Data from CSB, 2005

If we assume and suppose that histosol soils in cultivated and natural meadows and pastures in 1990 occupied 19% then by making necessary adjustment we can find that proportion of histosols in agricultural lands is **7% from the total managed agricultural lands**.

When analyzing report and recalculation (Table 2) it was found that if we similarly to Danish experts exclude unmanaged meadows and pastures from managed meadows and pastures then we reach the result which corresponds with the opinion of above mentioned experts – 7% from managed/cultivated agricultural lands are histosols.

For the estimates of histosol areas we applied proportion of managed meadows and pastures in histosol soils given in percentage in Table 3.

Assuming that in Latvia from agricultural lands, 7%- arable land, permanent crop and managed meadows and pastures are histosols and where in 2004 according to Central Statistics Bureau data 13% was managed meadows and pastures, but in 2003 - 15,8%, then if estimate is done according to total area - in 2004 in Latvia ~ 77 thousand hectares were histosols. We suggest including this area in the estimates of nitrous oxide emissions in 2004.

Table 2 Adjusted proportions of histosol soils in agricultural lands, 1985-1990

Type of the land management	Inspected area, thousand ha	Proportion of histosol soils, % from total agricultural lands	Area of histosol soils, thousand ha
Fields	1565.95	1.5	23.85
Perennial plantations (orchards and berry fields)	2.98	0.7	0.021
Managed and natural pastures	300.19	6.9	20.57
Cultivated and natural meadows	172.65	19.0	108.87
Average arable land	2041.76	**7.03**	153.32

Source: author's estimates according to Timbare's,(Timbare, 2002) data

Table 3 Proportion of managed meadows and pastures in histosol soils, 1990 - 2004

Year	%
1990-2002	18.6
2003	15.8
2004	13.0

Source: author's estimates

Conclusions

Conclusions of the research are that in Latvia:

- organic – histosol soils take up **~ 7%** from managed/cultivated agricultural lands;
- with the decreasing number of livestock since 1990, proportion of managed meadows and pastures in histosol soils has decreased.

During the research conclusions are drawn that for the accurate and detailed estimates of histosols in agricultural lands soil classification in Latvia corresponding to scientific researches and international standards is lacking; also not all of the international database inventory parameters correspond with IPCC requirements or they are not sufficiently detailed.

Detailed information about AWMS:

In the Research (2005)[8] was reassessed AWMS due to:

Previously submitted information about AWMS in the Latvia's National Inventory report submitted under the UNFCCC in April 2005;

IPCC GPD (2003) Guidelines;

Central Statistical bureau (CSB) data – real situation in the country.

Problems that were listed in the Research are following:

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

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

Calculation steps:

Step 1:

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

Table 1 Proportion of Dairy cows in different farm size

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

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

Table 2 Proportion of Cattle in different farm size

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

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

Table 3 Proportion of Swine in different farm size

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

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

Table 4 Proportion of Poultry in different farm size

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

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

Step 2:

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

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

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

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

Step 3:

AWMS was calculated by type of livestock taken into account previously mentioned calculations as well as different available information (expert judgements, researches etc.). The results are shown under sub category Manure Management in the section 6.3. (Table 6.6, Table 6.7 and 6.8.).

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

Average N excretion per head of livestock was reassessed in the Research [8] which was made by Latvian State Institute of Agrarian Economics if compared previously submitted. For N excretion calculations was used newest published information of “Centre of Agrochemical researches” on different produced manure amount of livestock type in year and N amount in the manure, which was justly with results of manure analyses (Table 6.9).

For reassessing values of N excretion per head of livestock was used in the Table 6.9 shown information, information from Research [21] previously submitted as well as IPCC Guidelines.

Table 6 Additional standards for manure of livestock type

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

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

ANNEX 6 RELEVANT BACKGROUND INFORMATION – LULUCF SECTOR

New methodology that is planed to use for submission 2009 regarding LULUCF

1. General methods of Latvian NFI

In accordance with Republic of Latvia Cabinet Regulation No 169 Adopted 15 April 2003 „Regulations regarding Circulation of State Forest Register Information" (Issued pursuant to Section 34, Paragraphs two and three and Section 39, Paragraphs three and six of the Law on Forests) "The methodology for the performance of the forest statistical inventory and calculation of secondary parameters of a forest stand" is approved by Minister for Agriculture.

Inventory is performed by The Latvian State Forestry Research Institute „Silava". The Latvian State Forestry Research Institute „Silava" is responsible for the accuracy of the inventory data. Each year by 1 April, the Latvian State Forestry Research Institute „Silava" submits to the Ministry of Agriculture the information obtained during the inventory of the previous year. The content of the submission of the information is determined by the Ministry of Agriculture. The results of the inventory are presented in tables.

„Silava" is ensuring that the inventory data is permanently kept in electronic form in a chronological sequence according to the forest inventory periods.

1.1. Aim and object of forest statistical inventory

The aim of the inventory is to get quick and precise information about forest resources to satisfy needs of national and international statistics, to control dynamics of forest area, to get precise information about structure and dynamics of wood resources, to evaluate effectiveness of usage of resources and forest ecosystem (dynamics of damages and biological diversity) and to accumulate historical information about way of development of forest stands.

The object of forest statistical inventory is the whole territory of the country, which according to the Law of Forests is qualified as land used for growing forests independently to form of ownership. Simultaneously continuous control of the whole land area of the country is performed to ensuring observation of the dynamics of land property and evaluation of naturally or artificially afforested land.

1. 2. Net of sample plots and sampling design

1. 2.1. Overall characteristics of net of sample plots

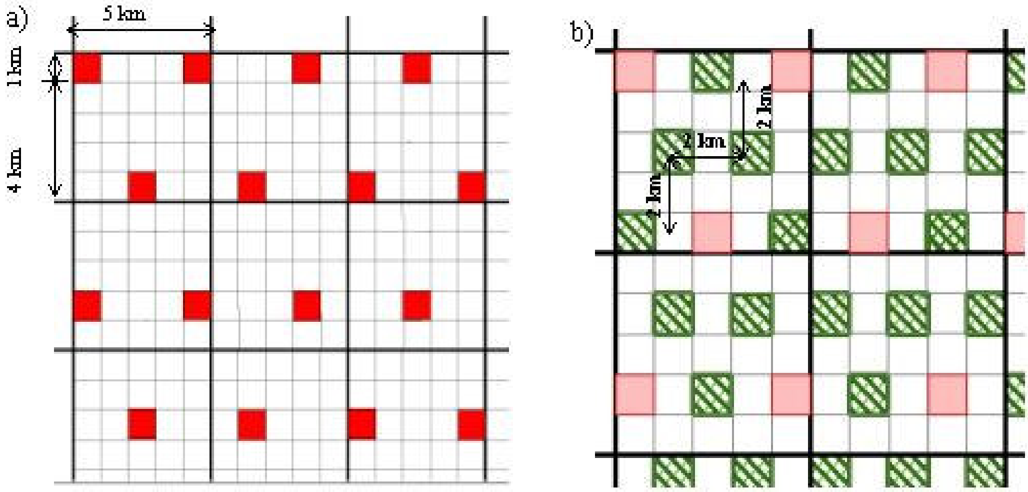
Forest statistical inventory is based on the method of continuous, combined, multistage sampling and GIS technology.

Forest statistical inventory is done according to three stage selection principle:

1. By using ortofoto maps (1:10 000) in whole territory of Latvia initial inventory units following each other after 250 m are placed to estimate the land use categories in accordance with State land service.

2. Net of permanent and temporary sample plots (hereinafter - SP) is estimated by selecting tracts of permanent SP with 4 SP in each as well as tracts of temporary SP with 8 SP in each:

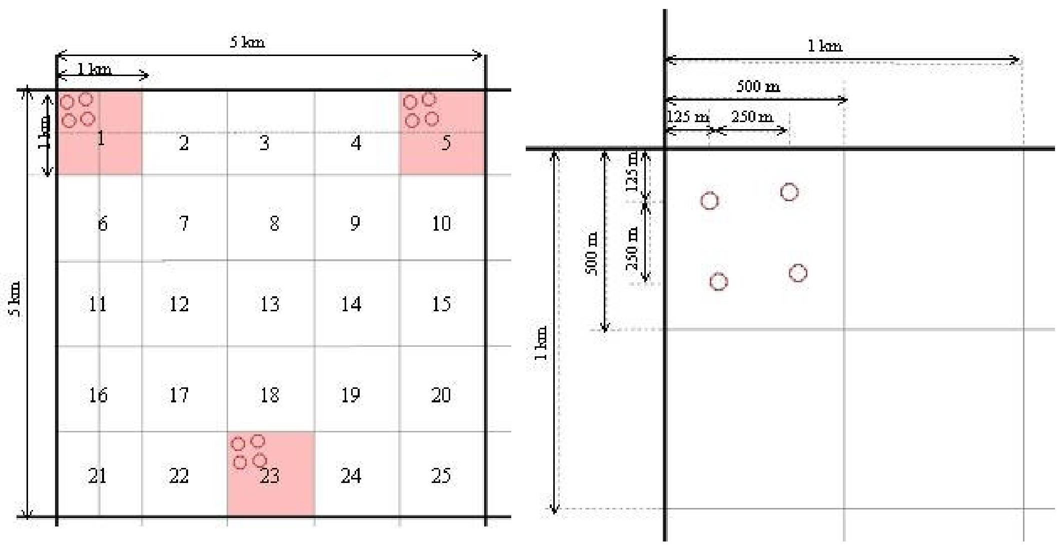
2.1. The net of permanent SP tracts is placed evenly in whole territory of country in distance 4*4 km from each other in a way that they are making equilateral triangles (picture 1.a.). Each year 1/5 from all permanent SP is measured.



Picture 1 Schema of layout of permanent (a) and temporary SP (b) tracts

Temporary SPs are placed according to 2*2 km net with target to push up confidence level of results (picture 1.b). By quantity temporary SPs are 1/3 from yearly measured permanent SPs. Temporary sample plots are no re-measured.

SP tracts are placed on ortofoto. Permanent SPs are grouped by 4 in one tract. SP in tract are placed in peaks of quadrate 250*250 and centre of SP is moved by 25m from peaks of this quadrate (2.Picture).



Picture 2 Schema of selecting permanent and temporary sample plots on ortofoto.

In all permanent and temporary SPs accounting trees are selected with target to evaluate height, age, increment, quality and damages. These trees are selected in proportion with diameter of existing trees. Intensity of selection is 20-30% form all trees, whose diameters are measured.

Net of permanent SPs is established according to systematic schema of placement with random start. Each SP is measured once in one period of NFI (it means once in 5 years). One permanent plot represents area of 400 ha.

For placement of temporary SPs, random selection in used. By using tables of random numbers, number of 1*1 km quadrant is gradually selected for each tract. From selection of temporary SP tracts 1*1 km quadrants with permanent SPs are excluded as well as temporary SPs from previous years.

Temporary SPs are measured like permanent SPs, but measurement is made only once and without fixing geographical placement of trees. In the same tract, together with SPs for accounting of trees, stump sample plots are placed with aim to deal only with accounting of felled trees. In these SPs (stump) unlike in permanent and temporary SPs other characteristics of forest land is not accounted.

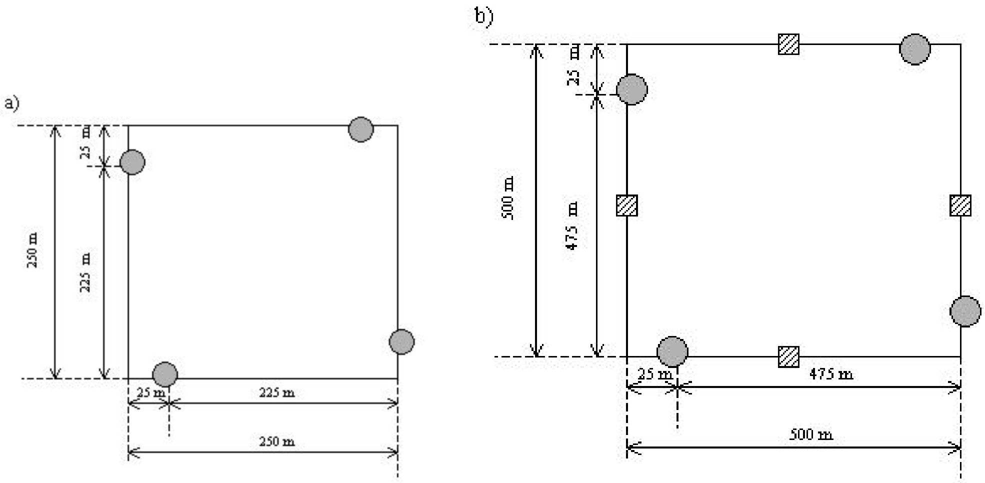
Each temporary plot after one year measurement represents territory of 6000 ha, but during 5 years – 1200 ha. Taking together permanent and temporary SPs, each plot during one year represents 1500ha, but during 5 years 300 ha. By making repeated measurements in permanent SPs changes in 5 years period are evaluated, but taking together permanent and temporary SPs present condition of forest stands is evaluated.

1.2.2. Schema of sample plots.

In net of permanent SPs, plots are placed in tracts whose margins (with length of 250 m) are oriented in direction of north, east, south and west. Centre of SP is moved from peak of tract by 25 m. (3.a. picture)

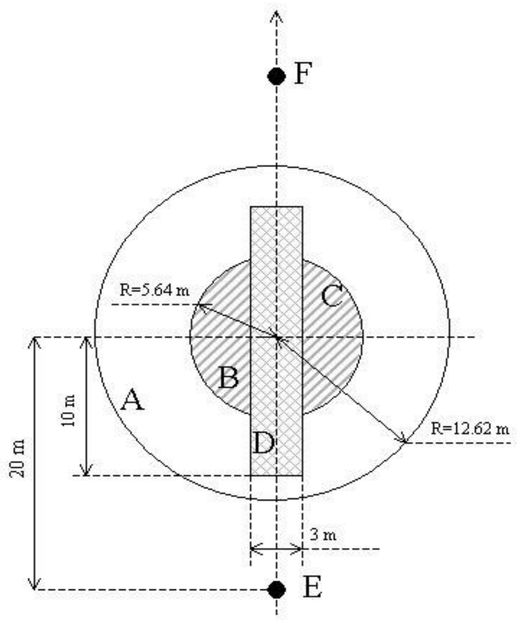
Temporary SPs are placed in quadrates of 500*500 m and they are divided in two parts - stump SPs, where only stumps are measured and SPs for accounting of trees which are measured like permanent SPs, but without fixation of placement of trees.

In tracts of temporary SPs plots for accounting of trees are placed in corners of 500*500 m quadrate, but stump SPs - in midpoints of quadrate margins. SPs are moved aside by 25 m in opposite to direction of movement. (3. b picture).



Picture 3 Schema of placement of permanent sample plots (a) and temporary sample plots (b)

Main element of measurements is permanent SP with fixed radius, with square of 500 m2 (R = 12.62 m), where measurements of trees with diameter >= 14.1 cm at 1.3 m height above root collar, stumps with diameter >= 14.1 cm at root collar and dead wood are done (4.Picture).



Picture 4 SP schema (A – 500 m^2 SP, B – 100 m^2 SP, C – 25 m^2 SP, D – SP for Understorey and brushwood , E and F – SP for measurements outside the permanent SP (used for radial increment measurement with boring method)

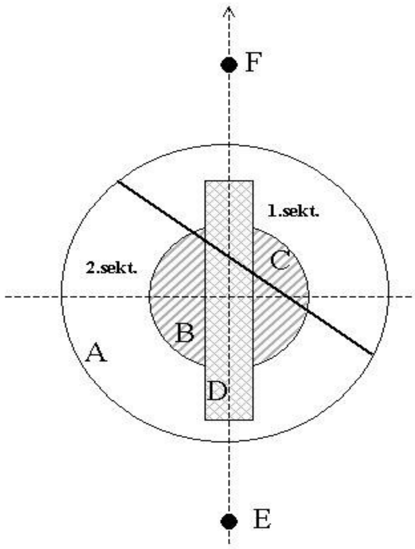
In the centre of SP another circular sample plot is singled out (B) - 100 m^2 (R=5.64 m), where all trees, stumps and deadwood with diameter >= 6.1 cm are measured. In the first ¼ of this SP (accounting from north direction) in 25 m2 (C) all naturally growing saplings and shoots with diameter >=2.1 cm in height of 1.3 m above the root collar and stumps with diameter >=2.1 cm at root collar are measured.

Understorey and brushwood are taken into account in a 3*20 m strip-like plot allocated within the main plot. For 1. and 3. SPs - in E-W direction, for 2. and 4. SPs - in N-S direction.

1.2.3. Dividing sample plots in sectors.

Sample plots occurring on the boundaries of several forest compartments are divided into smaller units – sectors. Each singled out sector is described separately, with trees being measured as in a separate sampling unit. The sample plots are divided in sectors, if there is different property form, land use, forest land category, origin of stand, forest site type, main species; age differences exceed 20 years, stocking level of the main storey differs by 0.3 or more.

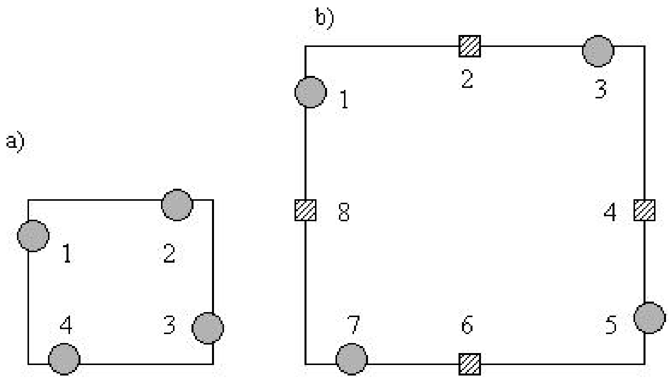
During identifying sectors of SP, azimuths and distances till centre of SP for those points, where sectors making line crossing border of SP, is fixed. (5.picture)



Picture 5 Sample plot dividing in sectors – schematic picture.

1.2.4. Numbering of tracts and sample plots

Sample plots within tracts are numbered from „1” to „8” clockwise. (6. b Picture).



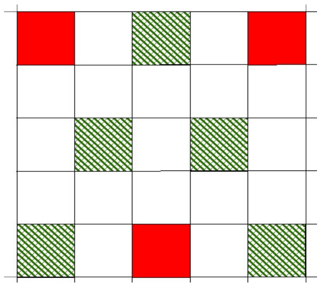
Picture 6 Schema of numbering permanent sample plots (a) and temporary sample plots (b)

1.2.5. Determination of coordinates of tracts and sample plot centres

According to Latvian system of coordinates, ortofoto maps and schema shown in 1.Picture coordinates of permanent SP tract centres are calculated. On the 5*5 km sheet of ortofoto map in the middle of territory of Latvia permanent SPs tracts are placed in centres of three 1*1 km quadrates (7.Picture). Starting from three sample plot tracts in the central ortofoto sheet of Latvia to the north, east, south and west directions coordinates of next centres of tracts are calculated in distance 4 km for all inland territory of Latvia. Coordinates of each next tract centre are calculated using coordinates of neighbour tract centre.

Coordinates of sample plot centres are calculated following coordinates of tract centres taking into account principle that centre of tract is centre of 250*250 m quadrate in whose corners sample plots are placed. Additionally displacement of sample plot centre from corners of quadrate by 25 m is calculated (3.Picture).

Coordinates of centres of temporary sample plot tracts are calculated analogically taking into account distance of 2*2 km between sample plot tracts and placement of sample plots in corners of quadrate 500*500 m and midpoints of margins (3.Picture).



Picture 7. Schema of placement of permanent and temporary sample plots in central 5*5km ortofoto sheet of Latvia.

1.3. Organisation of forest statistical inventory

1.3.1. Periodicity of forest inventory

Forest statistical inventory is performed each year in whole territory of Latvia. During first 5 years number of permanent SPs is gradually growing - each year 1/5 form overall count of SPs is measured.

After each 5 years according to cartographic materials - ortofoto and satellite pictures – changes in forest area distribution by land use categories are fixed. Re-measurements of permanent SPs are done during each next 5 years. Time period between re-measurements of permanent sample plots is 5 years +/- 20 days.

Temporary SPs each year are established in new places and measurements are done once – temporary SPs are not measured repeatedly.

1.3.2. Preparatory work of forest inventory

Preparatory work ensures timely and successful start and progress of field work. Preparatory work is done in period December - April, until beginning of field work.

By using ortofoto maps (not older than 5 years) according to calculated coordinates of tracts and SPs is fixed following information – either SPs of tracts is in forest or not as well as if they touches to separate trees or groups of trees. As a result there is prepared list about those SPs, which has to be measured or inspected – to get precise information if SP is in forest land or touches separate trees. SPs in other land use categories (except forest) are inspected as well.

Following documentation is prepared - printouts of ortofoto maps (S 1:10000), copies of forest land maps (S 1:10000) and maps of land cadastre, printouts of satellite images (S 1:50000).

Preparatory work includes also preparing measuring instruments for field work.

1.3.3. Organisation of field work

Measurements in SPs are done by at least 5 field work field work groups. Field work group consists from group leader and 2 technical workers. Group leader organises work of field group, trips, chooses the routs of visiting tracts, organises detection of tracts and measurements in SPs, takes responsibility about all documentation, training of group workers and compliance with methodology as well as taking care about transport and storage and verification of measuring instruments.

1.3.4. Quality assurance of field work

Field work is controlled with aim to prevent mistakes of measurements and the causes of these mistakes. Not less than 5 % from SPs measured by each field group are checked. Quality control is done by separate control group that consists from 3 specialists.

During field work control is done regarding all those parameters that are re-measured repeatedly in next cycles (azimuth of trees, distance, diameter, and height). Random control is placed also on parameters that are not going to be re-measured (width of growth rings, present deadwood and stumps). Control is performed each year in permanent sample plots.

1.4. Measurements and data registration

1.4.1. Identification of sample plots

For allocation of SP centre GPS receivers are used accordingly to calculated coordinates in navigation regime. In case it is not possible to found centre of SP with GPS receiver (low ability of data receiving in forest environment), coordinates of centre are found in nearest open area as well as distance and azimuth where to go to identify the point. The centre of SP in this case is found by using measuring-tape and compass. SP centre detection is fixed in documents.

After inspection all sample plots and their parts are divided in accessible and inaccessible. Sample plot is considered as inaccessible if it is not possible to reach its centre because of different reasons – centre is in water reservoirs, bogs etc. Situation is fixed in SP description.

Measurements for inaccessible SPs are done outside SP in plots whose centre are placed as close as possible to theoretical centre of SP. In this case a location of centre of plot, used for measurements, is described in SP description and nearest trees is marked.

If SP is accessible, but its centre matches with some natural barrier (stone, asphalt etc.), the centre of SP is marked at closest possible distance from theoretical centre (nearest trees are marked), but measurements are done from theoretical centre. The same methodology is used if centre of SP falls in places where destruction of centre is very possible (cropland or object of forest infrastructure). Changes are fixed in documents and design of marked centre is depictured.

Established permanent SPs in time period until next measurements should be as less visible as possible. The centre of SP is marked invisible with iron pole under surface of soil and nails (with diameter of head of a nail at least 0,7mm) in roots of nearest trees after measurements are done. If it is not possible to mark SP centre using trees or stumps in SP (for example in coppice), then trees outside SP are found but not further than 20 m from centre of SP. If proper trees are located further than 20 m, they are not marked. Identification of SP centre is documented by indicating species, distance to centre of SP and azimuth of marked trees.

During re-measurements of permanent SPs, centres are found with metal detector – seeking for iron pole and marked trees. If iron marks are destroyed, then GPS ore distance measurer is used.

For detection of sample plots in nature the same methodology is used for permanent and temporary sample plots.

1.4.2. Sample trees outside the sample plot

Sample trees for detection of age and increment in permanent sample plots are selected outside the permanent sample plot, but for temporary sample plots these measurements are done within the sample plot. Sample trees outside the sample plots are chosen following principle that these trees according to dimensions should fit to average tree in sample plot and are located in the same forest stand where sample plot is.

Outside of SP the age of growing trees is estimated (+/- 1 year) by boring method in 1.3 m height from roots collar. Diameter in 1.3 m from roots collar and tree species are estimated for sample trees as well. If trees of corresponding species in SP is more than 40%, age is measured for 3 trees, if less than 40% - for 1 tree. Age is fixed also in breakdown by stand stories.

For increment estimation measurements of growth rings of sample trees are done in forest, but data are fixed in inventory card. Increment is estimated for not more than10 borings and growth rings are measured for last 2 five-years.

All data gathered in field work are registered in tables for data accumulation, but initially inventory card of tract is completed.

*1.4.3. Estimation of forest site typ*e

Forest site types are defined by ascertaining mean height of tree species, woody vegetation and the presence of characteristic grassy vegetation as well as the intensity of draining is considered. For each forest sample plot or its sector forest site type is assessed by using Latvian typology of forest by K. Bušs (Bušs K. 1981. Meža tipoloģija un ekoloģija. Riga).

1.4.4. Estimation of understorey and brushwood

Understorey and brushwood is assessed in all forest lands (except lands under objects of forest infrastructure) as well as in lands outside forest land if this area is in sector and starts to cover with forest or brushes.

As understorey are fixed trees of forest element which in height of 1.3 m have not reached 2.1 cm diameter. If forest element with diameter less than 2.1 cm is making dominant stand then trees are not accounted as understorey. Artificially planted trees are not accounted as understorey.

Understorey and brushwood is accessed in strip with 20 m length and 3m width (4. Picture, strip-like plot D). In case of sectors this area may be smaller or to stay away at all – it is fixed in description of sector.

For trees of understorey and brushwood - species, number of individuals, height and diameter in the mid of middle shoot is accessed.

According to quality individuals of understorey and brushwood are sorted in healthy and perspective or damaged and prospect less. Trees are accounted as healthy if they are well grown, but with small damages (animal damages less than 30%, bark is not damaged).

For each tree species of understorey and brushwood average age is assessed – by counting whorls or growth rings for tree felled down outside of sample plot. During assessment of brushwood all shoots are accounted.

1.4.5. Measurements of trees

1.4.5.1. Choosing of sample trees

Sample trees are chosen from living trees (whom measurements of diameter in 1,3 m height are done) in sample plot. If certain forest element is formed only by dead trees, sample trees are measured from them. In general not less than 1 tree from seven should be selected. For selecting of sample trees third, 10th and 17th and so on tree is selected. Sample trees are selected accordingly to species composition in stand – in case of stand with several tree species and stories – more sample trees are selected. If it is not possible to gather appropriate number of sample trees systematically – missing trees are selected from trees with larger dimensions.

Sample trees are selected in temporary as well as in permanent sample plots. For chosen sample trees additional measurements are done - measurements of diameter at root collar, height of tree, height of first green branch, height of first dry branch, evaluation of defoliation.

Trees are not bored in permanent sample plots. Number of growth rings and increment is assessed outside of sample plot. During re-measuring of permanent sample plots the same sample trees are measured. If sample trees are felled down or shriveled up systematically next sample tree is selected.

1.4.5.2. Estimation of tree distance to centre of sample plot

Distance from centre of sample plot to centre of tree in height of 1.3 m is measured with ultrasound device. In permanent sample plots distance is measured for each tree, in temporary sample plots only for border trees to identify is it in the sample plot or outside. For distance measurements in the centre of sample plot is set up rack to which ultrasound device reflector is fastened. Ultrasound source with indicator of measurements is placed in horizontal position against reflector at central axis of tree.

In card of inventory of trees only distance of living trees to centre of sample plot is fixed. Distances for fallen trees and stumps are measured only to detect their belonging to sample plot.

1.4.5.3. Estimation of azimuth

From centre of sample plot with compass, which is fixed on rack, azimuths of trees are measured with precision of 1^o. Azimuth is fixed as indication from instrument without taking into account magnetic declination. Azimuth is measured only for living and standing dead trees, but not for stumps and lying trees. Measuring of trees starts from magnetic north and movement is clockwise. Azimuth is determined against magnetic north.

Distance to tree is measured in height of 1,3 m against axis of tree (1/2 form diameter). If tree is situated in slope, distance is measured parallel surface of land at height of 1.3 m and distance is recalculated taking into account angle of land surface. If, because of inconvenient visibility of tree (measurements are interfered by projection of stem of other tree), measurement of azimuth or diameter is not possible precisely in height of 1.3 m, cause of possible mistake is fixed in trees inventory card.

1.4.5.4. Estimation of parameters of tree stems

In each sample plot measurements of trees and stumps are done.

For each tree following measurements are done and fixed in inventory card - distance of tree to the centre of sample plot (+/- 1 cm), azimuth of tree (+/-1^o), tree species, stand storey, Kraft class, diameter in height of 1,3 m (+/- 1 mm), for sample trees root collar diameter (+/- 1 mm), for sample trees height of tree (+/- 0.5 m), height of first living and first dry branch (+/- 0.5 m), damages (type, intensity, height (placement on tree stem) of damage).

For stumps following measurements are done and fixed in inventory card – diameter (specifying with or without bark) (+/-1 mm), root collar diameter (+/-1 mm), height above root collar (+/-1 cm), species.

For evaluating deadwood following measurements are done and fixed in inventory card – species, length (+/- 0.5 m), diameter at thin end (+/- 1 mm), diameter at butt end (+/- 1 mm), quality group, position (standing or lying deadwood)

1.4.5.5. Estimation of tree storey

In permanent sample plots as well as in temporary sample plots for each tree, whose diameter is measured, belonging to first or second storey of stand is assessed.

In first storey goes trees with a height difference which, when compared to the average height of trees, does not exceed 20 %. The second storey is identified separately if the average height of trees thereof is not less than one quarter of the average height of trees of the first storey of the forest stand.

1.4.5.6. Estimation of Kraft class

According to Kraft biological classes (grouping of trees that characterize tree accordingly to its position in forest stand) for each tree of first storey in permanent and temporary sample plots (whose diameter is measured) Kraft class is assessed. Kraft classes are accessed following such principles –

I. Class – trees with largest height and diameters and well developed crown. Tops of these trees are above average crown coverage of stand.

II. Class – trees that forms main crown coverage of stand. Stems have a bit smaller dimensions as trees in I. class. II. Class trees are bout 20-40% form total number of trees in stand, but growing stock is 40-70% total growing stock of stand.

III. Class – trees with relatively smaller crowns - squashed into crowns of trees of I. and II. Class. Crowns are in the lower layer of main crown coverage.

IV. Class – trees with shorter and narrower crowns to compare with trees in III. Class. Crown tops touches lower layer of main crown coverage of stand. Trees have considerably smaller dimensions than trees in I. – III. Class.

V. Class – trees with mortifying or already dead crowns that are under main crown layer of stand.

1.4.5.7. Estimation of diameters of trees

For all trees in sample plot, that has reached 2.1 cm diameter in height of 1.3 m, diameter measurements are done in 1.3 m height with accuracy of 0.1 cm. For sample trees root collar diameter is also measured. The place of diameter measurements on stems is not marked.

During re-measurements diameter of trees has to be measured in the same place. Following prescriptions are considered:

- Place of tree diameter measurement at 1.3 m height is identified using a 1.3 m long ruler. If trees branching out lower than in 1.3 m height, diameters of two trees are measured. If there is scar or outgrowth in 1.3 m, diameter is measured above and below this point and recalculations of middle value made;
- If tree has not reached 2.1 cm diameter at 1.3 m height, diameter is not measured;
- If tree is situated at the border of sample plot, then diameter is measured at 1.3 m height above root collar;
- If vertical axis of tree is in sample plot, then tree is measured, if outside border of sample plot – diameter is not measured;
- For sample trees root collar diameter is measured in direction, where diameter is least;
- Living trees diameters at the 1.3 m height and at root collar are measured with bark. If trees are without bark, the diameters are measured without bark and respective remarks are made;
- Diameters of stumps are measured only in temporary sample plots, but in permanent sample plots during first time of survey.

1.4.5.8. Estimation of height of trees

Height is measured only for sample trees. Total height of tree, height of first living branch and height of first dry branch (diameter at least 2 cm) is measured. Accuracy of height measurements is 0.5 m.

Height is measured from place from which top of tree is well observable. In case tree is growing slantwise, distance for height measurements is determined from place, which is situated on the surface perpendicularly to top of tree. Height is measured from place against which slope of tree is directed. In general if it is possible to choose appropriate sample tree, height of slantwise tree is not measured.

Height of beginning of crown is measured analogically. Crown beginning is detected taking into account first living branches.

1.4.5.9. Estimation of increment and age

Radial increment with boring method is assessed for those forest elements whose middle diameter exceeds 10 cm.

If middle diameter is less than 10 cm, annual increment is assessed by dividing growing stock of forest element with age. For this reason outside of sample plot in 1.3 m height is felled tree (with average dimensions) whose growth rings are counted.

If middle diameter of forest element exceeds 10 cm, age is determined as follows:

- selects trees for age detection;
- if growing stock of forest element in stand exceeds 40%, 2 trees are bored for age detection. If age difference exceeds 15 years, third tree is bored;
- if growing stock of forest element in stand is less than 40%, 1 by eye chosen middle tree is bored;
- age is detected for all forest elements.

For increment detection additional trees (to those whose age is detected) are bored. Increment is accessed about last 5 and 10 years. Last growth ring is not measured. For increment detection at least 3 trees are bored. Bored trees should represent different groups of diameter. In general increment is accessed for 1-2 thinnest, 1-2 largest and 2-3 middle trees of stand (including trees that are bored for age detection).

Borings for increment detection are always made in thickest place of bark. If it is possible borings for increment detection are not made for eccentric trees. If boring should be made in trees that are damaged by animals, boring is made in opposite side of stem.

During detection of increment in forest, widths of last 5 and 10 years growth rings is fixed (for coniferous, oak and ash with 0,1 mm, for other tree species with 0,5 mm accuracy), as well as bark thickness to growth ring of current year. During age detection additionally thickness of wood part from bark to beginning of rot is accessed.

1.4.5.10. Estimation of damages

Remark about damages is made for each tree in sample plot.

Defoliation and dehromation is accessed only for sample trees and only for coniferous. Defoliation is fixed if it reaches 20%. Loss of needles is evaluated by comparing with normal. Needle losses are estimated for whole crown (from beginning to top). Distance for evaluation of defoliation is chosen close to height of tree. During evaluation of defoliation form of crown, development, embranchment etc. is taken into account.

For damaged tree type of damage, intensity and placement is fixed. Following damages are reported – pest damages, disease damages, wild animal damages, fire damages, windfall (snow-thrown wood) and damages by other abiotic factors, damages with other causes.

Intensity of damage is estimated as follows:

- stem damages – width of damage (%) form perimeter of tree;
- damaged shoots, buds, needles, leaves – damaged percentage from total;
- defoliation – amount of needles (%);
- dehromation - amount of needles and leaves (%).

Placement of damage is registered as part of tree where damage is fixed. Following placements of damages are fixed:

- roots and stumps along 30 cm above root collar;
- lower part of stem from stump height to first living branch;
- whole stem from stump height to top;
- upper part of stem from first living branch to top;
- top;
- branches in living crown;
- branches growing from the stem with diameter more then 2 cm;
- buds and shoots;
- needles and leaves.

If tree has more than one type of damage, damage more closely to root collar is fixed.

1.4.5.11. Measurements of deadwood

During measurements of deadwood species, position (standing or lying) and diameter (in thin end and butt-end) is detected.

If lying deadwood has stem with stump, diameter of butt-end is measured at 1.3 m distance from root collar, but thin end is assumed - 1 cm.

If lying deadwood is tree top, diameter of butt-end is measured at break place, but thin end is assumed - 1 cm.

If lying deadwood is broken part of stem, diameters are measured at both ends.

For standing deadwood diameter is measured at 1.3 m height and at the end of standing deadwood. If near is found lying deadwood, what had been part of standing deadwood, diameter of thin end of standing deadwood is assumed as butt-end of this lying deadwood.

If standing deadwood is shorter than 1.3 m, butt-end of standing deadwood is measured at the root collar.

If it is not possible to measure diameter of thin end directly, it is detected accordingly to height of standing deadwood.

Newly felled timber, hauling roads, felled as well as shorter than 0.5 m broken stumps are not recorded as deadwood.

Lying deadwood is measured if diameter of butt-end exceeds 6.1 cm. Belonging of lying deadwood to sample plot A or B is detected accordingly to butt-end location inside or outside of sample plot. If butt-end is located in sample plot, all length of lying deadwood is measured (also if part of lying deadwood is located outside of sample plot). If butt-end of lying deadwood is situated outside of sample plot, deadwood is not measured.

Lying deadwood is measured by degree of decomposition:

- fresh deadwood – until the beginning of bark peeling;
- old deadwood – from the beginning of bark peeling until the beginning of dissemination of epiphyte mosses (less than 10% from visible part of stem surface);
- rotten wood - dissemination of epiphyte mosses more than 10% from visible part of stem surface.

1.4.5.12. Measurements of stumps

Stumps are measured in permanent and temporary sample plots if they are younger than 5 years. Diameters of stumps are measured only in temporary sample plots and in permanent sample plots if they are measured for first time.

Remark is made if stump is measured with or without bark. Diameter is measured for stump and at root collar of felled tree. Height of stump above root collar is also detected. Information about stump measurements is fixed separately for each sector.

1.4.6. Data registration and storage

Data gathered during sample plot measurements initially are registered in working tables or in field computers.

Data from field computers are transferred to data basis not rare than once in two weeks. After logical control found mistakes are sent back to the measurement groups for correction. Finally checked data comprise primary database. Primary data are stored according to the measurement year and full cycle of five years. A permanent database gives possibility to supplement it with new parameters any time.

Information summarized during preparatory work and cartographic materials are stored in printouts until next measurements, when they as possible are renewed with new data.

1.5. Calculation of secondary parameters of a forest stands

Calculations of secondary parameters of a forest stand are done during cameral work of forest statistical inventory in accordance with standard algorithms for estimation of all stand characteristics in a sample plot.

2. The determination of 1990 land use category in areas at 2006 described as forests

In cartographical material for Latvian NFI, the data of sample plots are prepared in digital shape file format accordingly to Latvian coordinate system LKS-92.

It is possible to make spatial comparison of NFI sample plots with all other digital map layers in appropriate coordinate system. In such way as background materials digital raster data - ortophoto maps – are used now.

To assess the historical land cover information of NFI sample plots, they will be compared to LANDSAT satellite images of Latvia's territory, screened at 1990, preparing them at coordinate system LKS 92.

The assessment of NFI sample plots land use on satellite images is possible visually, or using remote sensing programs, in such way producing the layer of 1990 and 2006 forest in digital shape format.

3. The methods of forest resources assessment in NFI's sample plots at 1990

3.1. The methods of growing stock and annual increment assessment for stands more than 17 years old (at present)

3.1.1 General principles

The growing stock and annual increment are assessed for separate forest element (stands part of one species and storey trees). The total growing stock and annual increment of forest stand is assessed as the sum of all forest element values.

In accordance with Latvian NFI methods for the assessment of growing stock it is necessary to get information about:

- average diameter of forest element;
- number of trees of forest element;
- average height of forest element.

Basal area of forest element is calculated, using values of average diameter and number of trees

Growing stock is calculating, using values of basal area and average height.

Additionally, annual increment can be calculated, using value of average width of growth ring.

3.1.2. The estimation of forest element average diameter at 1990

At this moment we have information about:

a. the average diameter of forest element at 2006
b. The average width of growth rings at the period of 2002-2006 and 1997-2001.
c. the average thickness of bark.

For the estimation of average diameter at 1990 it is necessary to take of from average diameter at 2006:

a. the width of growth rings from 1997 (measured in field works of NFI)
b. the width of growth rings Z_5 from 1991 to 1996 what means one period of five years and one single year
c. the thickness of bark produced during last 16 years.

To estimate width of growth rings produced from 1991 it is possible to use the assumption that the width of growth rings at previous period of five years differs from the width of current period of five years in the same proportion as the current width of rings differs from the next period of five years, or if the width of growth rings at 1997_2001 is less than at 2002_2006, the proportion is estimated and the width of rings at 1992_1996 is calculated:

Example: $Z_5$2002-2006=7mm, $Z_5$1997_2001=6mm, $Z_5$1992-1996=$Z_5$1997_2001/ (Z_5 2002_2006 / V 1997_2001) or 6/(7/6)= 5,143

- if the width of growth rings at 1997_2001 is more than at 2002_2006, the calculation is done inversely;
- if the width of growth rings at 1997_2001 is equal than at 2002_2006, the width of growth rings at $Z_5$1992-1996 is assumed the same.
- Having value of width of 5 growth rings Z_5 at 1992_1996, it is easy to calculate width of one ring and is possible to accept that it is the same also at 1991.
- It is assumed that the annual increment of bark thickness is equal to result acquired by dividing the thickness of bark by the age of tree.

Example of total calculation:

measurements of NFI:

year 2006: age – 50 years; averageD =27 cm; Z_5 2002-2006 = 9mm, $Z_5$1997_2001=12 mm;
bark - 6 mm

parameters to be calculated:

$Z_5$1992-1996= 12*12/9=16mm
One annual ring $Z_1$1992-199616/5=3,2 mm
annual increment of bark 6/50=0,12 mm

calculation:

D_{1990} = D_{2006}-2* $Z_5$2002_2006-2*$Z_5$1997_2001-2*$Z_5$1992_1996-2*Z11991-2* bark incr. =

=2700-2*9-2*12-2*16-2*3,2-16*0,12= 18,77 cm.

3.1.3. The estimation of forest element average height at 1991

Having value of tree diameter, it is possible to use equation for calculation average height depending from the diameter of tree and forest site index. The equation is produced by using tables of tree growing progress accepted in Latvia's forest inventory. Site index for each sample plot is calculated accordingly to methodology of Latvian NFI, depending from the tree height at the definite age and don't change in the result of forest growing.

Table1. Algorithms for tree height calculation depending from site index and diameter at the breast height

Site index	**Species**	**Height**
Ia	pine	
I	pine	
II	pine	
III	pine	
Lower than III	pine	
all	spruce	
all	deciduous	

3.1.4. The estimation of number of trees at 1990 in the sample plot

If the thinnings are not done in forest, the number of trees at 2006 may differ from the number of trees at 1900 as a result of natural mortality. It is identified theoretically that annual natural mortality in Latvia's forest is approximately 4 mill m^3 per year or 0.6 % of the total growing stock of living trees. It is possible to consider, that the number of trees at NFI sample plots at 1990 was more than 9.6% than at 2006.

As the thinnings are done, it is the expert's opinion, that 50% of dead trees are felled at thinnings. In such way the impact of natural mortality to decrease number of trees since 1990 can be assumed as a half of theoretically calculated – 4.8%.

In the field jobs of NFI the stumps are registered and measured if their age don't exceed 5 years. In this case it is possible to calculate the average number of cutted trees during the last period of five years.

By using official data of the forest statistics, it is possible to have data about felled volume in thinings in tree periods of five years: 1992-1996, 1997-2001; 2002-2006 in three groups of forests: pine, spruce and deciduous stands.

Using previous information, it is possible to estimate the proportion of felled volumes.

Accepting as basis of evaluation, that the proportion of felled volumes is similar to proportion of number of felled trees, the number of felled trees in previous two periods of five years and average annual volume will be calculated.

As a result of calculations the number of felled trees per period 1990 – 2006 will be clarified.

Counting the measured living trees and calculated dead and felled trees in sample plot, the number of trees in NFI sample plots at 1900 will be clarified.

3.1.5. The estimation of basal area at 1991 in the sample plot

Using data calculated previously (average diameter $D_{vid.}$, number of trees N), is possible to calculate basal area of forest element:

$$G=PI()*D_{vid}.\verb|^|2/4*N.$$

3.1.6. The estimation of growing stock at 1991 in the sample plot

Using data calculated previously (average diameter $D_{vid.}$, average height of forest element H_{vid}., basal area of forest element G), it is possible to calculate growing stock of forest element at 1990 in accordance with NFI methods.

The sum of forest element's growing stock forms the total growing stock of forest land at 1990.

3.1.7. The estimation of annual increment at 1991 in the sample plot

Using data calculated previously (average diameter $D_{vid.}$, average height of forest element H_{vid}., basal area of forest element G, average growth ring Z_{1990}, is possible to calculate annual increment of forest element at 1990 in accordance with NFI methods.

The sum of forest element's annual increment forms the total annual increment of forest land at 1990

3.2. The methods of growing stock and annual increment assessment for stands less than 17 years old (at 2006)

There were not strictly defined regulations for forest regeneration depending from the previous stand structure use in practical forestry after 1990. Therefore general assumptions must be used to identify stand structure at 1990 for the areas with less than 17 year old forests at 2006.

In Latvia national forest typology (ecosystem classification) is used to characterise forest ecosystems. Typology identifies 23 forest ecosystem types. The main variables used in forest type identification (vegetation, growing conditions, process of forest regeneration and growing) are not changing in process of new stand establishing after forest cutting, and are the same for the new forest.

In the field jobs every NFI sample plot is characterised by forest type, and it is possible to produce the list of forest types for all areas felled since 1990 and regenerated till 2006.

It is possible to assume that the division of felled areas (since 1990) by forest types is similar that division of matured stands at 1990. For this reason it is possible to characterise felled areas using the average values of growing stock and increment from the group of all matured stands at 1990 calculated by us previously.

The identical approach will be used to characterise cutovers described at 2006.

3.2.1. The software of calculations

After the methods of calculation will be approved by customers, the additional software module of Latvian NFI will be produced, preparing reports about forest growing stock and annual increment separately by main species and age groups of ten years, applying to forest situation at 1990.

ANNEX 7 QUALITY IMPOVEMENT PLAN

Quality Improvement Plan
GHG inventory 2008

Latvian Environment, Geology and Meteorology Agency

Introduction

For submission 2008, GHG inventory quality improvement plan was prepared according to Quality Control and Quality Assurance program made by LEGMA and "Report of the review of the initial report of Latvia" made by UNFCCC (FCCC/IRR/2007/LVA 14 December 2007).

Improvement plan covers general issues that were possible to resolve by LEGMA.

1 Aims of quality control and quality assurance for GHG inventory

The aim is to prepare a good quality feasible GHG inventory where quality assurance and quality control activities taking into account emission uncertainties are implemented.

Salient aims are according to inventory principles about data and information transparency, completeness, consistency, comparability and accuracy.

Planned aims for GHG inventory 2008:

- Enforce recommendations made by UNFCCC reviewers (ERT) during in – country visit (May 2007) as well as in the report of the review of the initial report of Latvia;
- Include foreseeable information about emission calculation and summary about changes related with lucidity since last inventory in the national inventory report;
- Submit emissions in all IPCC categories and possible gases;
- Checking the time series and succession;
- Include information about recalculations in the National inventory report;
- For emission calculation and submitting use methodologies and format according to IPCC, UNFCCC and Kyoto Protocol;
- Prepare uncertainty assessment from LULUCF;
- Perform internal GHG inventory quality control according to 2nd point from QC/QA program prepared by LEGMA;
- Prepare and submit GHG inventory to the EC and UNFCCC in due time.

2 Essential improvements by sectors

2.1 Energy

	ERT identified problems	Comments
Page 14, point 41	ERT recommends Latvia to improve its documentation of country-specific methodologies, specifically for the transportation categories, and to provide better documentation in the NIR of the AD used in the calculations (e.g. transportation).	Included in NIR 2008 as Annex.
Page 15, point 45	Latvia reports the carbon stored in bitumen and lubricants in CRF table 1.A(d). Details on the AD and storage factors are not provided in the NIR. No other feedstocks and no possible non-energy uses of fuels are reported. The ERT recommends that Latvia report details on the calculations for these non-energy uses of fuels in a more transparent way in the NIR in the next inventory submission.	Detailed information is included in NIR 2008.
Page 15, point 46	For the base year, because only limited data are provided by Latvia's CSB surveys (included in the 2006 national energy balance), most stationary combustion emissions are reported under energy industries (1.A.1). During the in-	Detailed information is included in NIR 2008.

	ERT identified problems	Comments
	country review, Latvia presented new data for the years 1990.1993 from the CSB (included in the 2007 national energy balance), which provide more disaggregated consumption data within the stationary combustion sectors. In particular, the energy formerly consumed by public heat plants. (and to a lesser extent, public [combined heat and power] CHP) has been disaggregated into autoproducer CHP and autoproducer heat plants. (i.e. it has been reallocated from energy industries to manufacturing industries and construction and other sectors). This revision of the consumption data applies mostly to residual fuel oil and natural gas.	
Page 15, point 47	Following the review the ERT recommended that Latvia pursue revisions of the emission estimates for stationary combustion for 1990 and incorporate the new, more disaggregated CSB data, which conforms better to the IPCC good practice guidance and the UNFCCC reporting guidelines and which have been included in the 2007 inventory submission, using the 2007 national energy balance. The ERT requested that Latvia provide revised emission estimates for the categories energy industries (1.A.1); manufacturing and construction industries (1.A.2); and other sectors (1.A.4).	All necessary recalculations of historical years are done by using detailed data from Central Statistical Bureau. All additional information and explanations of performed recalculations are reported in NIR 2008
Page 16, point 49	In submission 2006, Latvia estimates CO2 emissions from motor gasoline combustion in road transportation using the COPERT III model, which uses EMEP/CORINAIR default EFs for European countries (which are not reported in the NIR). However, according to the NIR, a country-specific motor gasoline CO_2 EF was applied to the off-road combustion of gasoline. Using different EFs for the same fuel is not in line with the IPCC good practice guidance. Moreover, the ERT informed Latvia that the use of the higher EMEP/CORINAIR default CO_2 emission factor, rather than the lower country-specific CO_2 EF, appears to the ERT to result in an overestimation of the base year emissions.	Latvia revised estimates of CO_2 emissions from road transportation (1.A.3(b)) gasoline usage using the country -specific CO2 EF for gasoline.

2.2 Industrial processes and solvent and other product use

	ERT identified problems	Comments
Page 17, point 57	The ERT noted that Latvia mainly uses EFs mandated under the EU ETS. The ERT encourages Latvia to develop and implement an improvement plan, including the development of plant-specific EFs, to be used for the estimation of GHG emissions from the industrial processes and solvent and other product use sectors in its next inventory submission.	According to ERT recommendations plant specific CO_2 EF are developed for Cement and Lime producers. Also plant specific CO_2 estimation methodology is developed for Iron & Steel plant. For CO_2 emission estimation from limestone, dolomite and soda ash use plant specific CO_2 EF are used. Detailed information is reported in NIR 2008 in particular chapters.
Page 17, point 60	The ERT recommends that in its next inventory submission Latvia describes the non-energy-related industrial processes associated with production activities in accordance with the IPCC good practice guidance. This information would facilitate the identification of the sources of such emissions and the selection of appropriate methodologies in accordance with the IPCC good practice guidance. In addition, Latvia should provide explanations of the recalculations in CRF table 8(b) so as to improve consistency as between the NIR and the CRF tables.	CO_2 emission recalculations for Cement, Lime and Steel producers are made in accordance with IPCC GPG 2000 and according to ERT recommendations. Detailed information of recalculations made is reported in NIR 2008 in particular chapters.
Page 18, point 61	The NIR indicates that Latvia used the IPCC Tier2 method to estimate CO_2 emissions from cement production (2.A.1). During the in-country review, the ERT identified that the method was equivalent to the IPCC tier 1 methodology and concluded that the use of the tier 1 method is not in line with the IPCC good practice guidance, as this category was a key category in 1990. In addition, the ERT identified that the EF from the EU ETS used by Latvia to estimate CO_2 emissions from cement production appears high. The EF it uses 0.525 (Gg CO_2/Gg cement) is equivalent to that provided by the IPCC good practice guidance tier 2 default method, with 3 per cent cement kiln dust (CKD). Information provided to the ERT during the in-country review clearly indicates that Latvia has also reported additional CKD emissions in the base year. The ERT noted that the reporting of emissions from CKD in addition to the use of the EF from the EU ETS appears to overestimate CO_2 emissions from	Emissions were revised using the IPCC tier 2 method, based on plant-specific conditions and according to ERT recommendations. Detailed recalculations are described in NIR 2008.

	ERT identified problems	Comments
	cement production in the base year.	
Page 18, point 62	The ERT recommended that Latvia revises its estimates of CO_2 emissions from cement production (2.A.1) using the IPCC tier 2 method with a correct emission factor that is based on plant-specific data, thus avoiding the separate calculation of additional emissions from CKD in the base year.	
Page 18, point 63	To ensure comparability, as required by the IPCC Good practice guidance, and also to reflect the national circumstances of Latvia, the ERT recommended that where the plant-specific CKD ratio exceeds 8 per cent Latvia use the maximum permissible IPCC good practice guidance limit of CKD (6 to 8 per cent).	
Page 18, point 64	Latvia reports limestone and dolomite use under the category other, mineral products (2.A.7), which is not in line with the IPCC good practice guidance. The ERT acknowledges the improvements made by Latvia, in response to the recommendations of the previous (2005) review, in the reporting of CO_2 emissions from the category limestone and dolomite use, as Latvia has disaggregated limestone and dolomite use in different mineral products (e.g. limestone, dolomite, potash, and fluorspat) and in metal production by end-use for the entire time series. However, the ERT reiterates the recommendation of the 2005 review that Latvia should report the aggregate of CO_2 emissions from all limestone and dolomite under limestone and dolomite use (2.A.3). It also recommends that Latvia recalculate the emissions from limestone and dolomite use (2.A.3) for the entire time series.	Emissions from limestone and dolomite use in glass and metal production are reported under limestone and dolomite use sector since submission 2007 (2.A.3).
Page 19, point 67	The ERT recommends that for next inventory submission Latvia collects and uses plant-specific parameters on the reduction of the carbon content in crude iron steel and crude steel for the calculation of the entire time series in accordance with the IPCC good practice guidance. The ERT also recommends that for its next inventory submission Latvia recalculate the emissions from iron and steel production (2.C.1) for the entire time series based on the available AD from the EU ETS.	Plant specific CO_2 estimation methodology is developed for Iron & Steel plant. Detailed information of recalculations made is reported in NIR 2008.

2.3 Agriculture

	ERT identified problems	Comments
Page 20, point 75	Latvia has to improve the transparency and accuracy of its inventory by including the distribution of manure management in determining the country-specific factors. During the in-country review, Latvia provided the ERT with additional materials on the assumptions used and the values of the calculation parameters used to derive country-specific nitrogen excretion rate (Nex) values. The ERT recommended Latvia to include this additional information in the NIR of its next inventory submission.	Information is added to NIR 2008 as Annex.
Page 20, point 78	CH_4 emissions from manure management have been estimated based on the IPCC tier 1 methodology and IPCC default EF values for Eastern Europe in cool regions. This is not in line with the IPCC good practice guidance since this is key category. Also, information on annual average temperature is not provided in the NIR to support the use of the default EFs.	Information about temperature is provided in NIR 2008.
Page 20, point 79	For the period 1990-2004, Latvia has applied constant country-specific Nex values for all animal types except swine. Different Nex values for swine were applied for different parts of the time series: 10 kg/head/year was applied for the years 1990 - 2003 and 7.3 kg/head/year was applied for 2004. No information is provided in the NIR to explain the change in the Nex values for swine. During the review, Latvia explained that the values reflect the results of different studies and publications on Nex values for swine. However, no further explanation was given for the use of different values for different years. With no additional explanation for the reduction for the Nex values, such as feed change or other changes in animal husbandry, the ERT was not able to determine whether the lower value applied in 2004 is appropriate.	For submission 2008, for all years constant Nex value 10 kg/head/year was applied.
Page 21, point 81	Latvia states in the NIR that the area of cultivated histosols has been reassessed based on materials from the Ministry of Agriculture, the CSB, and foreign and Latvian publications. The area of cultivated histosols calculated by national experts was 7.0 per cent of the cultivated area in Latvia. However, the ERT noted that the information the NIR provides on the method used to arrive at this value is not sufficient. During the in-country	Emissions were revised based on consistent data source – sown area. Data source: Central statistical bureau. Information is included in NIR 2008 too.

	ERT identified problems	Comments
	review Latvia provided further information on the background to this calculation. However, the ERT considered that this value had resulted in an overestimation for 1990. During the in-country review the ERT recommended that Latvia provide revised estimates of these emissions based on values from a time-consistent data source, for example, the data on sown area of agricultural crops; 1990-2005 from the CSB (if appropriate), and document all the parameters used in the revised calculations.	
Page 21, point 82	The ERT recommends that in next inventory submission, Latvia improves transparency, of documents as well as the assumptions and methods used and the values of the parameters used to calculate area of cultivated histosols. Also, Latvia should take into account any changes in N excretion from animals (manure management (4.B.2) in calculating direct N2O emissions from agricultural soils.	
Page 21, point 83	IPCC default EFs have been applied to estimate the indirect N_2O emissions from nitrogen used in agriculture, and there are large inter-annual fluctuations. Latvia explained that the emission profile for this category reflected inter-annual fluctuations in the AD, which are taken from national statistics. The ERT recommends that Latvia explains the trend in the AD in its next inventory submission. The ERT also recommends Latvia to take into account any changes in N excretion from animals (manure management (4.B.2)) in calculating indirect N2O emissions from agricultural soils.	Inter-annual fluctuations in the AD are occurred due to economical situation in Latvia. It is described in NIR 2008.
Page 21, point 84	Field burning of agricultural residues is reported as NE. During the in-country visit Latvia explained that it considers these emissions as negligible. The fraction of crop residues burned (FracBURN) reported under direct soil emissions are reported as 0.1 kg N/kg crop-N. The ERT recommends Latvia to maintain consistency in its reporting across the CRF tables with respect to field burning of agricultural residues and to ensure that the correct values and notation keys are used in the CRF tables of its next inventory submission.	The information was received from Ministry of Agriculture that field burning of agricultural residues isn’t occurred in Latvia. Therefore under category Field burning of agricultural residues is used indicator NO. The fraction of crop residues burned (FracBURN) was excluded from formula estimated N input from crop residues.

2.4 Land use, land-use change and forestry

	ERT identified problems	Comments
Page 22, point 89	The ERT identified that uncertainty estimates have not been provided for the LULUCF sector and recommends Latvia to include this sector in the uncertainty analysis in its next inventory submission.	Uncertainty range for activity data and calculations were assessed. This information is included in NIR.
Page 22, point 91	The NIR does not provide sufficient documentation on the representation of land areas in the 2006 submission. During the in-country review, the ERT identified that Latvia has used the IPCC approach 1 (i.e. basic land-use data presented in the IPCC good practice guidance for LULUCF) to represent land areas. Also, during the in-country review Latvia presented a new method by the Latvian State Forestry Research Institute, Silava, for the NFI. The ERT recommends Latvia to provide in its next inventory submission more documentation on the identification of land areas and to develop the land-use change matrix using this new method. In response to the ERT recommendations, Latvia advised the ERT that it will implement and document the new method of National Forest Inventory in its 2008 inventory submission.	The information about new methodology for identification of land areas is added in the NIR 2008 as Annex.
Page 23, point 97 *Page 23, point 98*	Estimating CO_2 emissions from cropland remaining cropland (5.B.1) Latvia used the IPCC tier 1 method to calculate the carbon stock change in living biomass (which resulted in CO_2 removals from orchards) and in soils. CO_2 emissions from organic soils and agricultural lime application are together responsible for all the emissions from the category. Between 1994 and 1995, these CO_2 emissions decreased from 212.65 to 23.18 Gg CO2. Latvia explained during the in-country review that this change was caused by a change in the source of AD for cropland. From the State Land Services (used for the years 1990-1994) to the CSB (used for the years 1995-2004). The ERT recommends Latvia to use the same source of data and the same method to estimate the area of cropland for the whole time series in its next inventory submission. Following the in-country review Latvia provided to the ERT revised estimates of N_2O emissions from agricultural soils by area sown (based on CSB data). The ERT recommends that in next inventory submission Latvia ensures that the	The emissions from organic soils were reassessed using for all time series consistent AD source – Central Statistical Bureau. This information is described in NIR 2008.

	ERT identified problems	Comments
	LULUCF information in table 5.B should be consistent with the data source used to estimate N_2O emissions from agricultural soils.	
Page 24, point 100	The ERT recommends that Latvia explains in next inventory submission why cultivated organic soils resulting in CO_2 emissions are reported in this category and not under cropland (5.B).	Explanation is included in NIR 2008. Under category 5B is reported CO_2 emissions from sown area, but under 5C CO_2 emissions from cultivated meadows and pastures.

2.5 Waste

	ERT identified problems	Comments
Page 24, point 105	Recalculations for the whole time series (1990 - 2003) are reported in the 2006 submission. They are due to changes in methodology, the preparation and collection of new data, and changes in the allocation of amounts of landfilled waste between different types of landfill - managed, unmanaged and uncategorized. The ERT recommends Latvia to provide information on recalculations in its next inventory submission.	Information about landfilled waste amounts between different types of landfill is included in NIR 2008. Better explanation not available – it is inventory expert assumption.
Page 25, point 106	Latvia does not report category-specific QA/QC procedures, as recommended by the IPCC good practice guidance, for the waste sector. During the in-country review it presented QA/QC procedures that are planned to be implemented. The ERT commends Latvia for taking such steps and recommends it to commence the development of these QA/QC procedures in the preparation of its next inventory submission.	For inventory 2008, QA/QC procedures according to IPCC Tier 1 were implemented.
Page 25, point 109	The ERT recommends that for future submissions Latvia use surveys and thoroughly documented expert judgments to collect country-specific data on the amount of wastewater treated in anaerobic conditions in the different existing systems (e.g. latrine, septic tanks, lagoons) in order to be able to move to a tier 2 methodology for estimating CH4 emissions from wastewater handling (6.B.1). Latvia should also apply the appropriate parameters (e.g. methane conversion factor (MCF); methane producing capacity (Bo); and biochemical oxygen demand (BOD)) based on research. In addition, the ERT recommends that the method used by Latvia to estimate emissions from industrial wastewater be reported in both the NIR and the CRF tables in the next inventory submission, in order to improve consistency.	The used method to estimate emissions from industrial wastewater is reported in both the NIR and the CRF tables in submission 2008.

3 Conclusions

The implemented aims for 2008 GHG inventory:

Aim	Activity
Enforce recommendations made by UNFCCC reviewers (ERT) during in – country visit (May 2007) as well as in the report of the review of the initial report of Latvia	Partly fulfilled. All recommendations that were implemented per sector are described in second chapter above, but that weren't shown in the Table below.
Include foreseeable information about emission calculation and summary about changes related with lucidity since last inventory in the national inventory report	Information about emission calculation and changes is included in the NIR under each category.
Submit emissions in all IPCC categories and possible gases;	Emissions and information about available IPCC categories and gases are prepared.
Checking the time series and succession	Time series were checked during internal quality control.
Include information about recalculations in the national inventory report	Information about recalculations is included in NIR 2008 under each sub sector.
Prepare an uncertainty assessment from LULUCF	Partly fulfilled. In the NIR information regarding uncertainty for activity data and calculation is included. As uncertainty range are defined only for all sector and hadn't divided by sub-sectors.
For emission calculation and submitting use methodologies and format according to IPCC, UNFCCC and Kyoto Protocol	For emission calculation methodologies according to IPCC are used. For emission reporting format and guidelines approved by UNFCCC COP/MOP is used.
Perform internal GHG inventory quality control according to 2nd point from QC/QA program prepared by LEGMA	During January - March internal quality control procedures were performed by members of GHG inventory preparation team taking into account issues prepared by EC in the "Consistency_report_LV" too.
In due time prepare and submit GHG inventory to the EC and UNFCCC.	GHG inventories for EC and UNFCCC were prepared in time.

There are shown aims that were planned to implement in GHG inventory2008, but for a various reasons aren't performed.

	ERT identified problems	Comments
Enforce recommendations made by UNFCCC reviewers (ERT) during in – country visit (May 2007) as well as in the report of the review of the initial report of Latvia:		
Page 14, point 44	Data on bunker fuels are based on surveys collected by the CSB for the energy balance. According to the explanation provided to the ERT during the in-country review, all jet fuel surveyed is considered as bunker fuel, as there are no internal commercial flights using jet fuel from the Riga airport. Latvia commissioned a study of domestic aviation in Latvia, detailing flight information broken down by the International Civil Aviation Organization (ICAO) engine type and hours flown. For marine bunkers all fuels delivered to the ports are also considered to be for international bunker fuel uses. To differentiate bunker fuel use from domestic use, a study of domestic navigation was also carried out on seasonal watercraft use in Latvia. Both studies are only available in Latvian, making it difficult for the ERT to fully review them. It also remains unclear how the current use of the CSB surveys on the ports differentiates the potential uses for domestic navigation along the Daugava River from international bunker uses. The ERT recommends that the results of the surveys be further explained and investigated by the CSB, to verify that the assumption that all fuel deliveries to the ports are indeed only for international bunker fuel uses is correct. In response to the ERT.s recommendations, Latvia advised the ERT that this will be clarified in the 2008 inventory submission.	The problem is clear, but wasn't solved on GHG inventory 2008 because more time is necessary for detailed study.
Page 19, point 68	Latvia reports actual emissions of HFCs and SF_6 for the years 1995 - 2004. Potential emissions are reported only for HFCs in 2004. The ERT recommends Latvia to report both actual and potential emissions for the whole time series 1990 - 2004.	It isn't possible to comply this recommendation due to impossibility to collect necessary data for calculation of actual and potential f-gases emissions.
Page 22, point 87	The methodology used to estimate the LULUCF categories is the IPCC tier 1 method. The ERT recommends Latvia to progress to a higher-tier method, in line with recommendations of the IPCC good practice guidance for key categories in its next inventory submission. In response to the ERT's recommendations, Latvia advised the ERT that it will implement and document a higher-tier method in the 2008 inventory submission.	Latvia works on arrangement of legislation. At the moment discrepancy on the years appeared because new data submitted by Ministry of Agriculture to LEGMA will be in the end of 2008, then in 2009 the data will be submitted to UNFCCC using new methodology.