LATVIA'S
NATIONAL INVENTORY REPORT

Under UNFCCC and the Kyoto Protocol

Submission to the European Union

Common Reporting Formats (CRF)
1990 – 2008

2010

PREFACE

Latvia's National Inventory Report under the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol contains 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 years 1990-2008 including KP-LULUCF data tables. The CRF tables are compiled with the UNFCCC CRF Reporter software (version 3.2.3.2).
3. SEF (Standard Electronic Tables) for reporting of Kyoto units (AAU, ERU, CER, t-CER. l-CER, RMU) in the registry as for 31.12.2009 and transfers of the units during the year 2009.

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UNITS AND ABBREVIATIONS

t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g
Mg	1 megagram = 10^6 g = 1 tonne (t)
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
Tg	1 teragram = 10^{12} g = 1 megatonne (Mt)
TJ	1 terajoule = 1000 Gigajoule = 10^{12} J

AWMS - Animal waste management systems

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

EMEP/CORINAIR – EMEP/EEA air pollutant emission inventory guidebook 2009

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

SAM – State Agency of Medicines of Latvia

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 on GHG inventories, climate change and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

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. On May 30, 2002 the Parliament 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.

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.

Single national entity with overall responsibility for the Latvia's GHG inventory is the Latvian Ministry of the Environment. The preparation of GHG inventory is collaborative work of different involved institutions.

This report contains of updated information on anthropogenic emissions by sources and removals by sinks for the direct CO_2, CH_4, N_2O, HFCs and SF_6 and indirect CO, NO_x, SO_2, NMVOC greenhouse gases. Greenhouse gas inventory covers the years 1990-2008.

The GHG inventory is prepared according to the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006). For the preparation of the 2010 submission CRF Reporter v.3.2.3.2 software has been used. Greenhouse gas inventory is compiled according to the methodologies recommended by the IPCC.

ES.2 Summary of National Emission and Removal Related Trends

ES.2.1 GHG inventory

Latvia's total GHG emissions without LULUCF in 2008 showed a decrease of 55.57% comparing to the base year.

In 2008, Latvia's total GHG emissions including LULUCF demonstrated a decrease of 310.86% from the base year.

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

Table 1 Aggregated GHG emissions by gases and sectors (1990, 1995, 2000 - 2008), Gg CO_2 eq

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	CO2 equivalent (Gg)															(%)
CO2 emissions including net CO2 from LULUCF	356.88	-12 349.25	-13 260.65	-12 360.92	-12 365.44	-12 987.67	-14 599.31	-15 691.23	-15 521.28	-15 775.56	-17 628.26	-17 600.26	-21 443.43	-20 275.19	-20 752.36	-5 914.91
CO2 emissions excluding net CO2 from LULUCF	19 264.18	9 116.42	9 183.66	8 680.42	8 293.77	7 709.94	7 084.98	7 508.59	7 513.92	7 661.93	7 676.29	7 866.72	8 316.99	8 718.62	8 301.02	-56.91
CH4 emissions including CH4 from LULUCF	3 751.66	2 173.90	2 133.45	2 116.57	2 054.09	1 951.77	1 984.18	2 041.37	2 046.59	1 970.78	1 975.96	2 021.42	1 920.36	1 958.61	2 002.47	-46.62
CH4 emissions excluding CH4 from LULUCF	3 732.38	2 137.89	2 097.35	2 070.34	2 002.61	1 894.24	1 925.80	2 008.56	2 007.43	1 933.29	1 941.95	1 986.62	1 883.27	1 927.37	1 974.41	-47.10
N2O emissions including N2O from LULUCF	3 942.55	1 491.02	1 496.72	1 503.31	1 442.62	1 340.42	1 359.43	1 477.04	1 453.22	1 531.76	1 522.90	1 618.40	1 665.20	1 715.00	1 682.94	-57.31
N2O emissions excluding N2O from LULUCF	3 789.87	1 336.43	1 341.69	1 347.31	1 285.87	1 182.71	1 201.67	1 322.03	1 296.88	1 375.82	1 367.59	1 462.91	1 508.00	1 559.70	1 536.01	-59.47
HFCs	IE,NA,NE,NO	0.65	0.88	1.24	2.38	3.14	4.83	7.60	10.08	12.97	18.19	27.09	48.62	67.26	80.10	100.00
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
SF6	NA,NE,NO	0.25	0.29	0.51	0.71	0.98	1.28	1.98	3.38	4.41	5.37	7.53	7.12	8.60	10.08	100.00
Total (including LULUCF)	**8 051.09**	**-8 683.44**	**-9 629.31**	**-8 739.30**	**-8 865.63**	**-9 691.35**	**-11 249.59**	**-12 163.24**	**-12 008.01**	**-12 255.64**	**-14 105.84**	**-13 925.82**	**-17 802.12**	**-16 525.74**	**-16 976.78**	**-310.86**
Total (excluding LULUCF)	**26 786.43**	**12 591.64**	**12 623.87**	**12 099.81**	**11 585.35**	**10 791.01**	**10 218.55**	**10 848.75**	**10 831.70**	**10 988.42**	**11 009.39**	**11 350.87**	**11 764.00**	**12 281.54**	**11 901.61**	**-55.57**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	CO2 equivalent (Gg)															(%)
1. Energy	19 338.07	9 555.78	9 624.00	9 084.52	8 660.84	8 022.51	7 412.05	7 846.39	7 842.83	7 961.77	7 978.74	8 165.43	8 558.98	8 921.35	8 502.68	-56.03
2. Industrial Processes	576.78	150.32	150.18	157.34	163.46	195.35	151.88	171.41	188.52	205.34	218.14	245.44	271.42	335.40	343.91	-40.37
3. Solvent and Other Product Use	55.70	46.17	48.27	48.90	48.30	49.46	49.11	55.16	53.41	54.07	55.32	54.20	64.08	55.06	53.40	-4.12
4. Agriculture	5 972.53	2 117.82	2 068.14	2 055.53	1 932.13	1 727.19	1 744.06	1 888.92	1 862.24	1 912.72	1 890.51	2 011.30	2 040.98	2 131.55	2 084.74	-65.09
5. Land Use, Land-Use Change and Forestry	-18 735.34	-21 275.08	-22 253.18	-20 839.11	-20 450.98	-20 482.36	-21 468.14	-23 011.99	-22 839.71	-23 244.06	-25 115.23	-25 276.69	-29 566.12	-28 807.28	-28 878.38	54.14
6. Waste	843.35	721.56	733.27	753.50	780.62	796.49	861.45	886.86	884.70	854.52	866.69	874.50	828.55	838.18	916.88	8.72
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total (including LULUCF)	**8 051.09**	**-8 683.44**	**-9 629.31**	**-8 739.30**	**-8 865.63**	**-9 691.35**	**-11 249.59**	**-12 163.24**	**-12 008.01**	**-12 255.64**	**-14 105.84**	**-13 925.82**	**-17 802.12**	**-16 525.74**	**-16 976.78**	**-310.86**

ES.2.2 KP-LULUCF activities

Latvia's emission limitation target for the Kyoto Protocol's first commitment period (2008-2012) is to limit its greenhouse gas emissions to the 8% from the emissions in the base year. Latvia's base year is 1990, except for F-gas emissions for which the year 1995 was selected. The assigned amount for the first commitment period is 119182130 tonnes CO_2 equivalents, which is approximately 23836426 tonnes CO_2 eq. annually on average.

For the LULUCF activities under Article 3 paragraphs 3 and 4, of Kyoto Protocol Latvia has chosen period accounting. Therefore the accounting quantity will be reported in the annual report commitment submitted for the last year of the commitment period (in 2014) and calculated over the entire commitment period. Article 3.3 covers direct, human induced aforestation (A), reforestation (R) and deforestation activities, and accounting of these activities is mandatory. Under Article 3.4 Latvia has elected the activity Forest Management (FM) for the first commitment period. Latvia's cap value for the commitment period is 6233.33 Gg CO_2 equivalents.

Net emissions from ARD activities in 2008 were 62.92 Gg CO_2 eq, and net removals from FM activities were 29150.04 Gg CO_2 eq.

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 (CRF 1), Industrial processes (CRF 2), Solvent and other product use (CRF 3), Agriculture (CRF 4), Land use, Land use change and Forestry (LULUCF – CRF 5) and Waste (CRF 6). GHG emissions by sectors are shown in the Figure 1. In comparison to 2007, total emissions decreased by 3.1% in 2008.

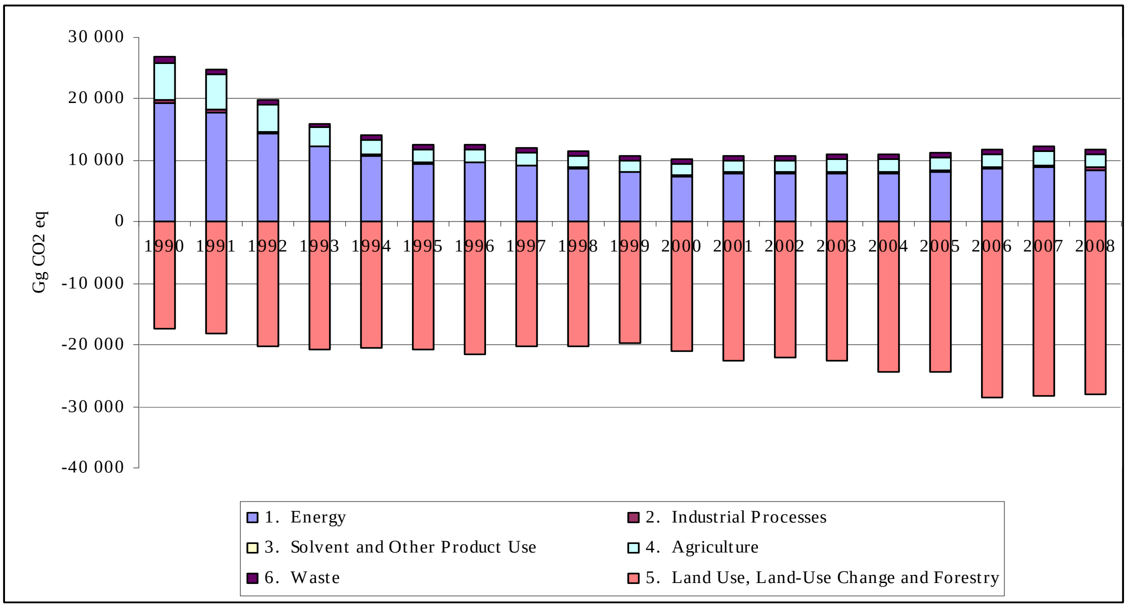


Figure 1 Latvian greenhouse gas emission trends by sector, Gg CO_2 eq.

The **Energy sector** is the most significant source of GHG emissions with 71.44% share of the total emissions in the 2008. CO_2 emissions from the Energy sector in the latest years are stable with a peak point in 2007 that is explained with sharp increase of national economy. GHG emissions in 2000-2007 have increased by 20.35% in the Energy sector. In the second half of 2008 recession in national economy already started caused by the crisis. That's why all GHG emissions decreased in 2007-2008 by 4.68%. The decrease of CH_4 emissions since 2004 is mainly influenced by the decrease of emissions in transport sector.

Agriculture is the second most significant source of GHG emissions, with approximately 17.5 % of Latvia's total emissions. GHG emissions decreased in 2008 by 2.2% compare with 2007. The annual emissions have reduced approximately by 65% since 1990 due to decreases in the number of livestock and in nitrogen fertilisation and etc.

GHG emissions from **Waste sector** have been increased since 1990. In 2008, emissions were approximately 8.72% higher than in 1990. In 2008, emissions from the Waste sector were 916.88 Gg CO_2 equivalents; it contributes about 7.7 % of total GHG emissions (excluding LULUCF).

The **Industrial Processes** category contributes approximately 2.89% of the total GHG emissions. The largest decrease in emissions occurred between years 1991 and 1993, when industry was going through a crisis. Since 2000, and after the crisis in national economy of Russian Federation in 1999-2000 with whom Latvia has strength economic relations, GHG emissions from Industrial Processes sector have increased by 55.85% in 2000-2008.
It is explained with sharp development of Latvian industry when amount of construction activities increased and industrial production of building materials also increased.

Solvent and Other Product Use made only about 0.45% of Latvia's total GHG emissions. Emissions in the Solvent and Other Product Use sector are linked with the economic situation of the country. The annual emissions have reduced approximately by 4.12% since 1990.

Land use, Land use change and forestry (LULUCF) is a net sink in Latvia. In 2008, CO_2 removals were 28878.38 Gg CO_2 compared to 18735.34 Gg CO_2 in the base year that is approximately 65.09 % higher than in 1990. In 2008, the main sink is Forestland with net removals of 29386.55 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

	NO_x	CO	NMVOC	SO_2
1990	72.75	508.85	101.78	102.12
1991	66.36	440.10	71.87	83.47
1992	56.01	427.11	66.88	71.98
1993	49.56	416.94	65.06	67.73
1994	46.10	399.36	63.45	67.02
1995	43.54	385.66	61.72	48.71
1996	43.27	392.10	62.90	54.72
1997	42.88	361.69	61.57	42.45
1998	41.72	335.60	59.35	38.16
1999	39.88	321.85	58.61	28.95
2000	39.72	311.09	56.42	15.08
2001	42.77	317.89	57.43	11.44
2002	41.96	306.49	57.50	9.89
2003	42.29	308.28	58.99	7.50
2004	41.58	306.25	58.67	5.35
2005	41.12	303.61	58.82	4.60
2006	41.15	300.63	58.49	3.71
2007	40.92	284.95	56.71	3.64
2008	37.90	270.86	53.97	2.81

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.

PART 1: ANNUAL INVENTORY SUBMISSION

CHAPTER 1: INTRODUCTION

1.1 Background Information on greenhouse gas inventories, Climate Change and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1.1.1 Background information on climate change

Latvia is a country by the Baltic Sea with total area of 64 559 km^2 and there are 2 281305 (2007) inhabitants. Baltic coastline is approximately 498 km. 45.5% of Latvia's territory is covered by forest, 37.9% of territory is used for agriculture, but 16.6% includes other land, roads, courtyards, bogs, and bushes (data on 01.01.2008). 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.

The analysis of long-term climatological data series in Latvia has shown that the climate has changed during last centuries. Air temperature has increased for the whole period of observations (from the 1795), however it has been more expressed during winter and spring and for the last decades. Increasing trends are evident in precipitation series for the cold period, while the decreasing trends were fond for summer and autumn seasons. Ice and snow cover period in Latvia become shorter during last decades. River discharge regime has been subjected to major changes in relation to climate changes. Well expressed regular changes of high-water and low-water periods are evident. Seasonality indices have changed: increased values of growing degree days especially from the beginning of the 20th century, decreased number of frost days, reduced heating degree-days.

The climate change and climate variability have and will have a notable impact on inland and sea hydroecosystems as well as changes in vegetation. The increasing growth of aquatic vegetation in recent years has been related to climatic factors – higher mean temperature and earlier spring. The absence and lowering of the ice cover during winter's causes the prolonged growing season. There is a significant temporal gradient in vegetation dynamic from light nutrient-poor and species-poor forests to more nutrient-rich, more diverse species and closed forests.

This is evident that the future climate changes will has significant effect on natural and socio-economical systems in Latvia.

1.1.2 Background information on greenhouse gas inventories

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 well as are the designated single national entity.

The new legislation act No. 157 of Cabinet of Ministers (17.02.2009) determinates the institutions that are responsible for GHG inventory preparation. The national inventory compiler is the Latvian Environment Geology and Meteorology Centre (LEGMC).

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 2008. The structure of this NIR follows the "Annotated outline of the national Inventory Report including elements under Kyoto Protocol" prepared by UNFCCC.

1.2 A description of the institutional arrangement for inventory preparation, including the legal and procedual arangements for inventory planning, preparation and management

1.2.1 National Greenhouse Gas Inventory System in Latvia

Latvian national GHG inventory system is designed and operated according to the guidelines for national system under article 5, paragraph 1, of the Kyoto Protocol (Decision 20/CP7) to ensure the transparency, consistency, comparability, completeness and accuracy of inventory.

Inventory activities include planning, preparation and management.

The inventory phases are:

- collecting activity data;
- selecting methods and emission factors appropriately;
- estimating anthropogenic GHG emissions by sources and removals by sinks;
- implementing uncertainty assessment;
- implementing QA/QC activities.

The new Regulation No. 157 was approved and adopted by the Cabinet of Ministers on 17 February 2009. Detailed functions (roles) and responsibilities of institutions that are involved in the preparation of the National inventory are prescribed in the regulation, including the designation of an institution controlling the QA/QC procedures. A schematic model for the national system (NIS) is shown in the Figure 1.1

Single national entity with overall responsibility for the Latvian GHG inventory is the Ministry of the Environment of the Republic of Latvia (MoE) Climate Policy and Technology Department. The MoE is responsible for:

- Informing the inventory compilers about the requirements of the national system;
- Final checking and approving the inventory before official submission to the EC and UNFCCC;
- Formal agreements with inventory experts regarding Transport sector and for experts that evaluate quality assurance process;
- Coordinating the work between the inventory compilers, EC and UNFCCC (including coordination the UNFCCC inventory reviews).

Since 1st of August 2009 Latvian Environment, Geology and Meteorology Centre (LEGMC) is a governmental limited liability company and is responsible for preparing GHG inventory:

- Together with MoE coordinates the overall inventory preparation process, including the compilation of national inventory;
- Collects activity data - activity data are mainly collected from other institutions and LEGMC uses them to calculate emissions;
- Prepares the emission estimates for the Energy, Industrial Processes, Solvent and Other Product use, Agriculture and Waste sectors;

- Prepares sectoral parts of the NIR and compiles the final NIR;
- Fills in the sectoral data to the CRF Reporter (for relevant sectors);
- Prepares QC procedures;
- Documents and archives the prepared inventory and used materials.

On the GHG inventory issues in the LEGMC works five persons on partly load.

The main data supplier for the Latvian GHG inventory is the Central Statistical Bureau of Latvia (CSB). LEGMC has signed additional agreement for the supply of the necessary data too. Mainly LEGMC contacted with five CSB experts.

Since submission 2009, removals and emission calculations for the LULUCF sector were done by Latvian State Forest Research Institute "Silava" in collaboration with MoA.

Since submission 2009, Institute of Physical Energetics (IPE) calculates emissions for Transport sector according to agreement with MoE.

Before GHG inventory are reported to European Commission and UNFCCC secretariat it is forwarded to the involved ministries for review, check and approving.

One general meeting was held in the June to discuss and agree on the methodological issues, problems that have arisen and improvements that need to be implemented. There was discussion on the different problems that came up during the last inventory preparation to find solutions how to improve the overall system.

The following issues for solving different problems and to improve cooperation between inventory experts and inventory compilers are:

- Discussion on methodologies and possible changes in the future;
- Discussion on QA/QC plan, available resources and possible improvements;
- Discussion on data collection;
- Agreement on recalculations;
- Archiving system, updating and possible improvements;
- Exchange of relevant information;
- Reporting the conclusions from the meetings.

Additional small meeting were organised regarding Agriculture and LULUCF sectors. Responsible institutions were invited to discuss and find solutions for problems identified by ERT during in-country review 2009.

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

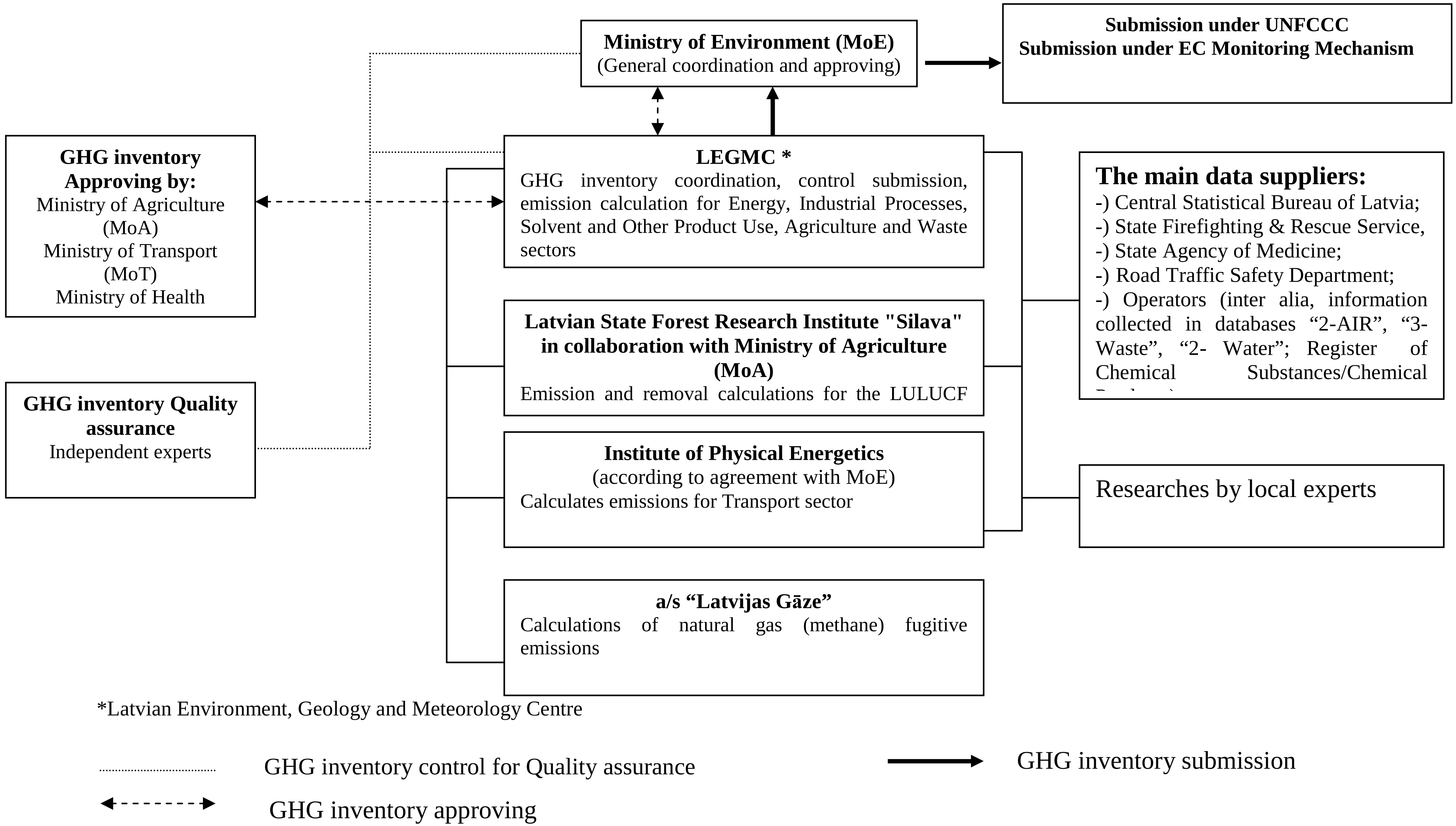


Figure 1.1 Structure of National Inventory System

Table 1.1 Institutions responsible for activity data and calculating emissions

CRF sectors	Data	Responsible institutions
Table 1.A(a) - Fuel Combustion Activities (Sectoral Approach)	Activity data	CSB, Road Traffic Safety Department (RTSD)
	Calculations	LEGMC, Institute of Physical Energetics (IPE)
Table 1.A(b) – CO_2 from Fuel Combustion Activities – Reference Approach	Activity data	CSB
	Calculations	LEGMC
Table 1.A(d) – Feedstock's and Non-Energy Use of Fuels	Activity data	CSB
	Calculations	LEGMC
Table 1.B.2. – Fugitive Emissions from Oil and Natural Gas	Activity data	CSB
	Calculations	LEGMC, a/s "Latvijas Gāze"
Table 1.C – International Bunkers and Multilateral Operations	Activity data	CSB
	Calculations	LEGMC
Table 2(I).A-G – Industrial Processes	Activity data	CSB, EU Emission Trading Scheme operator
	Calculations	LEGMC, EU Emission Trading Scheme operators
Table 2(II) F – Industrial Processes - HFCs, PFCs AND SF_6	Activity data	Central Statistical Bureau; a/s "Latvenergo"; State Agency of Medicines of Latvia; Enterprises operating with F-gases (reported to Chemicals Register of LEGMC)
	Calculations	LEGMC
Table 3 – Solvent and Other Product Use	Activity data	CSB; State Agency of Medicines of Latvia Research of experts; LEGMC "2-AIR" database
	Calculations	LEGMC
Table 4.A – Agriculture, Enteric Fermentation	Activity data	CSB
	Calculations	LEGMC
Table 4.B(a) - Agriculture, CH_4 Emissions from Manure Management	Activity data	CSB
	Calculations	LEGMC
Table 4.B(b) - Agriculture, N_2O Emissions from Manure Management	Activity data	CSB
	Calculations	LEGMC
Table 4.D - Agriculture, Agricultural Soils	Activity data	CSB
	Calculations	LEGMC
Table 5. A. Forest Land Table 5. B. Cropland Table 5. C. Grassland Table 5. D. Wetlands Table 5. E. Settlements Table 5. F. Other Land	Activity data	CSB; Starting from 2007 National Forest resource monitoring program (FRM)
	Calculations	Latvian State Forest Research Institute "Silava" collaborated with Ministry of Agriculture;
Table 5. B. Cropland -5.B.1 Cropland remaining Cropland	Activity data – Area of organic soil	National studies and expert judgment
	Calculations – Net carbon stock change in organic soils	National studies and expert judgment, Latvian State Forest Research Institute "Silava"
Table 5. C. Grassland - 5.C.1 Grassland remaining Grassland	Activity data - Area of organic soil	National studies and expert judgment
	Calculations – Net carbon stock change in organic soils	National studies and expert judgment, Latvian State Forest Research Institute "Silava"
Table 5.(IV) CO_2 emissions from agricultural lime application	Activity data	CSB
	Calculations	Latvian State Forest Research Institute "Silava"

CRF sectors	Data	Responsible institutions
Table 5. (V) Biomass Burning	Activity data	CSB; State Firefighting & Rescue Service
	Calculations	Latvian State Forest Research Institute "Silava", LEGMC
KP LULUCF	Activity data	Latvian State Forest Research Institute "Silava", LEGMC
	Calculations	Latvian State Forest Research Institute "Silava", LEGMC
Table 6 A - Waste, Solid Waste Disposal on Land	Activity data	LEGMC, Methane recovery installations
	Calculations	LEGMC
Table 6 B - Waste, Wastewater Handling	Activity data	CSB, LEGMC
	Calculations	LEGMC
Table 6 C - Waste, Waste Incineration	Activity data	LEGMC
	Calculations	
Table 6 D – Waste Other (composting)	Activity data	LEGMC

1.2.2 National Registry

The description for the national registry for initial report under the Kyoto Protocol was provided to UNFCCC secretariat as part of Latvia’s initial report under the Kyoto Protocol. Changes in the national registry in 2009 are addressed in Chapter 14.

Latvian Environmet, Geology and Meteorology Centre is responsible for national registry. The registry administrator Helena Rimsa is responsible for the Latvia’s Emission trading Registry system.

Latvia’s ETR technical infrastructure maintenance company and ETR technical administrator is Finnish company “Innofactor Oy”.

Finnish company “Innofactor Oy” is committed to produce the necessary information on emission reduction units, certified emission reductions, temporary certified emission reductions, long-term certified emission reductions and assigned amount units and removals units for annual inventory submissions in accordance with the guidelines for preparation of information under Article 7 of the Kyoto protocol.

This reporting has been done using Standard Electronic Tables (SEF) and Standard Independent Assessment Report (SIAR).

1.3. Inventory preparation

Latvia prepares a National Inventory Report (NIR) and Common Reporting Format (CRF) tables annually according to requirements of the UNFCCC, the Kyoto Protocol and the EU greenhouse gas monitoring mechanism. The 2010 submission contains estimates for the 1990-2008.

The organisation of the preparation and reporting of Latvia’s greenhouse gas inventory and the responsibilities of its different parties are detailed in the section 1.2.1 and Table 1.2.

All involved institutions to the inventory system produce emission estimates according to Regulation of Cabinet of Ministers No.157 inter alia the UNFCCC guidelines.

Latvian Environment, Geology and Meteorology Centre compiles national GHG inventory collaborating with other involved institutions and submit it for the approving by relevant ministries.

Ministry of the Environment submits national inventory report including CRF tables to the UNFCCC Secretariat and to the European Commission.

The annual GHG inventory is prepared according to reporting schedule.

Concerning EU monitoring mechanism to the Commission:

-) the annual inventory is submitted by 15 January;

-) updated submission by 15 March.

Concerning UNFCCC:

-) the annual inventory is submitted by15 April

Table 1.2 Inventory preparation plan

Element	Activity	Responsible performers	Procedures	Due date
To reconsider the changes needed for the next year's submission, taking into account comments and recommendations made by the review team (ERT)	All institutions		All institutions involved in inventory preparation process to reconsider the changes needed for the next year's submission, taking into account comments and recommendations made by the review team (ERT) and send to national inventory compiler for summarizing.	Middle of May
Annual meeting	All institutions		All institutions involved in inventory preparation and approval process to participate in annual workshop where all things relating next year's submission is discussed, including necessary improvements, changes and problems.	till 30th June
Agreement on the changes and adjustments to be made for next year's reporting	All institutions		All institutions involved in inventory preparation and approval process to come to an agreement on the changes and adjustments to be made for next year are reporting.	till 1st August
Activity data and description	Submission to LEGMC	EU Emission Trading Scheme (EU ETS) operators	EU ETS operators send to LEGMC activity data, CO_2 emission factors, CO_2 emissions and descriptions as verified GHG report for enterprises involved in EU ETS annually for previous year. LEGMC uses these data in GHG inventory.	till 30th March
		Operators	LEGMC collects information for emission calculation for CRF2, CRF 3, CRF 6 in following databases: • "2-AIR" database; • "3-Waste"; • "2-Water" databases; • Chemical Register. • Cement producer and Iron & Steel plant send additional information for detailed CO_2 emission estimation according to national legislation.	till 15th June till 1st October
		Statistical bureau of Latvia (CSB)	CSB send to LEGMC activity data regarding Energy, Agriculture, and Industrial Processes sectors according to interdepartmental contract. Many of received and used activity data is available in statistical databases: http://www.csb.gov.lv/csp/content/?lng=en&cat=355	till 1st October
		State Firefighting & Rescue Service (SFRS)	SFRS send to LEGMC activity data - area of last years grass (ha).	till 1st October
		Ministry of Health collaborating with State Agency of Medicines of Latvia (SAM)	SAM sends to LEGMC activity data.	till 1st October
Emissions and descriptions	Submission to MoE and LEGMC	IPE according to agreement with Ministry of Environment	IPE send to MoE and LEGMC report about emissions from Transport, including information about activity data, which was received from CSB.	till 1st December

Element	Activity	Responsible performers	Procedures	Due date
		a/s "Latvijas Gāze"	The only natural-gas transmission, storage, distribution, and sales operator in Latvia sends the total fugitive emissions for previous year and short information of emission fluctuation according to national legislation.	till 1st October
CO_2 removals and emissions, descriptions	Submission to MoA and LEGMC	Latvian State Forest Research Institute (LSFRI) "Silava" collaborated with Ministry of Agriculture	LSFRI "Silava" send to MoE and LEGMC report, CRF about CO_2 removals and emissions from LULUCF	till 1st December
CRF tables (XML)	Compilation of the CRF tables and QC by the LEGMC experts	LEGMC	LEGMC experts compile CRF tables, QC and send to national inventory compiler (LEGMC)	till 10th December
CRF data Short NIR according to Decision 280/2004/EC	Draft Inventory preparation, including QC activities	LEGMC	LEGMC send to MoE data in CRF and draft short NIR for approval	10th January
CRF data Short NIR according to Decision 280/2004/EC	Comments by the MoE	MoE	MoE send the comments and approval to LEGMC	10-14 January
CRF data Draft NIR according to Decision 280/2004/EC	CRF, NIR	LEGMC MoE	After corrections made by LEGMC, MoE send to EC CRF tables and draft short NIR through the Permanent Representation. LEGMC uploaded CRF tables, XML and draft NIR in the EIONET CDR, MoE electronically sent to EC notification about applauded data.	15th January
Quality control checks	QA/QC procedures, reports according to QC plan	LEGMC Other institutions involved in the preparation process	According to QC plan internal review was carried out.	January - February
NIR 1st draft		sectoral experts	Sectoral experts send NIR 1st draft to LEGMC (national inventory compiler)	End of January
NIR 1st draft		LEGMC	LEGMC send to involved institutions NIR 1st draft for comments and approving.	till 30 January
NIR 1st draft		Involved institutions	Involved institutions send to LEGMC comments about NIR 1st draft and approval.	23 February
Quality control checks	QC	All institutions involved in inventory preparation process	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.	1st March to 15th March
Quality control checks	QA	Expert	Expert who not involved in GHG inventory process reviewed Energy and Transport sectors. Check lists were prepared.	February
CRF data NIR according to Decision 280/2004/EC	CRF, NIR	MoE LEGMC	MoE sends to EC final CRF tables and final NIR according to Decision 280/2004/EC requirements through the Permanent Representation. LEGMA uploaded CRF tables, XML and draft NIR in the EIONET CDR, MoE electronically sent to EC notification about uploaded data.	15th March
NIR and emission data in CRF	Inventory submission	MoE, LEGMC	LEGMC coordinating with MoE uploaded approved GHG inventory to UNFCCC ftp folder.	15th April

1.4 BRIEF GENERAL DESCRIPTION OF METHODOLOGIES AND DATA SOURCES

1.4.1 GHG inventory

Latvia's GHG emissions inventory is 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) as well as 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.);
- Revised 1996 IPCC;
- IPCC GPG 2000;
- IPCC GPG LULUCF 2003;
- IPCC 2006;
- EMEP/CORINAIR Guidebook 2007 and 2009.

The updated CRF Reporter version 3.3.22 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 IV 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.

Emissions from Road Transport sector were estimated by using COPERT IV model for 1990–2008.

Emissions from Solvent and Other Product Use were estimated according to EMEP/CORINAIR 2007 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; LEGMC “2-AIR” database; Research of experts.	LEGMC; plant operators

Sector	Data Sources for Activity Data	Emission Calculation
Transport	Energy balance from Latvian CSB; IEA/AIE – EUROSTAT – UNECE Annual questionnaires; Data of Road Traffic safety Directorate; Research of experts.	IPE according to agreement with Ministry of Environment
Industry	National production and sales statistics; Direct information from enterprises operating with pollutants; Central Statistical Bureau; Chemicals Register; Assumption of experts.	LEGMC; plant operators
Solvent	Central Statistical Bureau; State Agency of Medicines of Latvia; Research of experts; LEGMC "2-AIR" database	LEGMC
Agriculture	National agricultural statistics obtained from CSB; National studies.	LEGMC
LULUCF	National forest inventory State forest service Ministry of Agriculture of Republic of Latvia Central Statistical Bureau State Firefighting & Rescue Service National studies and expert judgement	Latvian State Forest Research Institute "Silava" in collaboration with Ministry of Agriculture and LEGMC
Waste	Latvian Environment, Geology and Meteorology Centre "3-Waste" and "2-Water" databases; Methane recovery installations; CSB.	LEGMC

1.5 BRIEF DESCRIPTION OF KEY CATEGORIES, INCLUDING FOR KP-LULUCF

1.5.1 GHG inventory

The identification of key categories is described in the IPCC Good Practice Guidance (IPCC GPG, 2000), Chapter 7 and in the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG LULUCF, 2003), chapter 5.4.

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 methodologies offer 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 (Table 1.4). Detailed reporting tables can be found in Annex 1.

Table 1.4 Key categories identified using Tier 1 methodology

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	Key category	Criteria for identification
Mobile Combustion: Road Vehicles	CO_2	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF (2008). Level with and excl LULUCF (1990)
CO2 Emissions from Stationary Combustion-gas	CO_2	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF (2008). Level excl and incl LULUCF (1990)
CO2 Emissions from Stationary Combustion-oil	CO_2	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF (2008). Level excl and incl LULUCF (1990)
CO2 Emissions from Stationary Combustion-coal	CO^2	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF (2008). Level excl and incl LULUCF (1990)
Mobile Combustion: Railways	CO_2	Yes	Level without LULUCF(2008), Trend incl LULUCF (2008). Level excl and incl LULUCF (1990)
Non-CO2 Emissions from Stationary Combustion-biomass	CH_4	Yes	Level without LULUCF(2008), Trend excl LULUCF (2008)
Fugitive Emissions from Oil and Gas Operations	CH_4	Yes	Level without LULUCF(2008)
Emissions from Cement Production	CO_2	Yes	Level without LULUCF(2008). Level excl LULUCF (1990)
Emissions from Consumption of HFCs	HFC	Yes	Trend excl LULUCF (2008)
Removals from Forest Land	CO_2	Yes	Level LULUCF(2008), Trend (2008). Level (1990)
Emissions from Cropland	CO_2	Yes	Level (2008, 1990)
Emissions from Agricultural Soils	direct-N_2O	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend incl LULUCF (2008). Level excl LULUCF (1990)
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF (2008). Level excl and incl LULUCF (1990)
Emissions from Nitrogen Used in Agriculture	indirect-N_2O	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF(2008). Level excl and incl LULUCF (1990)
Emissions from Manure Management	N_2O	Yes	Level without LULUCF(2008), Trend excl and incl LULUCF(2008). Level excl and incl LULUCF (1990)
Pasture, Range and Paddock Manure	N_2O	Yes	Level without LULUCF(2008), Trend excl LULUCF(2008). Level excl LULUCF (1990)
Emissions from Solid Waste Disposal Sites	CH_4	Yes	Level without LULUCF(2008), Level with LULUCF(2008), Trend excl and incl LULUCF(2008). Level excl and incl LULUCF (1990)
Emissions from Wastewater Handling	CH_4	Yes	Level without LULUCF(2008), Trend excl and incl LULUCF(2008). Level incl LULUCF (1990)

1.5.1 KP-LULUCF inventory

In order to identify key categories of the items under the Kyoto Protocol Article

3.3, the association between the LULUCF key categories and KP Article 3.3 should be carried out. However, Latvia still is developing datasets required to report the complete greenhouse gas inventory in the LULUCF sector and the datasets developed for KP Article 3.3 are being built into the database of the whole LULUCF sector, the estimation of key categories of KP Article 3.3 has not been provided in this submission.

Key categories in CRF are based on expert judgment.

1.6 Information on the QA/QC plan including verification and treatment of confidentiality issues

This section presents the quality objectives and the QA/QC plan for the Latvia's GHG inventory. Source-specific QA/QC details are discussed in the relevant sections of this NIR.

1.6.1 Quality Assurance and Quality Control procedures

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

According to Regulation No. 157 all institutions involved in inventory process are responsible for implementing QC procedures. Mainly Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000 are used.

The legislation act determines:

-) the quality objectives for GHG inventory;

-) QA/QC plan that has been prepared to improve transparency, comparability, and completeness of GHG inventory. In the QA/QC plan quality control procedures to be used before and during the compilation of GHG inventory are described.

-) tasks and responsibilities of involved institutions;

-) check-list and procedure description for independent experts for quality assurance of GHG inventory.

Figure 1.6.1 shows the annual inventory process how the inventory is produced within the national system.

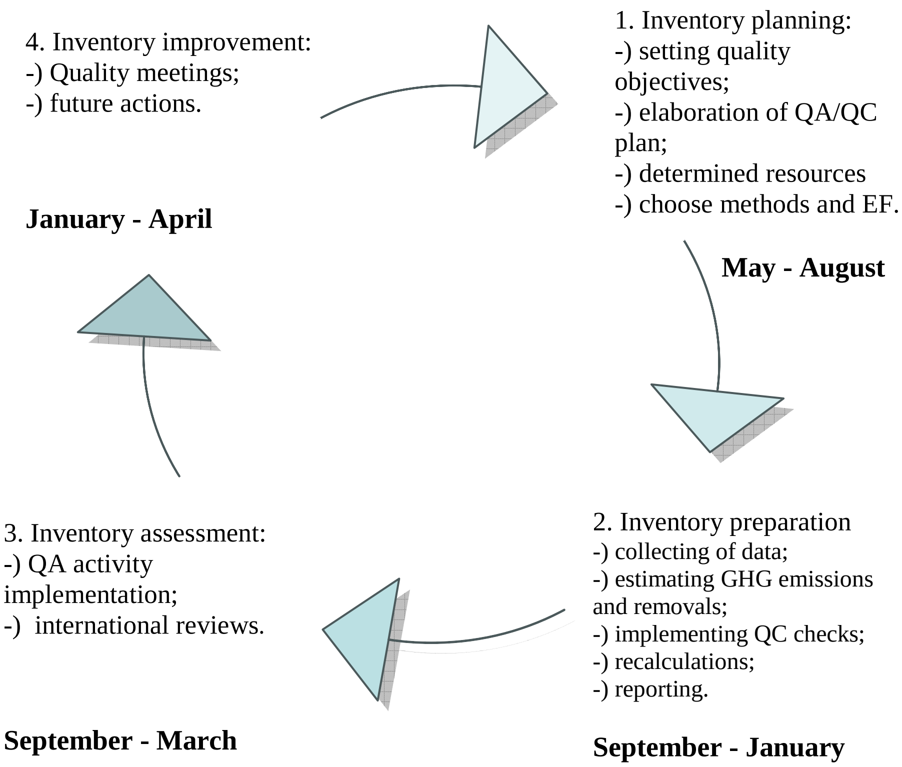
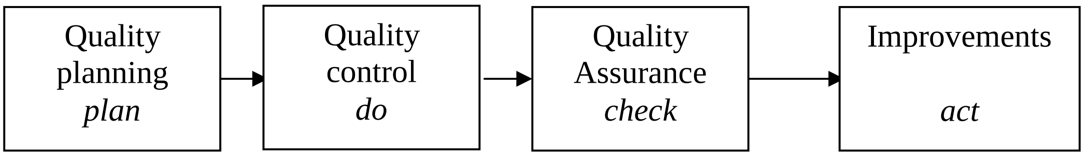


Figure 1.6.1 Inventory process

The result of quality is depended from four main stages – planning, preparation, evaluation and improvements and is ensured by inventory experts during compilation and reporting of inventory.

The inventory planning stage includes the setting of quality objectives and elaboration of the QA/QC plan for the coming inventory preparation, compilation and reporting work. The main objective of Latvia's GHG inventory system is to produce high quality GHG inventories.

The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness, accuracy, improvements and timelines. To ensure these inventory principles the following QA/QC activities of the inventory is done:



The setting of quality objectives is based on the inventory principles taking into account the available resources. The quality objectives for the 2008 inventory were the following:

In order to ensure improvements:

- All improvements promised in the NIR are carried out;
- Feedback on reviews is systematic;
- Inventory QC procedures meet requirements.

In order to ensure transparency:

- transparent information is included in the National Inventory Report and CRF (including information regarding the used methodology, activity data and emissions in tables);
- key words and indicators is used according to the IPCC guidelines;
- recommendations of inventory reviews regarding transparency is taken into account as far as possible;
- documentation regarding quality control check is indicated;
- a summary regarding the changes since the last inventory in relation to transparency is provided in the National Inventory Report.

In order to ensure consistency:

- time series are consistent;
- recommendations received during inventory review regarding consistency is taken into account after evaluation as far as possible;
- information regarding consistency and recalculations is provided in the National Inventory Report;
- an explanation for a decline or increase in emissions of time series is provided.

. In order to ensure comparability:

- methodologies and formats used in the inventory meet comparability requirements;
- emissions and CO_2 removal is localise and distributed according to the IPCC.

In order to ensure completeness:

- emissions from all potential sources and gases is calculated;
- recommendations of review – international experts – regarding improvements is taken into account as far as possible;
- information regarding completeness is provided in the National Inventory Report;

- all reasons for recalculations and reasons why a designation NE (not evaluated) and IE (included elsewhere) is used instead of data is indicated;

. In order to ensure accuracy:

- *Tier 2* or a higher method is used for the main sources as far as possible;
- uncertainties is calculated and information is provided in the National Inventory Report;
- a summary regarding changes in uncertainties and regarding improvements in comparison with the previous inventory is provided in the National Inventory Report.

In order to ensure timeliness:

- inventory reports reach their recipient (EU / UNFCCC) within the set time.

QC procedures implemented

MoE as national entity is responsible for overall QC procedures and quality assurance of national system, including UNFCCC reviews.

LEGMC is responsible for coordination of the whole process of annual greenhouse gas inventory and has an overall responsibility for QC.

For submission 2010, QC activities were carried out at the various stages of the inventory compilation process - processing, handling, documenting, cross checking, and recalculations. These activities are implemented by sectoral experts and inventory compiler (NIC).

QC system includes various activities set 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.

The QC procedures are performed by the experts during inventory calculation and compilation according to the QA/QC plan. General Schedule for Implementation of QC/QA Activities is presented in the Annex 6.

The QC procedures comply with the IPCC good practice guidance. General inventory QC checks (IPCC GPG 2000, Table 8.1 and IPCC GPG LULUCF 2003, Table 5.5.1) include routine checks of the integrity, correctness and completeness of data, identification of errors and deficiencies and documentation and archiving of inventory data and quality control actions.

For submission 2010:

-)The sectoral experts sent XML files to national inventory compiler (NIC - LEGMC) who imports all data together in CRF Reporter. NIC performed cross-checking for all sectors to verify that no mistakes occurred during import process as well as CRF completeness and recalculations checks were carried out.

-) The sectoral experts prepared relevant chapters of NIR and sent to NIC. NIC prepared NIR according to UNFCCC reporting guidelines. Sectoral experts before sending NIR to NIC checked if all information is consistent with CRF. It is checked if recalculations and methodological changes are explained in NIR.

-) Experts in LEGMC prepared quality control procedures according to QA/QC program using IPCC GPG 2000. All findings were documented by using check-lists and introduced in GHG inventory. All check-lists were archived;

-) LSFRI "Silava" checked data according to QC procedures that was outlined in IPCC GPG 2003, table 5.5.1. All information is conformed to MoA before sending to NIC. Corrections were sent to LSFRI "Silava" and NIC for including in the national inventory report;

The check list for KP-LULUCF reporting was prepared by MoA and sent to NIC for archiving.

-) For Transport sector quality control check was done by LEGMC, CSB and MoT. Findings were documented and introduced in the emission evaluation as well as in NIR.

Detailed source specific QA/QC descriptions are included under each sub sector.

Quality control of member states submissions is conducted under European Community GHG Monitoring Mechanisms (completeness and consistency checks). Findings on errors and deficiencies are taking into account before Latvia submits final annual inventory to the UNFCCC.

Quality assurance procedures implemented

The QA reviews are performed after the implementation of QC procedures to the finalised inventory. The inventory QA system comprises reviews to assess the quality of the inventory.

A basic review of the draft GHG emission and removal estimates and the draft report takes place before the final submissions to the EU and UNFCCC (January to March) by the involved institutions on GHG inventory preparation process.

The draft of National inventory report was sent to CSB, MoE, MoA, MoT till end of January for checking and approving. Received corrections were implemented in the GHG report.

During February/March 2010 expert not directly involved in the inventory compilation prepared quality control activities for Energy and Transport sectors based on contract with MoE.

On 28 February the European Commission (EC) consistency report of inventory was received. The possible corrections were elaborate in inventory.

UNFCCC reviews reports indicated the issues where inventory need of improvements. The possible improvements were elaborate in inventory.

The improvement plan for GHG inventory is compiled based on the finding of the UNFCCC, EC, internal reviews and other recommendations.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. According to Regulation No. 157 MoE is responsible for ensuring QA procedures for GHG inventory.

Documentation and Archiving

As part of general QC procedures, it is good practice to document and archive all information that is used for emission estimates. Documentation has a significant role in the inventory quality management.

All institutions involved in GHG inventory preparation process are responsible for archiving the collected data and estimated emissions. The expert organisations have archives located in their own facilities. Experts keep all information on the hard disks of the individual expert's desktops.

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

All information (including corresponding letters) used for inventory compilation are collected on the special server and the backup of data are made periodically.

Printed copies of NIR are stored in LEGMC archive in May each year, after completion and submission of the inventory. All information is archived on CDs.

1.6.2 Treatment of confidentiality issues

It is strictly determined in Law of Statistics what information could be provided to other institutions even though the information is needed in emission estimation and reporting under international conventions. CSB can't give the information of amount of production if one or two companies produce up to 95% from total market production in particular sector. Due to small market of Latvia almost all industrial production data is classified as confidential with exception of food and drink sector where wine and sugar production data is classified as confidential. LEGMC has interdepartmental agreement with CSB to receive confidential information for the emission estimation but these activity data has to be reported as "C" in CRF Tables and in NIR.

As all Latvia's industrial processes sector's companies are participating in ETS then data from these companies can be obtained from their annual GHG report within compliance obligations within ETS. These activity data used emission factors and used emission estimation methodologies can be reported in NIR and in CRF Tables as the data of ETS can't be confidential and all companies' annual GHG reports are published in LEGMC webpage.

1.7 GENERAL UNCERTAINTY EVALUATION

1.7.1 GHG inventory

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 2010 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 and LULUCF (Forest Land remaining Forest Land) sector. Uncertainties are estimated for direct greenhouse gases, e.g. CO_2, CH_4, N_2O and F-gases only.

The overall uncertainty (excluding LULUCF) is calculated to be approximately 5% and the trend uncertainty is 2.34%. The Tables 1; 2; 3 in the Annex 2 show the uncertainties separate for each direct GHG. The overall uncertainty for CO_2 is 3.58%, for CH_4 – 16% and for N_2O – 22%. The trend uncertainty is calculated for CO_2 – 1.66%, for CH_4 – 7% and for N_2O – 10%. Uncertainties for CH_4 and N_2O are higher basically due to use default emission factors.

The overall uncertainty (including LULUCF) is calculated to be approximately 22.5% and the trend uncertainty is 10.9%. The overall uncertainty (including LULUCF) for CO_2 is 24.38% and trend uncertainty – 11.91% (Table 4, Annex 2).

1.8 GENERAL ASSESSMENT OF THE COMPLETENESS

1.8.1 Completeness by source and sink categories and gases

Latvia has provided estimates for all significant IPCC source and sink categories according to the detailed CRF classification. Estimates are provided for the following gases: CO_2, N_2O CH_4, F-gases (HFC, PFC and SF_6), NMVOC, NOx, CO and SO_2. No additional sources and sinks identified.

In accordance with the IPCC Guidelines, international aviation and marine bunker fuel emissions are not included in national totals.

The notation keys presented below are used to fill in the blanks in all the tables in the CRF. Notation keys used in the NIR are consistent with those reported in the CRF.

NE (not estimated):

“NE” is used for existing emissions by sources and removals by sinks of greenhouse gases that have not been estimated.

IE (included elsewhere):

“IE” is used for emissions by sources and removals by sinks of greenhouse gases that have been estimated but included elsewhere in the inventory instead of the expected source/sink category.

NA (not applicable):

“NA” is used for activities in a given source/sink category that do not produce emissions or emissions are negligible.

C (confidential):

“C” is used for emissions that could lead to the disclosure of confidential information classified in the national legislation if reported at the most disaggregated level. In this case a minimum of aggregation is required to protect business information.

Assessment of completeness is included in Annex 5.

1.8.2 Completeness by geographical coverage

All territory of Latvia is covered by the inventory. All sources and sinks included in the IPCC Guidelines are covered.

1.8.3 Completeness by timely coverage

Both direct GHGs as well as indirect GHGs are covered by the Latvia’s inventory. A complete set of CRF tables are provided for all years and the estimates are calculated in a consistent manner.

CHAPTER 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).

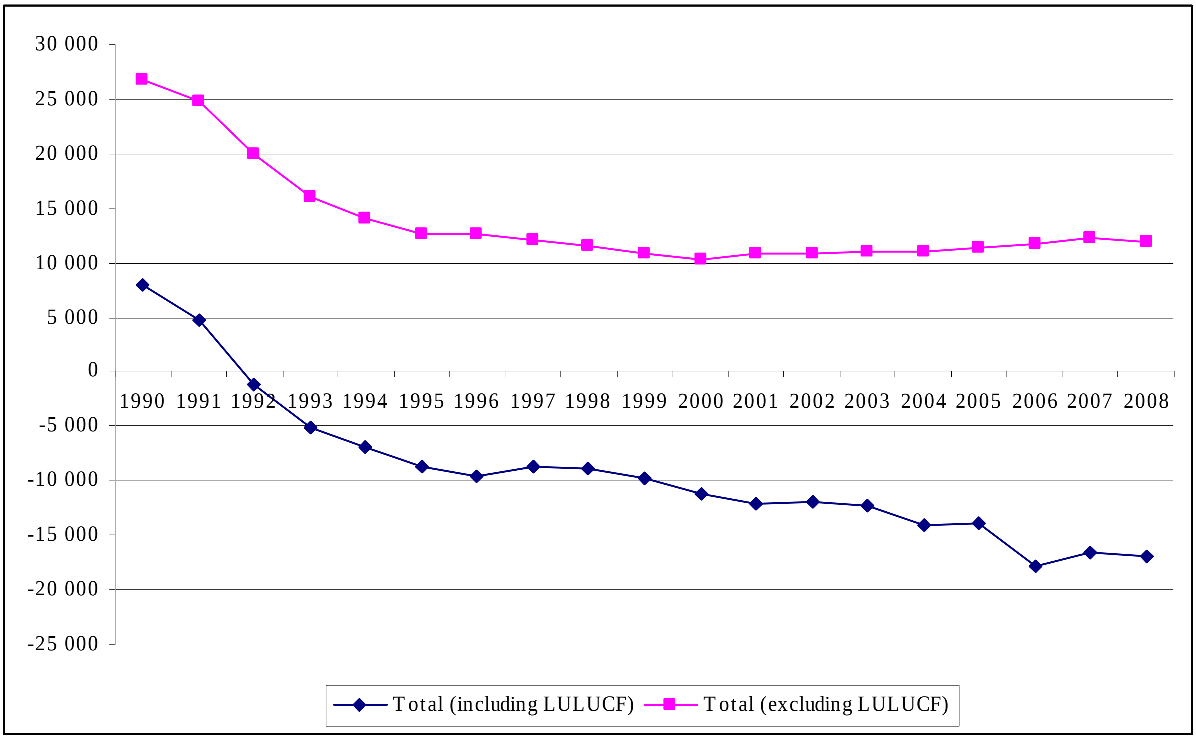


Figure 2.1 Latvia's aggregated greenhouse gas emissions in 1990-2008 (Gg CO_2 eq.)

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.

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.

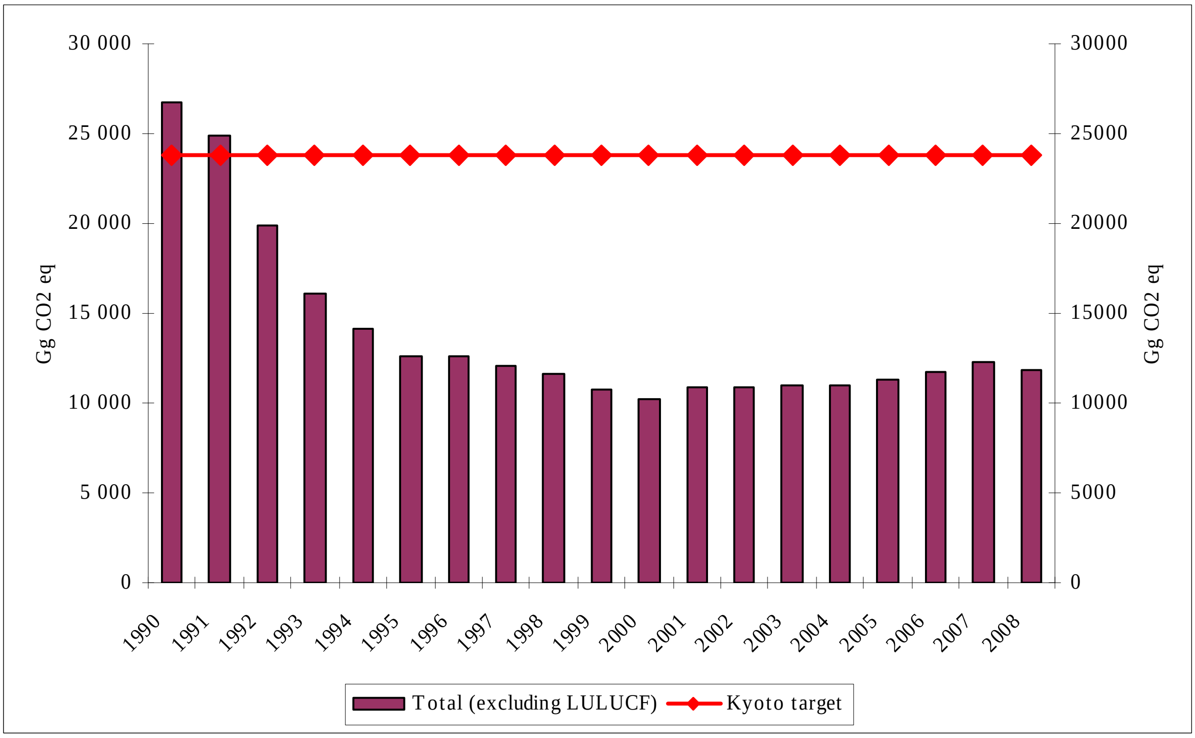


Figure 2.2 Trends in Gg CO_2 eq. emissions and emission target of the Kyoto Protocol

2.2 DESCRIPTION OF EMISSION TRENDS BY GAS AND CATEGORY

In the Annex 6, 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 2008, CO_2 emissions contribute 69.7% of Latvia's total greenhouse gas emissions. In 2008, total CO_2 emissions had decreased by approximately 56.91% since 1990.

The most important source of CO_2 emissions (Gg) in 2008 was fossil fuel combustion – 96.3%, including Energy Industries – 24.16%; Manufacturing Industries and Construction – 13.92%; Transport – 42.4%, Other sectors (Agriculture, Forestry, etc.) – 15.83%.

Other anthropogenic emission sources of CO_2 are Industrial Processes – 3.1%, Solvent and Other Product Use approximately 0.59%.

CO_2 removals take place by green plants absorbing CO_2 in the process of photosynthesis. In 2008, forests in Latvia removed 28878.38 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 2008 contribute approximately 16.59% of total GHG emissions (excluding LULUCF). The methane emissions (Gg) decreased by 47.1% in 2008 since 1990.

Agricultural soils are the main source of N_2O emission in Latvia generating 76.77% of all N_2O emissions (Gg) in 2008. 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 59.47% in 2008, mainly due the decrease in the emissions from agriculture.

Emissions from HFCs and sulphur hexafluoride (SF_6) consumption are reported for the period 1995-2008. Total HFCs emissions (Gg CO_2 eq) increased in 2008 compared with 2007. SF_6 emissions from electrical equipment are reported and contribute 10.08 Gg CO_2 eq in 2008.

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.

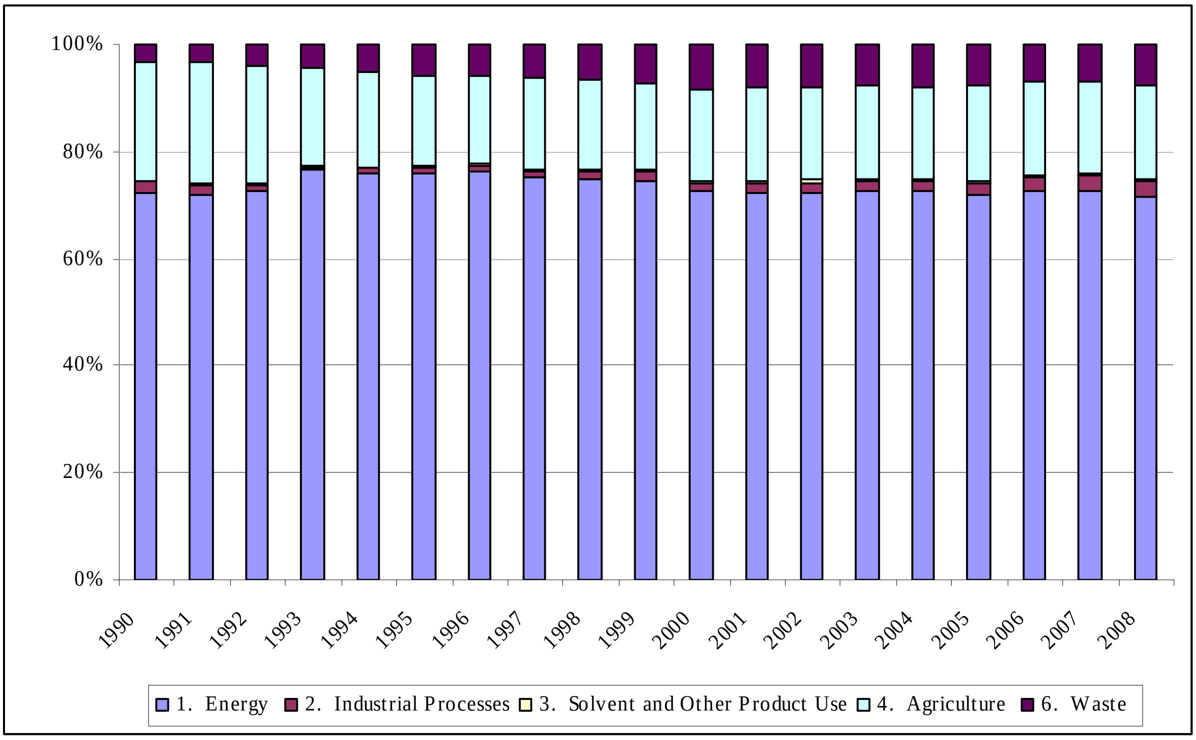


Figure 2.3 Latvia's greenhouse gas emissions by source 1990–2008 excluding LULUCF

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.

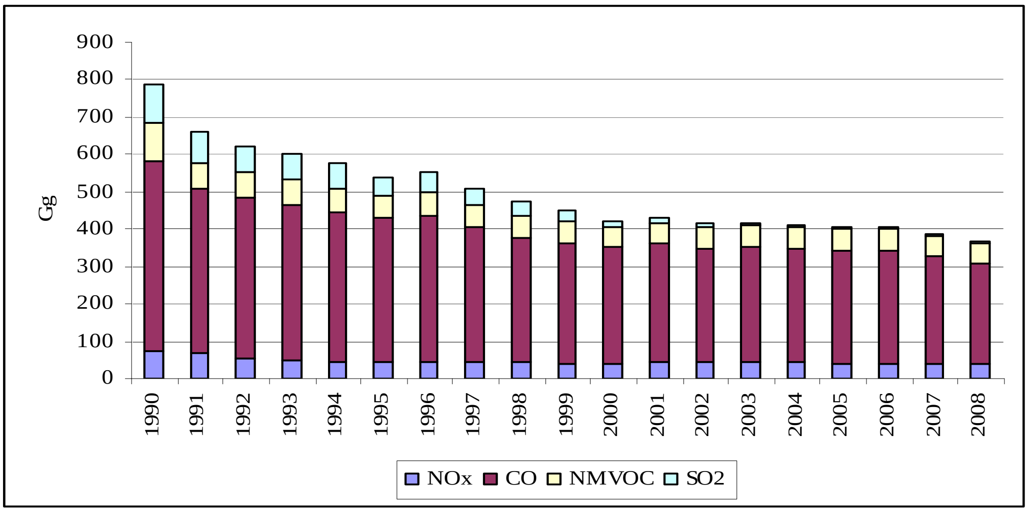


Figure 2.4 Total indirect greenhouse gas emissions trend 1990-2008 (Gg)

In 2008, the **sulphur dioxide emissions** were 2.81 Gg from which 91.5% originated in the Energy sector.

Nitrogen oxides were generated generally in the Energy sector 90.8% and 8.3% in the Industrial Processes. In 2008, the total emissions were 37.9Gg. The Transport sector was responsible for 52.1% of the total emissions.

In 2008, **Carbon monoxide** emissions were 270.86 Gg, originated generally in the Energy sector (95.6%).

In 2008, total emissions of **non-methane volatile organic compounds** were 53.97 Gg from which Energy sector generated 53.6%, Solvent and Other Product Use approximately 29.2%, but Industrial Processes 16.2%.

2.4 DESCRIPTION OF EMISSION TRENDS FOR KP-LULUCF INVENTORY IN AGGREGATE AND BY ACTIVITY, AND BY GAS

Coverage of reporting of carbon pools and emission sources with regard to activities afforestation (A), reforestation (R) and deforestation (under Article 3.3) and optional activity forest management (FM) (under Article 3.4) are presented in Table 1.7.

Table 1.7 Information table relating to Article 3.3 and elected activities under article 3.4

Activity		Change in carbon pool reported					GHG sources reported						
		Above-ground biomass	Below-ground biomass	Litter	Dead wood	Soil	Fertilization	Drainage of soils under forest management	Disturbance associated with land-use conversion to croplands	Liming	Biomass burning		
							N_2O	N_2O	N_2O	CO_2	CO_2	CH_4	N_2O
A 3.3	A/R	R	R	R	R	R	NO			NO	NO	NO	NO
	D	R	R	R	R	R			NO	NO	NO	NO	NO
A 3.4	FM	R	R	R	R	R	NO	R		NO	R	R	R
	CM	NA	NA	NA	NA	NA			NA	NA	NA	NA	NA
	GM	NA	NA	NA	NA	NA				NA	NA	NA	NA
	RV	NA	NA	NA	NA	NA				NA	NA	NA	NA

R (reported), NR (not reported), IE (included elsewhere), NO (not occurring), NA (not applicable)

Emissions and removals from KP-LULUCF activities are reported for the first time, thus trends are not yet available. Net emission from activities Afforestation and Reforestation, Deforestation in 2008 was 62.92 Gg CO_2 eq. 29201.92 Gg CO_2 eq, in 2008.

CHAPTER 3: ENERGY (CRF 1)

3.1 OVERVIEW OF SECTOR

3.1.1 Quantitative overview

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.

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 39.3% in 2008, including heavy fuel with about 0.6% although the residual fuel oil consumption in 1990 was 20.8% from total fuel consumption in country. Essential decrease of heavy oil share in energy balance is explained with implementation of the EU Directive 1999/32/EC prescribing that sulphur content of heavy oil must not exceed 1%. The biggest part from liquid fuel consumption contributes to gasoline and diesel oil with 80.6% from total liquid fuel consumption when gasoline is mostly consumed in transport sector but diesel oil consumption divides by combusted in transport sector – 81.1%, and combusted in stationary combustion installations – 19.1% from total diesel oil consumption.

Table 3.1.1 Consumption of energy resources in Latvia (TJ)[1,2]

	1990	**1995**	**2000**	**2004**	**2005**	**2006**	**2007**	**2008**
Energy consumption – total	**304109**	**173147**	**147491**	**169811**	**172333**	**180438**	**184143**	**176390**
Shale oil		79	2440	118	157	118	118	79
Liquefied petroleum gas	3689	1548	2140	2505	2550	2687	2414	2186
Gasoline and aviation gasoline	26796	18128	14831	15346	15126	16753	18299	16672
Jet kerosene	3067	1166	1123	2074	2463	2852	3414	4105
Other kerosene	648	432	43					
Diesel oil (including gasoil)	43000	17166	20693	31188	32887	36371	41343	39133
Residual fuel oil	63092	36134	9460	3735	3167	2152	1624	1096
White spirits	84	84	126	126	126	126	84	84
Lubricants	1633	963	879	1005	1088	1088	1088	1047
Bitumen	1633	712	2009	2009	2512	3098	3349	3600
Paraffin waxes			126	251	335	251	251	209
Petroleum coke				1088	429	627	132	
Other liquids	2637	712	2553	1088	209	1088	963	795
Used oils	879			497	848	263	234	263
Coal	26098	7172	2761	2570	3146	3409	4248	4248
Peat	3286	3838	2452	90	80	70	90	90
Peat briquettes	867	403	31				1	1
Coke	290	211	290	188	188	161	107	134
Oil shale	28							
Natural gas	98800.68	42297.42	45839.07	55860.17	56935.05	58984.04	57018	55894.05
Wood and wood products	27581	42102	39695	49434	49396	49748	48706	46018
Charcoal				30	60	30	45	60
Bioethanol						43		1
Biodiesel					107	60	73	82
Landfill gas				240	246	230	224	277
Sewage sludge gas				55	95	87	92	92
Straws						11	16	14
Used tires				314	183	131	210	210

[1] CSB. Annual Eurostat Energy Questionnaire, 2009
[2] http://data.csb.gov.lv/DATABASE/vide/Ikgadējie%20statistikas%20dati/Enerģētika/Enerģētika.asp

Total share of solid fuels in national market is quite low – approximately 2.5%. The solid fuel consumption in last two years is stable still consumption has increased by 57.1% since 2004 that is explained with coal consumption increase in minerals production although in 2006-2007 also coke consumption in steel production has increased by 25.2%.

Natural gas consumption has a stable place in total fuel consumption when natural gas consumption is 32.5% in 1990 and 31.7% in 2008. Natural gas consumption decreased by 43.4% in 1990-2008 due to total decrease of natural economy in comparison with 1990. Still in last three years natural gas consumption that had increasing tendency in prior years is again decreasing – by 5.2% in 2006-2008.

Biomass fuels are fuelwood, straw, charcoal and biofuels. In the total fuel consumption the share of firewood and other wood products is quite substantial and has reached to 26.1% in 2008 by the side of 1990 when fuelwood consumption was only about 9.1% from total energy consumption. The biggest users of fuelwood are households – 65.6%, commercial / institutional consumers – 14.9%, industry (including autoproducers and mainly wood processing companies) – 12.6%, and public heat and electricity supply companies – 9.7%.

Hydroelectric power plants (HPP) and CHPs 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)[3]

	Electricity								Heat				
	Production	Own use and losses	Import	Export	Final consumption				Production	Own use and losses	Final consumption		
					CRF 1.A.2	CRF 1.A.3	CRF 1.A.4	TOTAL			CRF 1.A.2	CRF 1.A.4	TOTAL
1990	16185.6	6883.2	25700.4	12798.0	11484.0	918.0	17550.0	29952.0	99439.2	15170.4	32929.2	51339.6	84268.8
1991	11790.0	6681.6	15217.2	7.2	10807.2	784.8	17254.8	28846.8	96120.0	16095.6	33393.6	46630.8	80024.4
1992	9075.6	5644.8	14688.0	7.2	8316.0	745.2	13777.2	22838.4	75441.6	10951.2	22633.2	41857.2	64490.4
1993	10350.0	6102.0	9619.2	612.0	5439.6	687.6	10904.4	17031.6	54846.0	9954.0	7153.2	37738.8	44892.0
1994	11898.0	6681.6	9532.8	2988.0	5076.0	669.6	10101.6	15847.2	46821.6	7329.6	1998.0	37494.0	39492.0
1995	10573.2	6372.0	9529.2	1407.6	5130.0	676.8	10267.2	16074.0	46112.4	8215.2	1969.2	35928.0	37897.2
1996	6699.6	7988.4	12376.8	759.6	4975.2	640.8	9266.4	14882.4	47138.4	8838.0	2044.8	36252.0	38296.8
1997	10634.4	7693.2	6566.4	3.6	5518.8	633.6	8935.2	15087.6	45720.0	8319.6	1976.4	35427.6	37404.0
1998	15544.8	6559.2	3290.4	1382.4	5295.6	612.0	10310.4	16218.0	42872.4	8949.6	1940.4	31982.4	33922.8
1999	9932.4	5774.4	9349.2	2311.2	5130.0	554.4	10375.2	16059.6	36190.8	8114.4	1162.8	26913.6	28076.4
2000	10162.8	5202.0	7588.8	1159.2	5158.8	547.2	10411.2	16117.2	31867.2	7160.4	658.8	24048.0	24706.8
2001	10209.6	5688.0	8424.0	1645.2	5562.0	622.8	10314.0	16498.8	33937.2	7567.2	640.8	25729.2	26370.0
2002	8906.4	5187.6	10216.8	1764.0	5493.6	518.4	11563.2	17575.2	33048.0	6732.0	630.0	25686.0	26316.0
2003	8330.4	5065.2	9615.6	136.8	5778.0	489.6	12456.0	18723.6	33516.0	6670.8	626.4	26218.8	26845.2
2004	16185.6	6883.2	25700.4	12798.0	11484.0	918.0	17550.0	29952.0	99439.2	15170.4	32929.2	51339.6	84268.8
2005	11790.0	6681.6	15217.2	7.2	10807.2	784.8	17254.8	28846.8	96120.0	16095.6	33393.6	46630.8	80024.4
2006	9075.6	5644.8	14688.0	7.2	8316.0	745.2	13777.2	22838.4	75441.6	10951.2	22633.2	41857.2	64490.4
2007	10350.0	6102.0	9619.2	612.0	5439.6	687.6	10904.4	17031.6	54846.0	9954.0	7153.2	37738.8	44892.0
2008	11898.0	6681.6	9532.8	2988.0	5076.0	669.6	10101.6	15847.2	46821.6	7329.6	1998.0	37494.0	39492.0

Types of fuels used for combustion in Latvia:

- Liquid Fuels are mainly imported from Latvia's neighbourhood countries – Lithuania, Belarus, Russian Federation, Norway and others and consist of:
    - motor gasoline;
    - motor diesel oil and heating gasoil;
    - residual fuel oil;
    - kerosene and kerosene type jet fuel;
    - gasoline type jet fuel;

[3] http://data.csb.gov.lv/DATABASE/vide/Ikgadējie%20statistikas%20dati/Enerģētika/Enerģētika.asp

- liefied petroleum gas;
- other liquid fuels (used oils and other liquids);

- Solid fuels consist of coal and coke imported from Commonwealth of Independent States (countries of former Union of Soviet Socialist Republics) and local fuels – peat and peat briquettes that are mainly produced inside country but not imported;
- Gaseous Fuels (natural gas) are 100% imported from Russian Federation;
- Biomass Fuels consist of:
  - solid biomass – wood and wood waste, charcoal, straws, is mainly produced and used inside of the country,
  - methane obtained from biogas that is 100% produced inside of the country – landfill gas that is used since 2002 when first landfill started to collect and combust biogas with energy recovery, and sludge gas that is combusted with energy recovery since 1993 in one sewage purification plant,
  - liquid biofuels – biogasoline, biodiesel, that are mainly imported from Latvia's neighbourhood countries and other liquid biofuels – glycerine that are remaining product in chemical industry.
- Other Fuels are industrial waste – used tires, collected by and combusted in cement production plant in Latvia.

Types of fuels used as feedstocks in Latvia:

- Liquid Fuels – lubricants, bitumen, white spirits and paraffin wax, are 100% imported from Latvia's oil importers from neighbourhood countries and Scandinavian countries.

3.1.2 Description

The **Energy sector** is the most significant source of GHG emissions with 69.14% share of the total emissions in the 2008. (Figure 3.1.1)

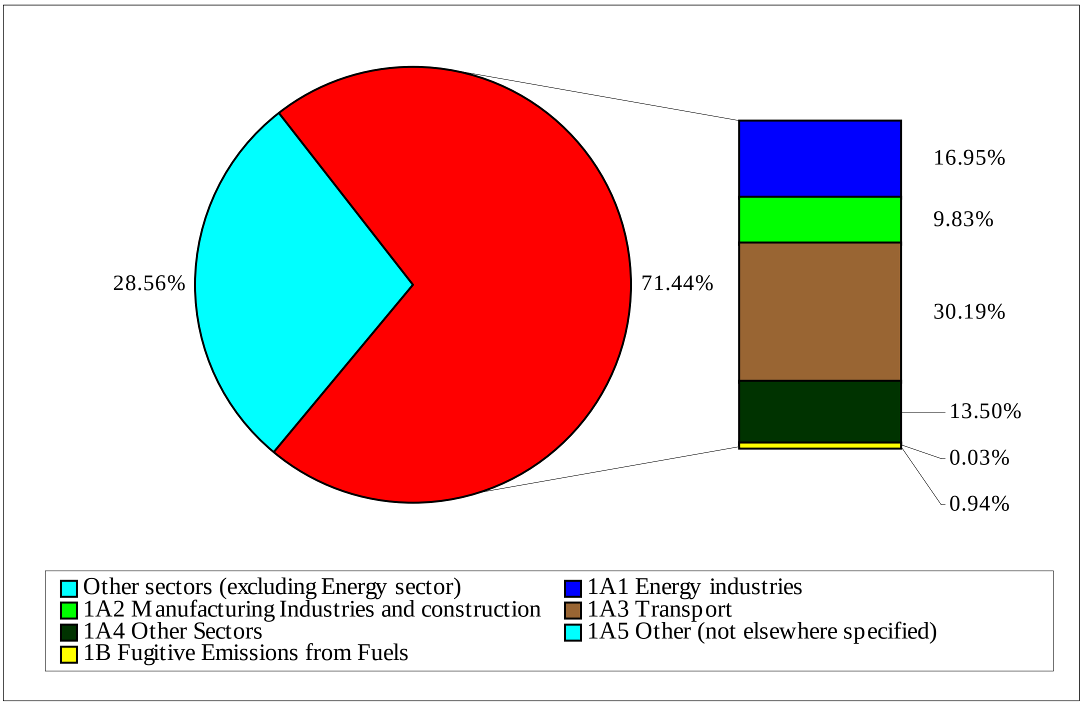


Figure 3.1.1 Emissions from the Energy sector in 2008

Biggest part of GHG emissions in Energy sector consists of Transport sector with 30.19% from total GHG emissions and 42.26% of total Energy sector's GHG emissions. Energy industries and Other sectors make 2nd and 3rd place with 23.73% and 18.9% of total Energy sector's GHG emissions.

Table 3.1.3 GHG emissions from Energy sector in 1990 – 2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
A Fuel combustion																			
CO_2	18631.8	17115.3	13828.6	11676.3	10101.1	8925.4	8991.5	8481.3	8089.0	7472.8	6892.2	7297.7	7291.1	7425.5	7432.2	7604.4	8047.6	8409.9	7997.8
CH_4	12.75	14.10	12.81	13.43	13.27	13.71	14.07	13.35	12.46	12.17	11.50	12.66	12.36	12.91	13.24	13.21	12.85	12.76	12.44
N_2O	0.53	0.52	0.47	0.41	0.39	0.40	0.41	0.41	0.39	0.37	0.36	0.39	0.40	0.43	0.44	0.44	0.44	0.45	0.43
B Fugitive emissions from fuels																			
CH_4	13.05	12.57	11.46	10.96	10.71	10.43	10.05	9.38	9.00	8.58	7.94	7.70	8.03	6.28	6.21	6.94	5.04	5.16	5.30

Decrease of emissions depends on economical and social situation in the beginning and ending of 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 the Energy sector in the latest years are stable with a peak point in 2007 (since 2000) that is explained with sharp increase of national economy. (Figure 3.1.2) GHG emissions in 2000-2007 have increased by 20.35% in the Energy sector. In the second half of 2008 recession in national economy already started caused by the crisis. That's why all GHG emissions decreased in 2007-2008 by 4.69%. The decrease of CH_4 emissions since 2004 is mainly influenced by the decrease of emissions in transport sector.

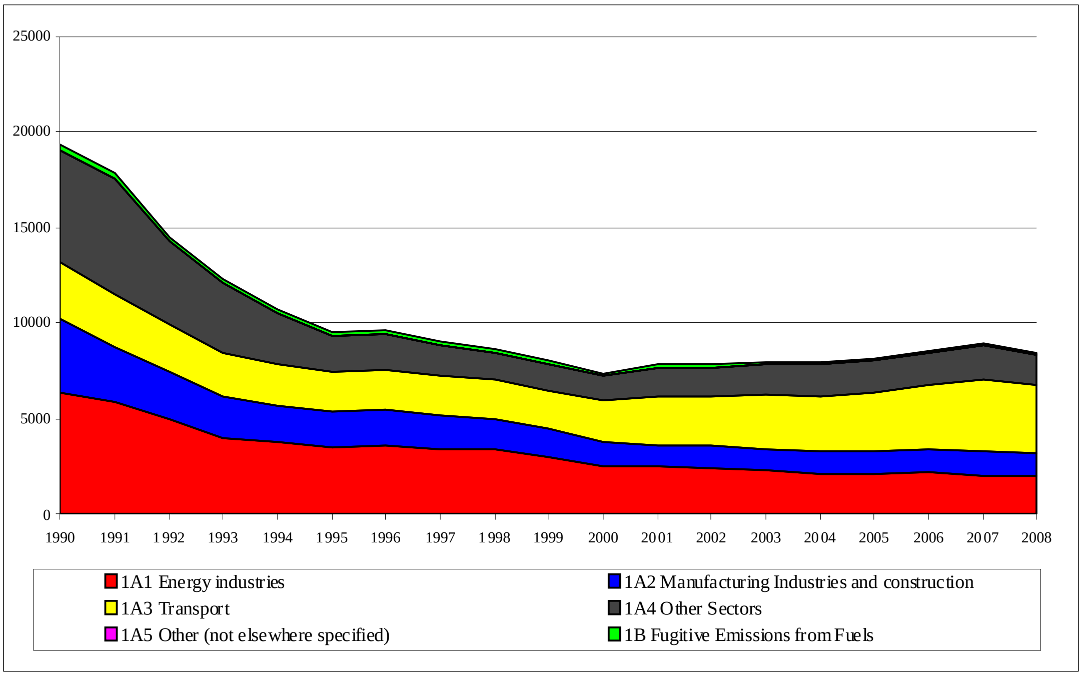


Figure 3.1.2 GHG emissions from Energy sector 1990–2008 (Gg CO_2 eq.)

Only CO_2 emissions from Other sectors (military aircrafts and navigation) have increased in 2007-2008 by 18.74% that is explained with increase of military activities and increase of the financing of these activities. Still CO_2 emissions from military activities have decreased by 61.87% in 2006-2007. Emissions from all other sectors have decreased in 2007-2008. That is explained with the national crisis starting in the second part of 2008. The biggest decrease of GHG emissions from Energy sector was for 1.A.2 sector and was 7.7%.

The decrease of industrial production was influenced by economical situation when development of national economy was made of development of financial and real estate sectors but import dominated over export. Increase of cost and price as well as total inflation led to total decrease of industry. The second biggest decrease was for 1.A.3 Transport sector – 5.56% that was influenced by sharp increase of fuel price and economy crisis when total wealth of inhabitants. In 2008, the largest part of indirect emissions contributes CO then NO_x and NMVOC emissions. Most CO and NMVOC emissions come from wood combustion in the Residential sector. (Figure 3.1.3)

The biggest decrease is observed in SO_2 emissions where emissions decreased from 100.71 Gg in 1990 to 2.57 Gg emissions in 2008 It is explained with 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. Indirect GHG emissions as direct GHG emissions have decreased in 2007-2008 that was also influenced by the inflation and following crisis.

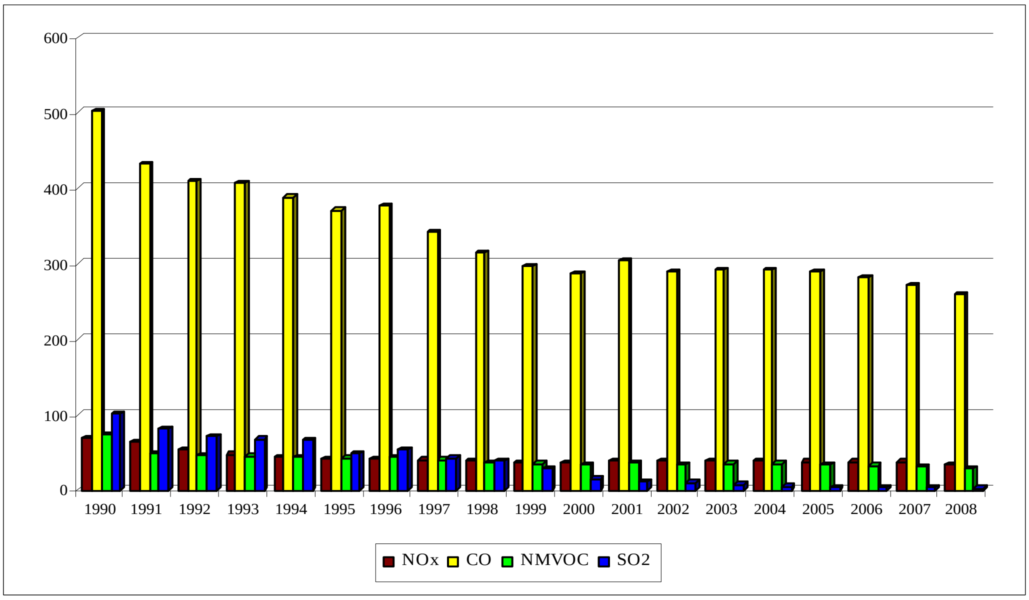


Figure 3.1.3 Total indirect GHG emissions from fuel combustion in 1990–2008 (Gg)

Key categories

Key categories reported in the Table 3.1.4 is estimated without taking into account LULUCF sector by using Tier1 estimation level

There are 4 key source categories of stationary fuel combustion in 2008 with respect to Level assessment without LULUCF sector – CO_2 emissions from natural gas combustion is second biggest key source with 26%; CO_2 emissions from liquid fuels combustion is third key source with 7%; CO_2 emissions from solid fuels combustion – 3%; as well as CH_4 emissions from biomass combustion – 2%. In 2008 with respect to Trend Assessment without LULUCF sector there are 4 key source categories in stationary fuel combustion sector – CO_2 emissions from liquid fuels – 31%; from solid fuels – 10%, from natural gas – 8% and CH_4 emissions from biomass – 2%. Road transport is a biggest key source in 2008 according to Level and the second biggest key source according to Trend assessment – 27% for both criteria.

There are two key source categories in 2008 with respect to Level assessment without LULUCF sector – mobile combustion in railways and CH_4 fugitive emissions from operations of natural gas with 2% and 1% respectively.

Table 3.1.4 Key categories in fuel combustion sector in 2008

Source category	Emission	Identification criteria	Percentage
Mobile Combustion: Road Vehicles	CO_2	L, T	27%, 28%
Stationary Combustion-gas	CO_2	L, T	27%, 9%
Stationary Combustion-oil	CO_2	L, T	7%, 32%
Stationary Combustion-coal	CO_2	L, T	3%, 10%
Mobile Combustion: Railways	CO_2	L	2%
Stationary Combustion-biomass	CH_4	L, T	2%, 2%
Fugitive Emissions from Oil and Gas Operations	CH_4	L	1%

3.2 FUEL COMBUSTION

Emissions from fuel combustion comprise all in-country fuel combustion, including point sources, transport and other fuel combustion. 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 – road transport, civil aviation, railways and domestic navigation;
- 1.A.4 Other Sectors (Commercial / Institutional, Residential, Agriculture / Forestry / Fisheries);
- 1.A.5 Other (Not elsewhere specified).

Reported greenhouse gas emissions are listed in Table 3.2.1.

Table 3.2.1 Reported emissions from fuel combustion in Latvia in 2008

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1.A.1 Energy Industries								
a. Public Electricity and Heat Production								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Petroleum Refining								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
c. Manufacture of Solid Fuels and Other Energy Industries								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
1.A.2 Manufacturing Industries and Construction								
a. Iron and Steel								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Non-Ferrous Metals								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
c. Chemicals								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
d. Pulp, Paper and Print								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
e. Food Processing, Beverages and Tobacco								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
f. Other:								
Non-Metallic Minerals								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	√	√	√	NO	NO	NO	NO
Transport Equipment								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
Machinery								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
Mining and Quarrying								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
Wood and Wood Products								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
Construction								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
Textiles and Leather								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
Non-specified (Industry)								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
1.A.3 Transport								
a. Civil Aviation								
	Aviation Gasoline	√	√	√	√	√	√	√
	Jet Kerosene	√	√	√	√	√	√	√
b. Road Transportation								
	Gasoline	√	√	√	√	√	√	√
	Diesel Oil	√	√	√	√	√	√	√
	LPG	√	√	√	√	√	√	√
	Other Liquid Fuels	NA	NA	NA	NA	NA	NA	NA
	Gaseous Fuels	√	√	√	NO	NO	NO	NO
	Biomass	√	√	√	NO	NO	NO	NO
	Other Fuels	NA	NA	NA	NA	NA	NA	NA
c. Railways								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	Other Fuels	NA	NA	NA	NA	NA	NA	NA
d. Navigation								
	Residual Oil (Residual Fuel Oil)	NO	NO	NO	NO	NO	NO	NO
	Gas/Diesel Oil	√	√	√	√	√	√	√
	Gasoline	√	√	√	√	√	√	√
	Other Liquid Fuels	NA	NA	NA	NA	NA	NA	NA
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
e. Other Transportation								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
1.A.4 Other Sectors								
a. Commercial/Institutional								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Residential								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
c. Agriculture/Forestry/Fisheries								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
1.A.5 Other								
a. Stationary								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Mobile – Military navigation and aircrafts								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO

CO_2 emissions from fuel combustion were 7 997.8 Gg (including Transport sector) in 2008 and accounted 96.35% of the total CO_2 emissions. (Table 3.2.2)

CH_4 emissions from fuel combustion were 12.44 Gg (including Transport sector) in 2008 that makes 10.89% from total CH_4 emissions. The biggest part of CH_4 emissions contributes Other sectors – 11.65 Gg. It is related with wood fuel combustion, especially in the Residential sector. Until now Latvia uses IPCC 1996 default CH_4 emission factor for wood combustion in Residential sector. According to Expert review team IPCC 1996 default CH_4 emission factor for biomass is very high.

N_2O emissions from fuel combustion were 0.43 Gg (including Transport sector) and accounted 8.12% of the total N_2O emissions in 2008.

Table 3.2.2 GHG emissions from fuel combustion in 1990–2008 (Gg)

	Total fuel combustion GHG emissions	**Energy industries**	**Manufacturing industries and Construction**	**Transport**	**Other Sectors**	**Other**	**CH_4**	**N_2O**
		CO_2						
1990	**19064.02**	6386.17	3804.95	2877.98	5562.64		267.70	164.56
1991	**17573.60**	5869.19	2856.38	2695.53	5694.20		296.15	162.14
1992	**14242.31**	5002.60	2406.27	2403.28	4016.43		269.07	144.66
1993	**12085.73**	4009.66	2118.32	2216.11	3332.18		282.10	127.36
1994	**10501.30**	3766.34	1919.68	2102.57	2312.54		278.77	121.40
1995	**9336.75**	3472.32	1888.98	2002.49	1555.48	6.12	287.92	123.43
1996	**9412.95**	3596.87	1851.68	1965.76	1573.95	3.25	295.38	126.05
1997	**8887.54**	3380.27	1806.02	1955.86	1326.83	12.34	280.42	125.80
1998	**8471.84**	3418.24	1584.54	1930.36	1152.65	3.25	261.74	121.06
1999	**7842.31**	2993.93	1437.01	1897.37	1135.18	9.33	255.52	113.96
2000	**7245.31**	2543.37	1190.01	2106.95	1051.70	0.14	241.53	111.61
2001	**7684.69**	2498.63	1098.70	2496.90	1203.34	0.17	265.89	121.06
2002	**7674.20**	2396.40	1140.46	2574.42	1173.01	6.87	259.57	123.47
2003	**7829.87**	2333.60	1085.14	2718.25	1282.21	6.33	271.12	133.21
2004	**7848.27**	2143.82	1085.83	2856.85	1336.11	9.61	278.12	137.93
2005	**8019.60**	2137.75	1159.67	2982.88	1316.52	7.60	277.50	137.68
2006	**8453.24**	2167.78	1191.11	3290.75	1390.49	7.49	269.78	135.85
2007	**8811.63**	2034.14	1253.43	3726.94	1389.57	2.86	267.96	138.02
2008	**8391.33**	2005.59	1155.29	3519.84	1313.66	3.39	261.23	132.33
share of total 2008 GHG emissions	**70.51%**	**16.85%**	**9.71%**	**29.57%**	**11.04%**	**0.03%**	**2.19%**	**1.11%**

3.2.1 Comparison of the sectoral approach with the reference approach (CRF 1.A(b), 1.A(c))

Reference approach (RA) is carried out using import, export, production and stock change data as well as data of fuel consumption in international aviation and international marine reported as bunkering from the CSB – Annual questionnaires for 1990-2008 prepared for EUROSTAT[4]. (Table 3.2.4)

Difference between CO_2 emissions estimated with RA and SA for liquid fuels is quite high from 0.15% in 1992 to 16.38% in 2005. Difference for solid fuels is smaller than for liquid fuels still it varies from 0.07% in several years to 7.72% in 2004. Due to non-reporting of distribution losses difference between two estimation approaches for natural gas vary from 0.18% in 1990 to 3.16% in 1993. No difference is observed for Other fuels.

The biomass consumption in the comparison is not included as this type of fuel is assumed as CO_2 neutral and CO_2 emissions from biomass combustion are taken into account in the CO_2 emission estimation from Energy sector. Amount of used tires combusted in cement production plant is reported as Other fuels.

Table 3.2.4 Difference between Sectoral and Reference approach data

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Fuel consumption - Liquid fuels																			
Reference approach (PJ)	144.76	124.69	105.15	97.81	94.66	78.72	81.53	69.91	69.52	58.52	48.03	50.92	48.09	52.10	54.66	54.65	58.51	64.47	60.90
Sectoral approach (PJ)	139.19	123.87	103.85	96.81	91.03	74.29	80.17	68.85	67.71	63.09	52.01	52.60	52.53	53.31	54.51	55.02	59.66	65.04	60.32
Difference (%)	1.59	-0.69	0.20	-0.35	2.20	3.60	-0.70	-2.24	-2.03	-12.68	-13.68	-8.21	-14.51	-8.56	-5.95	-8.07	-9.57	-8.23	-7.23
CO_2 emissions - Liquid fuels																			
Reference approach (Gg)	10444.5	9068.6	7668.7	7107.4	6879.6	5675.5	5893.9	4960.8	4881.5	4076.4	3266.1	3499.8	3252.3	3549.1	3491.7	3335.2	3886.2	4306.1	4032.1

[4] EUROSTAT Annual Questionnaire by CSB, 2009

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Sectoral approach (Gg)	10280.3	9137.1	7657.4	7139.9	6739.0	5484.8	5935.9	5069.2	4976.3	4626.2	3774.4	3801.0	3794.6	3855.4	3941.9	3988.3	4302.5	4693.8	4355.6
Difference (%)	1.60	-0.75	0.15	-0.45	2.09	3.48	-0.71	-2.14	-1.90	-11.88	-13.47	-7.92	-14.29	-7.95	-11.42	-16.38	-9.67	-8.26	-7.43
Fuel consumption - Solid fuels																			
Reference approach (PJ)	30.57	26.66	23.62	21.38	16.04	11.60	10.94	9.70	7.07	5.27	5.50	5.15	4.18	3.72	2.85	3.41	3.64	4.45	4.47
Sectoral approach (PJ)	30.39	26.53	23.50	21.29	16.04	11.60	10.94	9.70	7.06	5.35	5.47	5.17	4.18	3.48	2.84	3.41	3.64	4.45	4.41
Difference (%)	0.61	0.97	0.66	-0.32	-0.19	0.00	0.00	0.00	-1.61	-2.13	0.54	-0.30	0.00	6.93	0.35	0.00	0.00	-0.02	1.40
CO_2 emissions - Solid fuels																			
Reference approach (Gg)	2677.6	2341.4	2095.9	1894.9	1433.6	1066.8	1005.1	897.5	651.3	474.6	514.8	462.0	374.2	353.1	262.5	314.7	335.6	410.5	412.8
Sectoral approach (Gg)	2651.1	2322.2	2077.1	1881.5	1429.9	1062.5	1000.6	893.8	648.3	482.1	511.1	463.1	373.9	327.9	261.3	314.5	335.3	410.3	406.3
Difference (%)	1.00	0.83	0.91	0.71	0.26	0.40	0.45	0.41	0.46	-1.55	0.72	-0.25	0.07	7.72	0.47	0.07	0.07	0.04	1.58
Fuel consumption - Gaseous fuels																			
Reference approach (PJ)	98.80	99.61	72.24	47.60	34.64	42.30	36.58	44.58	43.71	41.86	45.84	53.27	54.14	56.41	55.86	56.94	58.98	57.02	55.89
Sectoral approach (PJ)	98.70	97.93	70.78	46.17	33.65	41.32	35.57	43.54	42.67	40.87	45.07	52.37	53.59	55.68	55.33	56.77	58.72	56.69	55.56
Difference (%)	0.10	1.71	2.07	3.08	2.96	2.36	2.82	2.39	2.44	2.41	1.71	1.72	1.04	1.31	0.96	0.28	0.44	0.58	0.60
CO_2 emissions - Gaseous fuels																			
Reference approach (Gg)	5710.6	5757.3	4182.1	2738.8	1991.0	2435.9	2114.6	2580.3	2526.4	2420.1	2642.0	3067.5	3129.7	3262.9	3236.1	3298.8	3417.1	3307.6	3255.8
Sectoral approach (Gg)	5700.3	5656.0	4094.1	2654.9	1932.3	2378.1	2055.0	2518.3	2464.5	2361.5	2595.8	3013.3	3095.2	3218.2	3203.0	3287.1	3399.4	3286.2	3218.0
Difference (%)	0.18	1.79	2.15	3.16	3.04	2.43	2.90	2.46	2.51	2.48	1.78	1.80	1.12	1.39	1.03	0.36	0.52	0.65	1.18
Fuel consumption - Other fuels																			
Reference approach (PJ)	-	-	-	-	-	-	-	-	-	0.04	0.13	0.25	0.33	0.29	0.31	0.18	0.13	0.21	0.21
Sectoral approach (PJ)	-	-	-	-	-	-	-	-	-	0.04	0.13	0.25	0.33	0.29	0.31	0.18	0.13	0.21	0.21
Difference (%)	-	-	-	-	-	-	-	-	-	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions - Other fuels																			
Reference approach (Gg)	-	-	-	-	-	-	-	-	-	3.04	10.85	20.29	27.46	24.08	25.99	14.53	10.40	16.67	17.85
Sectoral approach (Gg)	-	-	-	-	-	-	-	-	-	3.04	10.85	20.29	27.46	24.08	25.99	14.53	10.40	16.67	17.85
Difference (%)	-	-	-	-	-	-	-	-	-	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Fuel consumption - Total																			
Reference approach (PJ)	274.13	250.96	201.01	166.79	145.35	132.62	129.06	124.19	120.30	105.68	99.51	109.58	106.74	112.53	113.68	115.18	121.27	126.14	121.48
Sectoral approach (PJ)	268.28	248.33	198.13	164.27	140.72	127.22	126.69	122.10	117.45	109.35	102.68	110.38	110.62	112.77	112.99	115.40	122.16	126.39	120.50
Difference (%)	0.93	0.44	0.92	0.62	2.11	2.87	0.35	-0.41	-0.38	-6.52	-6.15	-3.11	-6.38	-3.18	-2.39	-3.71	-4.46	-3.97	-3.29
CO_2 emissions - Total																			
Reference approach (Gg)	18832.7	17167.3	13946.7	11741.1	10304.3	9178.2	9013.7	8438.5	8059.2	6974.1	6433.7	7049.6	6783.6	7189.2	7016.3	6963.2	7649.3	8040.9	7718.6
Sectoral approach (Gg)	18631.8	17115.3	13828.6	11676.3	10101.1	8925.4	8991.5	8481.3	8089.0	7472.8	6892.2	7297.7	7291.1	7425.5	7432.2	7604.4	8047.6	8406.9	7997.8
Difference (%)	1.08	0.30	0.85	0.56	2.01	2.83	0.25	-0.50	-0.37	-6.67	-6.65	-3.40	-6.96	-3.18	-5.60	-8.43	-4.95	-4.35	-3.49

3.2.1.1 Explanation of the difference

Energy balance

In the Annual questionnaires statistical differences and distribution losses are reported for certain fuels, whereas in the RA table only stock changes are possible to input. These data are not taken into account and not input in stock changes cells of CRF Reporter RA tables. That’s why the difference for liquid, solid and gaseous fuels is quite significant for many years as for example distribution losses for natural gas are quite visible.

CSB estimate total consumption data by taking into account production, import, export and international bunkering data. Final consumption data is estimated by taking into account sectoral consumption data reported by fuel consumers excluding reported distribution losses data. For several fuel types difference between these two estimation approaches is reported as statistical difference that is quite significant for some fuel types – diesel oil, gasoline, residual fuel oil. For solid fuels and natural gas amount of distribution losses is also quite significant but this amount is not taken into account in RA reporting.

Statistical difference for liquid fuels occurs due to national circumstances. For liquid fuels especially diesel oil, gasoline and residual fuel oil there is a common situation with the so-called black market and illegal trade – that means that some amount of diesel oil is just bought in neighbourhood countries and then transferred (by illegal pipeline constructions, by tanks built-in in trucks) to Latvia bypassing any custom and control institutions. There is a common situation that illegal port is made to oil transportation pipelines (these pipelines are used to transport oil products from neighbourhood countries to our harbours in transit). This illegal amount of diesel is sold to some other companies that report the amount as combusted amount. It means that company report the consumed amount of diesel oil but the company isn't responsible is or isn't this amount of diesel imported in legal way.

CSB reports the amount of fuel that was used in interproducts transfer but this amount wasn't also reported in RA tables that's why in RA tables consumption of fuel is reported although no fuel consumption was in practice in Latvia, for example other kerosene in 2004-2008.

CO_2 emissions

Default country specific emission factor for gasoline is used in reference approach but in the sectoral approach carbon emission factor differs for the gasoline used in road transport, domestic navigation and off-roads.

Paraffin Wax and White Spirit data is 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 be estimated 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 1.B tables are higher that it should be.

3.2.1.2 Methodological issues

The IPCC 1996 Tier1 Reference approach for the CO_2 emission estimations and comparison of CO_2 emissions were used. CRF Reporter software developed by experts from UNFCCC was used to report emission data. Annual import, export, production, international bunkers and stock changes data divided by fuel types is input in the RA tables of CRF Reporter as well as carbon emission factor and coefficient of fraction of carbon oxidized

Generally emissions are calculated by multiplying fuel consumption with country specific, plant specific or IPCC default carbon EF taking into account fraction of carbon oxidized.

Carbon emission factors were estimated by taking into account net calorific values and the molecular weight ratio of the carbon and CO_2. Net calorific values of the fuels are taken from EUROSTAT Annual Questionnaire prepared by CSB. The fuel consumers reported the NCV of the used fuels to CSB according to national legislation that obliges the enterprises that do any fuel use activities report it to CSB.

For several fuels NCV changes one time in whole time series in 2003-2004 or 2002-2003 but for natural gas and biogas NCV and also carbon emission factor changes for every year in whole time series. NCV of other liquid fuels changes in every year in time series are explained with the fluctuation of other oil fuel structure.

Carbon emission factor for bitumen and lubricants was taken from IPCC 1996[5] was used. Emission factor for paraffin wax were taken from Lithuanian submission but white spirit emissions factor were taken from Denmark submission. Finland's used carbon emission factor for peat briquettes was used as characterization of peat used for in-country production of peat briquettes is very similar in Latvia and Finland. Carbon emission factor for industrial wastes (used tires) was estimated based on CO_2 emission factor reported by cement production plant within ETS (Table 3.2.5)

[5] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf, page1.13

Table 3.2.5 Carbon emission factors (t/TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
gasoline	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.893	18.906	18.906	18.906	18.906	18.906	18.906
diesel oil	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400	20.400
RFO	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113	21.113
LPG	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126	17.126
jet kerosene	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.718	19.713	19.713	19.713	19.713	19.713	19.713
other kerosene	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.715	19.711	19.711	19.711	19.711	19.711
other liquid	20.012	20.633	20.633	20.633	20.012	20.122	20.012	20.012	20.012	20.204	20.652	20.432	20.300	21.887	22.627	26.222	21.670	21.659	22.103
shale oil	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047	21.047
bitumen	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
lubricants	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006	10.006
petroleum coke													27.500	27.500	27.500	27.500	27.500	27.500	
gasoline type jet fuel																19.352	19.352	19.352	
paraffin waxes										22	22	22	22	22	22	22	22	22	22
used oils												20.013	20.013	20.013	20.013	20.013	20.013	20.013	20.013
white spirit	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
coal	23.654	23.654	23.654	23.654	23.654	23.654	23.654	23.654	23.654	23.654	23.654	23.654	23.654	25.675	25.675	25.675	25.675	25.675	25.675
lignite	23.654	24.654	25.654	26.654	27.654	28.654	29.654	30.654	31.654	32.654	33.654	34.654	35.654	36.654	37.654	38.654	39.654	40.654	41.654
coke	24.221	24.221	24.221	24.221	24.221	24.221	24.221	24.221	24.221	24.221	24.221	24.221	23.841	23.841	23.841	23.841	23.841	23.841	23.841
peat briquettes	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473	26.473
peat	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925	28.925
natural gas	15.843	15.843	15.868	15.771	15.753	15.785	15.846	15.865	15.842	15.848	15.798	15.783	15.844	15.853	15.879	15.881	15.879	15.901	15.886
solid biomass	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015	30.015
biogas													14.919	14.920	14.748	14.770	14.399	14.770	14.621
liquid biofuels	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833	21.833
industrial wastes										23.030	23.030	23.030	23.030	23.030	23.030	21.655	21.655	21.655	23.182

3.2.1.3 Time series consistency

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are two such issues:

- Other Oil – CO_2 IEF in 2004 is 22.63 (t/TJ) but in 2005 – 26.22 (t/TJ) – 15.89% diff.;
- Other Oil – CO_2 IEF in 2005 is 26.22 (t/TJ) but in 2006 – 21.67 (t/TJ) – 17,36% diff..

In 2005 if comparing with neighbourhood years structure of other liquid fuels changed therefore average NCV in 2005 was lower (more light liquid fuels were used). That's why estimated CO_2 EF and estimated carbon emission factor increased in 2005

3.2.1.4 Source-specific QA/QC and verification

The best way to check RA data is to compare them with SA data that is done already in CRF Reporter. The difference between these two emission estimation and reporting methodologies has to be double-checked and explained.

There are several ways to do the checks of the activity data:

- Energy sector data is taken from the Annual Questionnaires that CSB prepares and reports to the EUROSTAT and IEA. CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge

base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.

- Data of RA are verified by CSB within National Inventory System and in case of inconsistency of data reported in NIR and in CRF with the data in Energy balance of CSB and data reported to EUROSTAT by CSB all the information of data mismatch is reported to LEGMC. After that Energy sector's sectoral expert check all again the reported data and incorporate necessary changes in CRF and in NIR. If the sectoral expert doesn't agree with reported data mismatch and considers that no changes are necessary the information of this is again sent to CSB with detailed explanation.

Estimated CO_2 emissions are checked:

- By comparing the emissions estimated with Reference Approach and Sectoral approach.
- By comparing used carbon emission factor with in Sectoral Approach used CO_2 emission factors.
- By performing the consistency check for the IEF estimated in CRF Reporter and additionally verifying all changes that are higher than 10%.

3.2.2 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 four years there can see stable increase. Total emissions of International Bunkering are shown in the Figure 3.2.1.

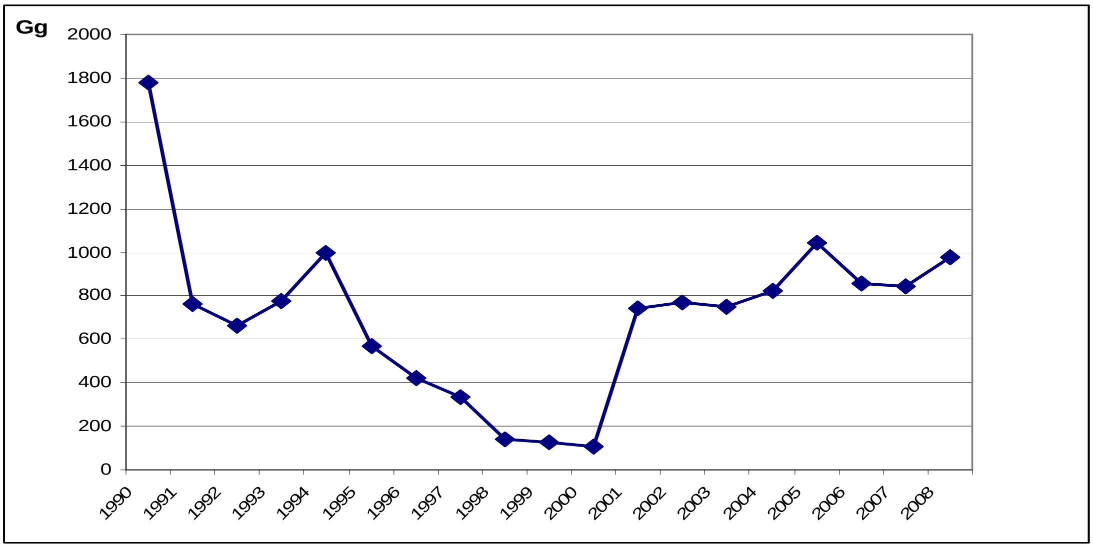


Figure 3.2.1 Emissions from International Bunkers (Gg CO_2-eq.)

Fuel consumption is obtained from CSB (Table 3.2.6).

Table 3.2.6 Energy consumption in international transport (TJ)[6]

	Aviation	Navigation	
	Jet Kerosene	**Diesel Oil**	**RFO**
1990	3067.2	5013.8	14737.8
1991	4147.2	807.3	5075.0
1992	1166.4	637.4	6820.8
1993	1166.4	1402.2	7429.8

[6] CSB. Annual Eurostat Energy Questionnaire, 2009

	Aviation	Navigation	
	Jet Kerosene	Diesel Oil	RFO
1994	1080.0	2974.3	8688.4
1995	1080.0	1104.7	5156.2
1996	1382.4	934.8	3126.2
1997	1382.4	849.8	2111.2
1998	1252.8	552.4	81.2
1999	1252.8	424.9	0.0
2000	1123.2	339.9	0.0
2001	1123.2	4249.0	3938.2
2002	1166.4	3611.7	4993.8
2003	1685.2	3101.8	4750.2
2004	2031.0	3186.8	5278.0
2005	2463.0	3824.1	7064.4
2006	2765.0	2761.9	5481.0
2007	3371.0	2506.9	4953
2008	4062.0	1912.0	6699.0

The emission factors are shown in Table 3.2.7.

Table 3.2.7 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	0.004	0.03	1.0	0.25	0.11
RFO	76.6	0.005	0.002	1.6	0.5	0.11

EMEP/CORINAIR 2006 Tier2 approach has been applied for emission calculation of jet kerosene in international aviation. Using Tier 2 approach, emissions for LTO (landing/take off) and cruise are calculated individually. Default EFs of LTO and cruise (jet kerosine) is used (EMEP/Corinair 2006).

The SO_2 emissions factors are used consistent with sulphur content in diesel oil (Table 3.2.8 and 3.2.9).

Table 3.2.8 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
2004-2008	0.035	42.49	0.016

Table 3.2.9 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
2000-2008	0.2	40.6	0.097

3.2.3 Feedstocks and non-energy use of fuels (CRF 1.A(d))

3.2.3.1 Source category description

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

Consumption of Bitumen, Lubricants, Paraffin Waxes and White Spirits is reported in 1.D tables for all years in time series 1990–2008.

Paraffin Waxes and White Spirits are not default types of fuels in CRF 1.A(d) tables so these fuels are reported under "Other Fuels" what caused some discrepancies with 1.A(b) tables that is described in Chapter 3.2.1.

3.2.3.2 Methodological issues

Emission factors used in different neighbourhood countries during preparation of submission were used in emission estimations due to lack of national carbon emission factors. Bitumen and Lubricants 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.

Activity data prepared by CSB and reported to EUROSTAT in EUROSTAT Annual Questionnaire formats were used. (Table 3.2.10)

Table 3.2.10 Activity data for Feedstock's and non-energy use of fuels in 1990–2008 (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Bitumen	1632.5	544.2	83.7	167.4	544.2	711.6	879.1	1632.5	2051.1	2344.2	2009.3	1507.0	2093.0	2176.7	2009.3	2511.6	3097.6	3348.8	3600.0
Lubricants	1632.5	1046.5	920.9	1088.4	1004.6	962.8	962.8	879.1	1004.6	879.1	879.1	837.2	837.2	920.9	1004.6	1088.4	1088.4	1088.4	1046.5
Paraffin Wax	-	-	-	-	-	-	-	-	-	125.6	125.6	167.4	167.4	167.4	251.2	334.9	251.2	251.2	209.3
White Spirit	83.7	83.7	83.7	83.7	83.7	83.7	83.7	83.7	125.6	83.7	125.6	125.6	83.7	83.7	125.6	125.6	125.6	83.7	83.7

Constant increase of bitumen since 2004 is explained with development of construction sector and availability of financial resources from European Union (Latvia is a member of European Union since 2004) for building and improvement of transportation infrastructure.

Coke consumption isn't included in this sector as coke is not used as feedstock but is combusted during crude iron and scrap metal melting to decrease carbon content in final crude steel.

Lubricants mainly are used in transport sector. It is assumed that 50% of lubricants are used as feedstocks and 50% is secondary combusted in the vehicle engine and running system.

Paraffin waxes and white spirits mainly are used as feedstocks in chemical industry.

3.2.4 CO_2 capture from flue gases and subsequent CO_2 storage

There is no CO_2 capture and storage performed in Latvia in time period 1990-2008.

3.2.5 Country Specific issues

Country specific issues regarding fuel combustion mainly are related to fuel characteristics – net calorific values and carbon contents that are used in estimation of country specific CO_2 and carbon emission factors. Also plant specific fuel characteristics are used to estimate CO_2 and carbon emission factors for sludge gas and landfill gas. Enterprises estimated and reported emissions are used in several categories – NO_x and SO_x emissions from public CHP and heat plants, fugitive NMVOC emissions from operations with liquid fuels and fugitive methane emissions from operations with natural gas.

All country specific issues are explained in details under relevant chapters of source categories and in Annexes.

3.2.6 Energy Industries (CRF 1.A.1)

3.2.6.1 Source category description

1.A.1 Energy industries sector include emissions from fuel combustion in point sources in energy production including emissions from off–road. Fuel consumption in autorproducers' combustion installations are excluded from this sector and included in particular sectors of 1A2, 1A4a and 1A4c sectors according to IPCC 1996.

Emissions from combustion installations with NACE2 codes 35.11 and 35.30 are reported in 1.A.1.a sector. 1.A.1 sector also includes the emissions from on-site use of fuel in the energy production facilities and emissions from manufacturing of solid fuels (peat briquettes plant) – these emissions are reported under 1.A.1.c Manufacture of solid fuels and other energy industries sector. (Table 3.2.11) There is no petroleum refining in Latvia.

Table 3.2.11 Emissions from 1.A.1 Energy industries in 1990–2008 (Gg)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	6386.1749	0.2741	0.0459	16.4180	5.0170	0.6270	37.2120
1991	5869.1930	0.2594	0.0418	15.0100	5.1310	0.6040	30.1790
1992	5002.5981	0.2544	0.0407	12.6620	5.5070	0.5630	27.5340
1993	4009.6609	0.2370	0.0389	10.1340	5.2380	0.4830	28.6890
1994	3766.3424	0.2443	0.0399	9.5440	5.2770	0.4680	32.4680
1995	3472.3226	0.2329	0.0361	8.6260	5.6790	0.4730	23.1200
1996	3596.8661	0.2517	0.0393	9.0140	5.8050	0.4850	28.8370
1997	3380.2709	0.2857	0.0413	8.5970	7.6540	0.5730	19.6180
1998	3418.2373	0.2822	0.0414	8.9740	7.2820	0.5620	20.4440
1999	2993.9265	0.2294	0.0337	7.9800	5.8110	0.4690	15.6590
2000	2543.3668	0.2201	0.0304	6.5790	6.2760	0.4640	7.1570
2001	2498.6258	0.1957	0.0265	6.6980	5.6220	0.4390	5.1900
2002	2396.3982	0.2011	0.0271	6.4920	5.8350	0.4450	4.8760
2003	2333.6018	0.2301	0.0305	6.5130	6.9050	0.4980	3.5200
2004	2143.8153	0.2071	0.0274	6.1120	6.1990	0.4540	2.1210
2005	2137.7501	0.1810	0.0237	6.0190	5.3830	0.4140	1.4550
2006	2167.7767	0.1976	0.0256	6.1580	5.9840	0.4470	0.6950
2007	2034.1359	0.1947	0.0256	5.8180	5.9310	0.4350	0.7980
2008	2005.5925	0.1895	0.02492	5.7442	5.7973	0.4266	0.4274
share of total 2008 emissions	**24.16%**	**0.20%**	**0.46%**	**15.16%**	**2.14%**	**0.79%**	**15.21%**

Emissions from 1.A.1 sector are decreasing year by year. (Table 3.2.12) In the beginning of 90-ties it is explained with economical crisis caused by changes of political and social situation in the country when national economy was totally reorganized. The increase of several emissions – CH_4, N_20, CO and NMVOC, in 1997 and 1998 comparing neighbourhood years is explained with increase of wood consumption by 56.7% and peat consumption by 7.7% in 1996-1997 and the decrease of same fuels consumption by 4.8% and 40.2% respectively in 1998-1999. At the end of 90-ties emissions started to decrease till 2005. Emissions slightly increased in 2006 but then decreased again in 2007. Decrease 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 fuels with lower costs and emissions – natural gas and biomass.

Also indirect GHG emissions from 1.A.1 Energy Industries were estimated. (Table 3.2.9) SO_2 had biggest decrease by 98.85% in 1990–2008. It is explained with fuel switching to natural gas and biomass from what sulphur dioxide emissions aren't emitted. Also other indirect GHG emissions in 2007–2008 decreased that is explained with the decrease of total fuel consumption combusted in stationary combustion installations.

3.2.6.2 Methodological issues

Methods

IPCC 1996 Tier1 Sectoral approach was used to calculate GHG emissions from the 1.A.1 sector. IPCC GPG 2000 Tier2 method was used to estimate CO_2 emissions from natural gas combustion as country specific parameters were used to estimate CO_2 emission factor for natural gas.

As sludge gas contents almost 50% of non-combustible components such as CO_2, sulphur and others and only 50% of sludge gas is combustible methane emissions from biogas was calculated only by taking into account the methane part of biogas. It means that under the biogas fuel the combustion of methane is reported. As this methane is obtained from sludge it is considered as biomass combustion and CO_2 neutral. Tier2 method from IPCC GPG 2000 was used to calculate CO2 emissions from methane obtained from sludge gas as plant specific parameters were used to estimate CO_2 emissions from methane obtained from sludge gas.

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

The general method for preparing inventory data was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (Gg)
EF – estimated or default emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

NO_x and SO_2 emission data of 2005-2008 from combined heat and power plants as well as heat production only plants are taken from database "2-AIR" where enterprises that do any pollution activity and have A, B or C category pollution permits report their emission data.

Emission factors and other parameters

The main sources for emission factors are:

- National studies for country specific parameters and emission factors;
- Plants' data of used fuels physical characteristics;
- IPCC 1996;
- IPCC 2006;

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

CO_2 emission factors

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. 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" (Annex 2). 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).

<u>Solid and liquid fuels and solid biomass</u>

For calculating CO_2 emission factors for liquid and solid fuels following equation was used:[7]

$$E'_{CO_2} = \frac{C^d \times M_{CO_2} \times 1000}{Q_z^d \times M_C \times 100}$$

where:
E'_{CO2} – emission factor for CO_2 (kg CO_2/MJ)
Q_z^d – net calorific value of fuel (MJ/kg (m^3))

[7] "Guidance manual for CO_2 emission estimations (Developed in accordance with UNFCCC and IPCC recommendations and physical characteristics of fuels used in Latvia)"

C^d – carbon content in fuel (%)
M_{CO2} – molecule weight for CO_2 – 44, 0098 (g/mcl)
M_C – molecule weight for C – 12,011 (g/mcl)

For submission 2010 CO_2 emission factors for certain types of fuels were recalculated according to CSB reported information of NCV changes in time period. NCV value was obtained from fuel consumers that have to report the used amount data and other fuel information. (Table 3.2.12)

Table 3.2.12 Characteristics of liquid, solid and solid biomass fuels and estimated CO_2 emission factors

Type of fuel	Carbon content in working mass of fuel (C^d) %	NCV (Q_z^d) MJ/kg	Oxidation factor (p)	Emission factor with oxidation factor (EF CO_2) kg/GJ
Coal	67.32	28.46 (1990-2002) 26.22 (2003-2008)	0.98	**84.93868** **92.19508**
Peat, W^d = 40%[8]	29.07	10.05	0.98	**103.86645**
Peat briquettes[9]		15.49	0.98	**95.06**
Coke	63.87	26.37 (1990-2001) 26.79 (2002-2008)	0.98	**86.97273** **85.60921**
Motor gasoline (for off-roads)	83.13	44 (1990-2002) 43.97	0.99	**68.53470** **68.58146**
Diesel oil	86.68	42.49	0.99	**74.001**
LPG	77.99	45.54	0.995	**62.43659**
Residual fuel oil	85.72	40.6	0.99	**76.58815**
Jet fuel	85.18	43.2 (1990-2003 43.21 (2004-2008)	0.99	**71.52524** **71.50869**
Shale oil	82.82	39.35	0.99	**76.34769**
Other kerosene	85.17	43.2 (1990-2002) 43.21 (2003-2008	0.99	**71.51684** **71.50029**
Wood, W^{d*} = 55%	20.11	6.70[10]	0.98	**107.77886**

Fuel characteristics for other liquid fuels and estimated CO_2 emission factor changes for every year in time series. (Table 3.2.13) The fuel characteristics depend on structure of other liquid fuels. CSB reported average NCV from the information obtained from fuel consumers

Table 3.2.13 Characteristics of liquid, solid and solid biomass fuels and estimated CO_2 emission factors

	1990	1991-1993	1994	1995	1996-1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Carbon content in working mass of fuel (C^d) %	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77	83.77
NCV (Q_z^d) MJ/kg	41.86	40.6	41.86	41.632	41.86	41.463	40.593	41.00	41.267	38.273	37.022	31.947	38.658	38.676	37.9
Oxidation factor (p)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Emission factor with oxidation factor (EF CO_2) kg/GJ	72.593	74.846	72.593	72.991	72.593	73.288	74.914	74.116	73.636	79.397	82.079	95.118	78.606	78.569	80.178

[8] moisture content
[9] emission factor was taken from GHG inventory of Finland
[10] for wood – Q_z^d is TJ/1000m^3

Natural gas

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

$$E'_{CO_2} = \frac{C^d \times M_{CO_2} \times 1000}{Q_z^d \times M_C \times 100} \times \rho$$

where:
E'_{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)
ρ – natural gas density (0.717 t/1000m^3) – for transition from density to mass units

Carbon content amount and NCV for all years in 1990-2008 of natural gas were obtained from only natural gas supplier A/S “Latvijas Gāze” that collects / measures these data by themselves. (Table 3.2.14)

Table 3.2.14 Characteristics of natural gas and estimated CO_2 emission factors

	Carbon content in working mass of fuel (C^d) %	**NCV (Q_z^d) TJ/1000m3**	**Oxidation factor (p)**	**Natural gas density (ρ) t/1000m3**	**Emission factor with oxidation factor (EF CO_2) kg/GJ**
1990	74.33	33.64	0.995	0.717	57.7591
1991	74.33	33.64	0.995	0.717	57.7591
1992	74.36	33.6	0.995	0.717	57.8512
1993	74.15	33.71	0.995	0.717	57.4996
1994	74.04	33.7	0.995	0.717	57.4313
1995	74.26	33.73	0.995	0.717	57.5508
1996	74.3	33.62	0.995	0.717	57.7702
1997	74.39	33.62	0.995	0.717	57.8401
1998	74.35	33.65	0.995	0.717	57.7575
1999	74.31	33.62	0.995	0.717	57.7779
2000	74.32	33.73	0.995	0.717	57.5973
2001	74.36	33.78	0.995	0.717	57.5430
2002	74.36	33.65	0.995	0.717	57.7653
2003	74.38	33.64	0.995	0.717	57.7980
2004	74.39	33.59	0.995	0.717	57.8918
2005	74.4	33.59	0.995	0.717	57.8996
2006	74.39	33.59	0.995	0.717	57.8918
2007	74.38	33.54	0.995	0.717	57.9703
2008	74.38	33.57	0.995	0.717	57.9185

Sludge gas

CO_2 emission factor was estimated for the methane obtained from biogas, it means that the CO_2 emission factor estimated below is estimated for pure methane that is obtained from collected sludge gas.

As wastewater treatment plant wasn’t able to provide the information of carbon content percentage in working mass of fuel that’s why constant methane value was used estimated basing on moll mass of components. Following equation was used to calculate this methane number:

[11] “Guidance manual for CO_2 emission estimations (Developed in accordance with UNFCCC and IPCC recommendations and physical characteristics of fuels used in Latvia)”

$$C^d = \frac{M_C}{(M_C + M_H)} \times 100$$

C^d – carbon content in fuel (%)
Mc – molecule weight for C – 12,011 (g/mcl)
M_H – H molecule weight (1.008 g/mcl)
100 – estimation of percentage

For calculation of CO_2 emission factor of methane obtained from sludge gas same equation as for natural gas was used.

NCV numbers of methane obtained from sludge gas that is combusted with energy recovery for all years are obtained from wastewater treatment plant. (Table 3.2.15)

Table 3.2.15 Characteristics of methane obtained from sludge gas and estimated CO_2 emission factors

	Carbon content in working mass of sludge gas (C^d) %	NCV of sludge gas (Q_z^d) TJ/1000m³	Amount of methane in sludge gas (%)	Default carbon content in working mass of methane (C^d) %	NCV of methane (Q_z^d) TJ/1000m³	Oxidation factor (p)	Natural gas density (ρ) t/1000m³	Emission factor with oxidation factor (EF CO_2) kg/GJ
2004	41.92582%	22.0	56.00%	74.86754%	39.286	0.995	0.717	49.81629
2005	41.92582%	22.0	56.00%	74.86754%	39.286	0.995	0.717	49.81629
2006	41.92582%	22.0	56.00%	74.86754%	39.286	0.995	0.717	49.81629
2007	41.92582%	22.0	56.00%	74.86754%	39.286	0.995	0.717	49.81629
2008	41.92582%	22.0	56.00%	74.86754%	39.286	0.995	0.717	49.81629

SO_2 emissions factors

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. Percentage amount of sulphur content in used fuels is taken from national database “2-AIR” where polluters report the sulphur content data for certain types of fuels. (Annex 2)

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 (%).

Other emission factors

The default CH_4, N_2O, NO_x, CO, NMVOC emission factors used in estimation of emission were taken from IPCC 1996 (Table 3.2.16). Emission factors for sludge gas were equalled to natural gas emission factors due to unavailability of particular emission factors for sludge gas.

Table 3.2.16 CH_4, N_2O, NO_x, CO, NMVOC emission factors (Gg/PJ)

	CH_4	N_2O	NO_x	CO	NMVOC
gasoline	0.05	0.002	0.21	27.0	1.0
diesel oil	0.003	0.0006	0.2	0.015	0.005
RFO	0.003	0.0006	0.2	0.015	0.005
LPG	0.003	0.0006	0.2	0.015	0.005
jet fuel	0.003	0.0006	0.2	0.015	0.005
other kerosene	0.003	0.0006	0.2	0.015	0.005
other liquid	0.003	0.0006	0.2	0.015	0.005
shale oil	0.003	0.0006	0.2	0.015	0.005
coal	0.001	0.0014	0.3	0.02	0.005
coke	0.01	0.0014	0.3	0.15	0.02
peat briquettes	0.03	0.004	0.1	1.0	0.05
peat	0.03	0.004	0.1	1.0	0.05
natural gas	0.001	0.0001	0.15	0.02	0.005
solid biomass	0.03	0.004	0.1	1.0	0.05
sludge gas	0.001	0.0001	0.150	0.020	0.005

SO_2 emission factors for fuel combustion are presented in Annex 2.

Activity data

Mainly emissions from fuel combustion are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2008 sent to EUROSTAT.

The CSB data collection system is based on detailed compulsory surveys 1–EK (semiannual) and 2-EK (annual). Form 1-EK "Survey on acquisition and consumption of energy resources" is collected from about 5000 enterprises and organizations (with all kind of economic activity) that are included in the lists of suppliers of statistical information. Consumption of fuel in sectors of national economy is surveyed in State and local government enterprises of all sectors regardless the number of employed, and in other enterprises employing 50 and more persons. Every half-year about 5000 respondents are surveyed. Data on enterprises and organizations employing less than 50 persons are obtained once a year with the help of random sampling and generalizing received results (survey 2–EK). 1–EK and 2–EK represents the basic tool for creating energy balances at a country level.

Table 3.2.17 Fuel consumption in 1.A.1 Energy industries in 1990−2008 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1.A.1 Energy industries																			
Liquid fuels	**40.479**	**33.253**	**28.440**	**27.170**	**30.860**	**20.519**	**27.336**	**17.438**	**20.662**	**17.491**	**7.901**	**5.277**	**5.076**	**3.606**	**3.144**	**2.395**	**1.512**	**1.389**	**0.905**
Solid fuels	**5.261**	**4.746**	**5.508**	**5.579**	**4.517**	**5.211**	**4.149**	**3.965**	**2.782**	**1.765**	**2.752**	**1.645**	**1.290**	**0.873**	**0.280**	**0.244**	**0.135**	**0.371**	**0.466**
Gaseous fuels	**48.609**	**49.859**	**39.792**	**24.255**	**16.779**	**24.117**	**18.828**	**28.442**	**27.088**	**25.733**	**28.868**	**33.579**	**32.544**	**34.078**	**32.415**	**33.355**	**35.235**	**32.668**	**32.698**
Biomass	**0.436**	**0.590**	**0.673**	**0.831**	**1.300**	**1.045**	**1.595**	**3.389**	**4.094**	**3.659**	**3.191**	**3.617**	**4.097**	**5.502**	**5.483**	**4.709**	**5.310**	**5.304**	**5.186**
1.A.1.a Public Electricity and Heat Production																			
Liquid fuels	**40.139**	**33.002**	**28.189**	**26.919**	**30.426**	**20.266**	**26.110**	**17.107**	**18.115**	**14.485**	**5.864**	**4.784**	**4.622**	**3.274**	**2.729**	**2.142**	**1.259**	**1.137**	**0.651**
diesel oil	5.524	5.226	3.824	0.935	0.382	0.085	0.042	0.297	0.085	0.085	0.127	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
RFO	32.561	26.146	23.183	24.563	30.044	20.016	25.984	16.768	17.905	14.007	4.831	4.141	4.222	3.045	2.598	2.071	1.177	1.056	0.609
LPG	0.046	0.046	0.046																
other liquid	2.009	1.583	1.137	1.421		0.126	0.084	0.042	0.126			0.167	0.042	0.029	0.088	0.029			
shale oil						0.039				0.394	0.905	0.433	0.315	0.157			0.039	0.039	
Solid fuels	**3.683**	**3.440**	**3.880**	**4.544**	**3.613**	**4.085**	**3.144**	**3.141**	**2.191**	**1.415**	**2.311**	**1.496**	**1.251**	**0.837**	**0.244**	**0.198**	**0.125**	**0.335**	**0.413**
coal	2.305	1.736	1.935	2.106	1.366	1.395	0.740	0.541	0.427	0.370	0.342	0.370	0.256	0.184	0.184	0.157	0.105	0.315	0.393

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
peat briquettes	0.031	0.015	0.015	0.015	0.015	0.077	0.062	0.077	0.015										
peat	1.347	1.688	1.930	2.422	2.231	2.613	2.342	2.523	1.749	1.045	1.970	1.126	0.995	0.653	0.060	0.040	0.020	0.020	0.020
natural gas	**47.802**	**49.234**	**39.162**	**23.631**	**16.143**	**23.172**	**17.785**	**27.871**	**26.347**	**25.094**	**28.059**	**32.700**	**31.737**	**33.203**	**31.542**	**32.481**	**34.295**	**32.098**	**31.892**
Biomass	**0.436**	**0.590**	**0.673**	**0.831**	**1.300**	**1.045**	**1.595**	**3.363**	**4.060**	**3.558**	**3.082**	**3.487**	**3.922**	**4.564**	**4.552**	**4.150**	**4.720**	**4.599**	**4.550**
solid biomass	0.436	0.590	0.673	0.831	1.300	1.045	1.595	3.363	4.060	3.558	3.082	3.487	3.922	4.564	4.497	4.055	4.633	4.513	4.463
sludge gas															0.055	0.095	0.087	0.086	0.087
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries																			
Liquid fuels	**0.339**	**0.251**	**0.251**	**0.251**	**0.433**	**0.253**	**1.226**	**0.331**	**2.547**	**3.005**	**2.037**	**0.494**	**0.455**	**0.332**	**0.415**	**0.253**	**0.253**	**0.251**	**0.253**
diesel oil	0.212	0.170	0.170	0.170	0.170	0.212	0.127	0.127	0.127	0.212	0.127	0.170	0.212	0.170	0.212	0.212	0.212	0.170	0.212
RFO	0.081	0.081	0.081	0.081	0.081	0.041	1.096	0.203	0.487	0.731	0.447	0.284	0.203	0.162	0.203	0.041	0.041	0.081	0.041
LPG	0.046				0.182														
jet fuel									0.216	0.346									
other kerosene				0.000	0.000		0.002	0.000											
other liquid									1.716	1.716	1.423								
shale oil											0.039	0.039	0.039						
Solid fuels	**1.578**	**1.307**	**1.628**	**1.035**	**0.905**	**1.126**	**1.005**	**0.824**	**0.591**	**0.350**	**0.441**	**0.149**	**0.039**	**0.036**	**0.036**	**0.046**	**0.010**	**0.036**	**0.052**
coal									0.028	0.028	0.028	0.028	0.028	0.026	0.026	0.026		0.026	0.052
peat	1.578	1.307	1.628	1.035	0.905	1.126	1.005	0.824	0.563	0.322	0.412	0.121	0.010	0.010	0.010	0.020	0.010	0.010	
natural gas	**0.808**	**0.625**	**0.630**	**0.624**	**0.637**	**0.944**	**1.042**	**0.572**	**0.740**	**0.639**	**0.809**	**0.878**	**0.808**	**0.875**	**0.873**	**0.873**	**0.940**	**0.571**	**0.806**
solid biomass								0.026	0.034	0.101	0.109	0.130	0.175	0.938	0.931	0.559	0.590	0.705	0.636

The biggest decrease in time period 1990–2008 for these two sub-sectors of 1.A.1 Energy industries sector was for liquid fuel consumption in 1.A.1.a subsector – 98.38% (Table 3.2.17, Figure 3.2.2). 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. In the latest years consumption of solid fuels is increasing that is explained with increase of coal consumption in Energy industries – 325% in 2006-2008. The increase of solid fuel consumption was promoted by increase of oil price in world when coal combustion was cheaper than combustion of residual fuel oil and diesel oil.

Consumption of biomass fuel has increased by 1069.5% in 1990–2008. Solid biomass has lower cost and liquid and solid fuels were switched to biomass and natural gas. Years 2006-2008 had quite high average temperature that's why fuel consumption for CHP and heat plants for heat production decreased as there wasn't any need of high heat production amount. Fuel consumption decrease in 1.A.1 Energy industries sector is explained also with decrease of central heating supply consumers when they switched to individual heating supply.

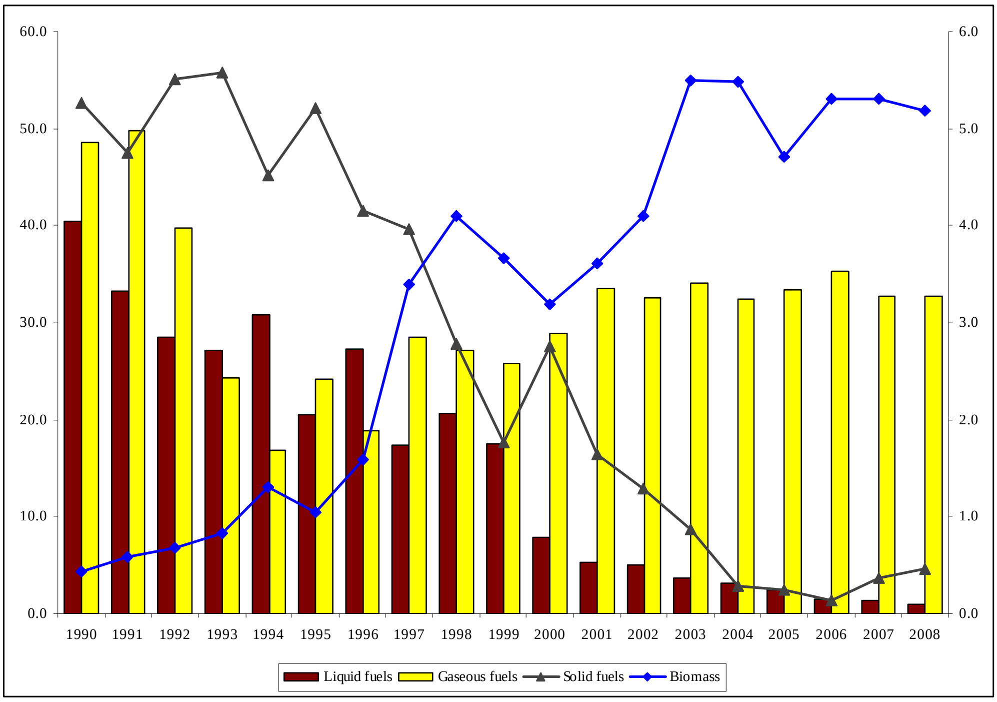


Figure 3.2.2 Fuel consumption in 1.A.1 Energy industries in 1990–2008 (PJ)

3.2.6.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in 1.A.1 sector is ±2% in 2008. CSB gives approximately 2% statistical sample error 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 biogas stationary combusted in enterprises covered by 1.A.1 Energy Industries sector was assumed rather low – 2% because the combusted fuel amount is obtained directly from wastewater treatment plant that has precise measurement equipment for accounting of combusted fuel. Still the methane percentage amount in combusted sludge gas is given approximate by the wastewater treatment plant that's why final uncertainty of combusted sludge gas is assumed as 20%.

CO_2 emission factor was estimated according physical characterization of used fuels in country basing on average NCV reported by fuel consumers and carbon content so uncertainty was assigned as quite low about 10%. For combustion of solid fuels uncertainty of CO_2 emission factor was assigned higher to 15% because CO_2 emission factor of peat briquettes was taken from GHG inventories of Finland. As well as CO_2 emission factor for natural gas was assumed rather low as 5% because plant specific fuel data is used to estimate emission factor. CO_2 emission factor for sludge gas was assigned as 10% because constant carbon content was used in emission estimation but plant specific NCV value is used. 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 1996 so uncertainty was assigned as very high about 50% according IPCC GPG 2000.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 3.2.18 were double-checked and large fluctuations were explained.

Table 3.2.18 IEF changes higher than 10% for 1.A.1 sector

Sectors	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comment
1.A.1.a	Other Liquid Fuels/CO_2	t/TJ	2004	82.079379	2005	95.118251	15.89%	In 2005 structure of other liquid fuels changed therefore average NCV in 2005 was lower (more light liquid fuels were used). That’s why estimated CO_2 EF and estimated carbon emission factor increased in 2005
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2006	5.6639462	2007	2.7359742	-51.69%	Large fluctuation of CH_4 IEF is explained with changes of solid fuels structure. In 90ties significant amount of peat and peat briquettes were used in the sector (CH_4 IEF for peat is 30 (kg/TJ) but for coal 1 (kg/TJ) and peat consumption dominated in the solid fuels consumption in the sector. Starting 2004 peat consumption is smaller than coal consumption and remains small when coal consumption increased three times in 2006-207
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2007	2.7359742	2008	2.4100145	-11.91%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2005	6.9021871	2006	5.6639462	-17.94%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2004	8.1715059	2005	6.9021871	-15.53%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2003	23.639193	2004	8.1715059	-65.43%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2000	25.714968	2001	22.825914	-11.23%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1999	22.418335	2000	25.714968	14.71%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1995	20.099937	1996	23.173736	15.29%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1993	16.557921	1994	19.034061	14.95%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1990	11.848051	1991	15.364398	29.68%	
1.A.1.a	Solid Fuels/N_2O	kg/TJ	2006	1.8181469	2007	1.5554042	-14.45%	Fluctuation of N_2O emissions is also explained with changes in solid fuels structure and mainly with changes in peat and peat briquettes consumption (N_2O IEF for peat is 4 (kg/TJ) but for coal 1.4 (kg/TJ) (see previous explanation)
1.A.1.a	Solid Fuels/N_2O	kg/TJ	2003	3.4297207	2004	2.0429626	-40.43%	
1.A.1.a	Solid Fuels/N_2O	kg/TJ	1990	2.3725839	1991	2.6878426	13.29%	
1.A.1.c	Solid Fuels/CH_4	kg/TJ	2006	30.0	2007	9.0355666	-69.88%	Changes of all emissions IEF are explained with changes in peat consumption. In 1990-1997 no changes in IEFs were observed as coal consumption appeared only in 1998. In 1998-2001 peat consumption was significantly bigger than coal consumption and only starting 2002 coal consumption exceeded peat consumption. In 2006 no coal was combusted in the sector therefore only peat IEF is reported.
1.A.1.c	Solid Fuels/CH_4	kg/TJ	2005	13.584197	2006	30.0	120.84%	
1.A.1.c	Solid Fuels/CH_4	kg/TJ	2004	9.0355666	2005	13.584197	50.34%	
1.A.1.c	Solid Fuels/CH_4	kg/TJ	2001	24.463035	2002	8.5681641	-64.98%	
1.A.1.c	Solid Fuels/CH_4	kg/TJ	2000	28.126399	2001	24.463035	-13.02%	
1.A.1.c	Solid Fuels/ CO_2	t/TJ	2001	100.25257	2002	89.878283	-10.35%	
1.A.1.c	Solid Fuels/N_2O	kg/TJ	2006	4.0	2007	2.1204301	-46.99%	
1.A.1.c	Solid Fuels/N_2O	kg/TJ	2005	2.5282383	2006	4.0	58.21%	
1.A.1.c	Solid Fuels/N_2O	kg/TJ	2004	2.1204301	2005	2.5282383	19.23%	
1.A.1.c	Solid Fuels/N_2O	kg/TJ	2001	3.5035825	2002	2.0785251	-40.67%	

3.2.6.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia’s national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

<u>3.2.6.4.1 General QA/QC checks for 1.A.1 sector</u>

For stationary fuel combustion following QA/QC checks are performed for all parts of national inventory.

There are several steps for activity data verification:

1. Activity data check at the data providing institution:
    - CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.

2. Activity data checked at the institution responsible for the emission estimation and reporting:
    - During the activity data is input in emission estimation database done by sectoral expert all the data changes comparing to previous inventory are agreed with CSB and the data changes reason in explained.
    - After the data is input in emission estimation database activity data is verified using diagrams that is the best way to reflect all the illogical data fluctuations.
    - The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR.
3. Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 5%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

Estimated emissions verification:

1. All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.
2. Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.
3. NO_x and SO_x emissions from national database “2-Air” are verified and approved by Regional Environmental Boards.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

<u>3.2.6.4.2 Additional QA/QC checks for Tier2 methodology</u>

Country specific CO_2 emission factors

Mainly Tier1 methodology is reported as used in the CO_2 emission estimation but according to IPCC 2006 it would be Tier2 methodology as country or plant specific emission factors are used. Country specific emission factors are estimated using NCV values reported by CSB. CSB collects these data from fuel combustion enterprises and reports annual average number in Annual Questionnaire tables. Carbon content values of the fuels are determined in local expert’s research. Detailed CO_2 emission factors estimation data is used and CO_2 emission factor is estimated to the last decimal place. Estimated CO_2 emission factors are within IPCC range. Even if the estimated CO_2 EFs are almost equal to IPCC default EFs or don’t differ at all the EFs are reported as country specific.

Plant specific CO_2 emission factors and Tier2 CO_2 emission estimation methodology

Tier2 methodology is used for CO_2 emission from natural gas and sludge gas combustion estimation as plant specific NCVs are used in CO_2 EF estimation. The parameters are reported to LEGMC by only natural gas supplier “Latvijas Gāze” and sludge gas collecting plant and the companies confirm that the data is reasonable and useful.

Natural gas supplying company measures NCV every day and reports the average annual number to LEGMC and CSB. All the measuring equipments are checked and verified.

The parameters also are verified by CSB comparing the data natural gas supplier and sludge gas collecting plant has reported within annual Energy balance surveys.

Also CO_2 emission estimation methodology differs from IPCC default because only methane obtained from sludge gas only is taken into account.

3.2.6.5 Source-specific recalculations

Natural gas consumption for year 1990–2007 was recalculated as data of natural gas characterization from only natural gas provider a/s "Latvijas Gāze" was obtained – net calorific value changes year by year. CO_2 emission factor for natural gas was changed for all years according to country specific natural gas characterizations reported by natural gas provider.

Sludge gas activity data were changed due to updated information received from Latvia's wastewater treatment plant. CO_2 emission factor for biomass also was changed according to sewage treatment plants and these are plant specific emission factors.

NCV changed for other liquid fuels for 2000-2007 due to possibility to divide used oil consumption from total other liquid fuels. NCV changes for all years in time series for natural gas and biogas.

CO_2 emission factor for all fuel types were précised to include numbers to the last decimal places. CO_2 emission factors were recalculated for some fuel types due /to change of NCV in particular time period of the time series, for example for other liquid fuels, used oils, coal and coke.

NO_x and SO_x emissions for 2005-2007 (and 2008) for 1.A.1.a are taken from national database "2-AIR" where enterprises that do any pollution activity and have A, B or C category pollution permits report their emission data.

Difference for submission 2009 and submission 2010 in reported GHG emissions is quite small for all years in time series 1990–2007 fluctuating from 0.49% in 1993 to 3.64% in 2006 with average difference 1.88%. (Figure 3.2.3)

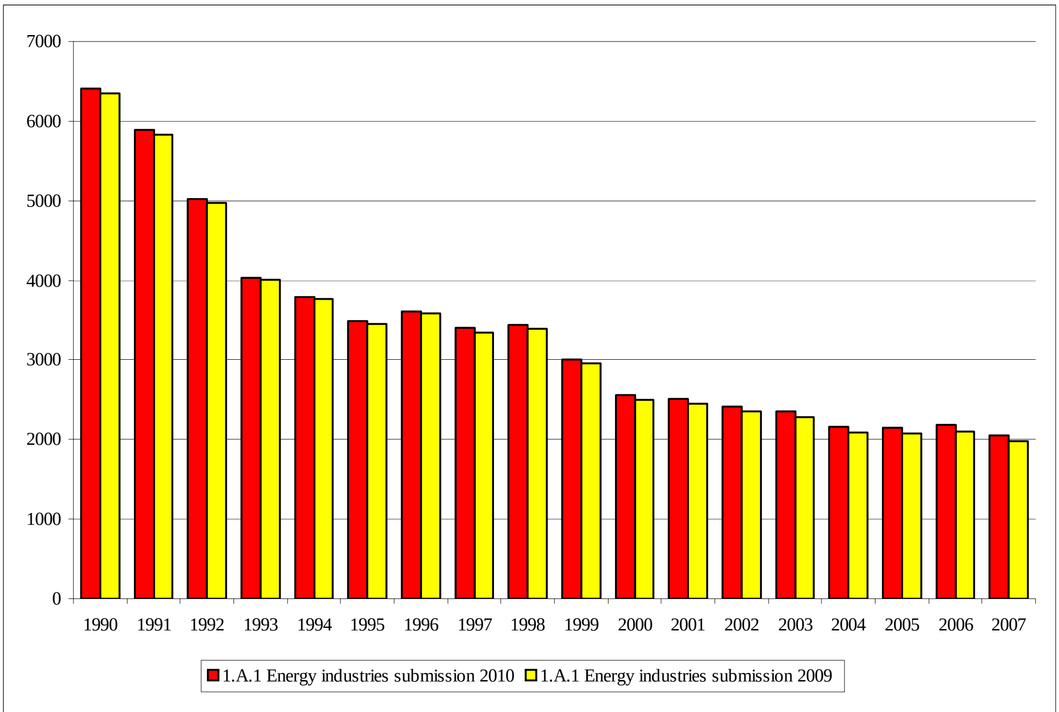


Figure 3.2.3 Comparison for GHG emissions from 1.A.1 Energy industries sector for submission 2009 and submission 2010 (Gg)

3.2.6.6 Source-specific planned improvements

The summarized necessary improvements are:

- Researches on use of the country specific emission factors for key category – CH_4 emissions from solid biomass combustion;
- Researches of possibility to use plant specific data from national database "2-AIR" where facilities that perform any of pollution activities have to report all emissions they create;
- Improving country specific CO_2 emission factors.

3.2.7 Manufacturing Industries and Construction (CRF 1.A.2)

3.2.7.1 Source category description

1.A.2 Manufacturing industries and construction sector include emissions from fuel combustion in combustion installations for industrial production including emissions from off–road. 1.A.2 sector also includes the emissions from on-site use of fuel in the industrial production facilities (autoproducers) – these emissions are reported under particular sub-sectors of 1.A.2 according to IPCC 1996. (Table 3.2.19)

Under 1.A.2 f Other sector emissions from following industrial sectors are reported:

- Non-Metallic Minerals
- Transport Equipment
- Machinery
- Mining and Quarrying
- Wood and Wood Products
- Construction
- Textiles and Leather
- Non-specified (Industry)

Table 3.2.19 Emissions from 1.A.2 Manufacturing industries and construction in 1990–2008 (Gg)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	3804.9547	0.2627	0.0259	10.1841	26.2829	1.2113	23.2593
1991	2856.3848	0.1937	0.0178	7.6253	8.2018	0.4807	14.0699
1992	2406.2672	0.1674	0.0159	6.4477	8.0751	0.4473	12.9962
1993	2118.3163	0.1767	0.0210	5.8805	10.2965	0.4877	14.3774
1994	1919.6762	0.1670	0.0215	5.3704	8.4777	0.3987	15.5351
1995	1888.9816	0.1657	0.0217	5.2526	6.6154	0.3131	14.9202
1996	1851.6821	0.1756	0.0225	5.1737	9.4753	0.4097	14.4692
1997	1806.0156	0.1735	0.0226	5.0616	8.4312	0.3663	13.9730
1998	1584.5440	0.1815	0.0225	4.5227	9.2961	0.3737	10.8191
1999	1437.0135	0.1740	0.0216	4.1297	8.0521	0.3188	8.7987
2000	1190.0139	0.1564	0.0176	3.4033	7.0279	0.2757	4.5315
2001	1098.7048	0.1981	0.0213	3.2598	9.3741	0.3294	2.3427
2002	1140.4569	0.1940	0.0196	3.2989	9.6650	0.3534	1.7825
2003	1085.1430	0.1853	0.0186	3.1160	8.2839	0.2997	1.2762
2004	1085.8294	0.2314	0.0242	3.2440	12.2824	0.4139	0.7614
2005	1159.6707	0.2610	0.0278	3.5637	14.0481	0.4702	1.0661
2006	1191.1058	0.2895	0.0320	3.8134	15.8847	0.5234	1.1611
2007	1253.4261	0.2656	0.0291	3.8937	13.8921	0.4834	1.2514
2008	1155.2928	0.2718	0.0303	3.6711	14.6762	0.4961	1.0089
share of total 2008 emissions	**13.92%**	**0.29%**	**0.56%**	**9.69%**	**5.42%**	**0.92%**	**35.91%**

Emissions from 1.A.2 were increasing in 2003-2007 due to sharp development of nation economy and industry as well as increase of demand of industrial production and improvement of well-being of population. Increase of CO_2 emissions are also caused by constant increase of solid fuels – coal, and other fuels (used tires) consumption that mostly is combusted in mineral and steel production industry. Decrease of emissions in 2007-2008 is influenced by the features of national economy development when in-country industrial production already started to decrease due to increase of costs of the production and dominance of imported products. Crisis in national economy in the second part of 2008 also influenced decrease of total emissions. Also increase of solid biomass consumption influenced the increase of CO_2 emissions.

Also indirect GHG emissions from 1.A.2 sector were estimated. (Table 3.2.20) Also in this sector SO_2 emissions had biggest decrease by 95.66% in 1990–2008. It is explained with fuel switching to natural gas and biomass from what sulphur dioxide emissions aren't emitted. All GHG emissions with the exception of CO emissions in 2007–2008 have decreased that is explained with the decrease of total fuel consumption combusted in stationary combustion installations. Increase of solid biomass consumption by 7.61% increased the CO emissions by 5.64% in 2007-2008.

3.2.7.2 Methodological issues

Methods

IPCC 1996 Tier1 Sectoral approach was used to calculate GHG emissions from the 1.A.2 sector. IPCC 2006 was used in the calculation of emissions from liquid biofuels used in chemical industry. IPCC GPG 2000 Tier2 method was used to estimate CO_2 emissions from natural gas combustion as country specific parameters were used to estimate CO_2 emission factor.

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

The general method for preparing inventory data was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (Gg)
EF – estimated or default emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

Emission factors and other parameters

The main sources for emission factors are:

- National studies for country specific parameters and emission factors;
- Plants' data of used fuels physical characteristics;
- IPCC 1996;
- IPCC 2006;

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

CO_2 emission factors

CO_2 emission factors for 1.A.2 Manufacturing Industries and Construction sector are estimated with the same equations and using same method as for 1.A.1 Energy industries sector with the exception for liquid biofuels and used tires that are not combusted in 1.A.1 Energy industries.

Liquid biofuels

Liquid biofuels – glycerine, CO_2 emission factor is taken from IPCC 2006 as there is no information available of used biofuels characteristics to estimate country or plant specific CO_2 emission factor. CO_2 emission factor 79.6 Gg/PJ from IPCC 2006 is used as for other liquid biofuels is used.

Used tires

EF for CO_2 emission estimation for other fuels – used tires, combusted in CRF 1.A.2.f Other Manufacturing Industries – cement production, category for years 1999–2008 is taken from GHG emission reports that plant submitted under ETS. (Table 3.2.20) This CO_2 emission factor is estimated at the plant by using plant specific data about combustion installation, as well as net calorific value and carbon content measured and obtained in the plant laboratory. EF for CH_4 and N_2O emissions estimations are taken from IPCC 2006.

Table 3.2.20 CO_2 emission factor (Gg/PJ)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Used tires	82.7556	82.7556	82.7556	82.7556	82.7556	82.7556	79.4	79.4	73.33	85.00

As it was mentioned since 2005 the cement production plant is participating in EU Emission trading scheme so estimated CO_2 EF is verified by accredited verifiers and the approved by Regional Environment Board.

SO_2 emissions factors

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. Percentage amount of sulphur content in used fuels is taken from national database “2-AIR” where polluters report the sulphur content data for certain types of fuels. (Annex 2)

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 (%).

Other emission factors

The default CH_4, N_2O, NO_x, CO, NMVOC emission factors used in estimation of emission were taken from IPCC 1996 (Table 3.2.21).

Table 3.2.21 CH_4, N_2O, NO_x, CO, NMVOC emission factors (Gg/PJ)

	CH_4	N_2O	NO_x	CO	NMVOC
gasoline	0.05	0.002	0.21	27.0	1.0
diesel oil	0.002	0.0006	0.2	0.01	0.005
RFO	0.002	0.0006	0.2	0.01	0.005
LPG	0.002	0.0006	0.2	0.01	0.005
jet fuel	0.002	0.0006	0.2	0.01	0.005
other kerosene	0.002	0.0006	0.2	0.01	0.005

	CH_4	N_2O	NO_x	CO	NMVOC
other liquid	0.002	0.0006	0.2	0.01	0.005
shale oil	0.002	0.0006	0.2	0.01	0.005
coal	0.01	0.0014	0.3	0.15	0.02
coke	0.01	0.0014	0.3	0.15	0.02
peat briquettes	0.03	0.004	0.1	1.0	0.05
peat	0.03	0.004	0.1	1.0	0.05
natural gas	0.005	0.0001	0.15	0.03	0.005
solid biomass	0.03	0.004	0.1	2.0	0.05
Liquid biofuels	0.003	0.004	0.1	2	0.05
used tires	0.03	0.004	-	-	-

Activity data

Emissions from 1.A.2 sector are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2008 sent to EUROSTAT. The data collection system for 1.A.2 sector is the same as for 1.A.1 sector. (Table 3.2.22)

Autoproducers data prepared by CSP are taken into account into the calculation of the emissions from 1.A.2 sector according to IPCC 1996.

Table 3.2.22 Fuel consumption in 1.A.2 Manufacturing industries and construction in 1990–2008 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1.A.2 Manufacturing industries and construction																			
Liquid fuels	**28.963**	**18.770**	**16.010**	**16.557**	**16.022**	**16.341**	**15.981**	**15.687**	**12.669**	**11.157**	**7.496**	**4.892**	**4.414**	**3.784**	**3.442**	**3.226**	**3.654**	**3.918**	**3.351**
Solid fuels	**1.598**	**1.008**	**1.110**	**1.748**	**1.645**	**0.824**	**0.767**	**0.740**	**0.686**	**0.702**	**0.518**	**0.518**	**0.496**	**0.397**	**0.407**	**1.105**	**1.498**	**2.126**	**2.130**
Gaseous fuels	**25.610**	**23.403**	**19.006**	**12.431**	**9.761**	**9.990**	**9.885**	**9.548**	**9.791**	**9.149**	**9.858**	**11.600**	**12.848**	**12.726**	**13.093**	**13.550**	**13.263**	**12.884**	**11.874**
Biomass	**0.617**	**0.603**	**0.616**	**1.779**	**2.101**	**2.414**	**2.664**	**2.740**	**3.188**	**3.180**	**2.696**	**3.856**	**3.393**	**3.309**	**4.706**	**5.535**	**6.428**	**5.388**	**5.798**
Other fuels										**0.037**	**0.131**	**0.245**	**0.332**	**0.291**	**0.314**	**0.183**	**0.131**	**0.210**	**0.210**
1.A.2.a Iron and Steel																			
Liquid fuels	**2.057**	**1.017**	**0.733**	**0.731**	**0.913**	**0.705**	**0.785**	**1.162**	**1.088**	**1.130**	**1.173**	**1.083**	**0.963**	**0.963**	**0.963**	**0.652**	**0.963**	**0.963**	**0.917**
diesel oil	0.042	0.042	0.042		0.042						0.042					0.042			
RFO	1.177	0.974	0.690	0.284	0.284	0.203	0.325	0.325											0.122
other liquid	0.837			0.447	0.586	0.502	0.460	0.837	1.088	1.130	1.130	1.005	0.963	0.963	0.963	0.610	0.963	0.963	0.795
shale oil												0.079							
Solid fuels	**0.053**	**0.105**	**0.132**	**0.134**	**0.185**	**0.158**	**0.158**	**0.264**	**0.264**	**0.264**	**0.264**	**0.264**	**0.241**	**0.134**	**0.188**	**0.161**	**0.134**	**0.107**	**0.134**
coal				0.028															
coke	0.053	0.105	0.132	0.105	0.185	0.158	0.158	0.264	0.264	0.264	0.264	0.264	0.241	0.134	0.188	0.161	0.134	0.107	0.134
natural gas	**4.238**	**3.602**	**3.426**	**2.893**	**3.109**	**2.361**	**2.521**	**3.955**	**4.038**	**3.902**	**3.913**	**4.066**	**3.904**	**3.970**	**4.031**	**4.131**	**4.098**	**4.125**	**3.827**
1.A.2.b Non-Ferrous Metals																			
diesel oil												**0.042**							
natural gas									**0.054**	**0.101**	**0.169**	**0.190**	**0.269**	**0.302**	**0.269**	**0.203**	**0.204**	**0.201**	**0.134**
1.A.2.c Chemicals																			
Liquid fuels	**3.642**	**2.059**	**1.684**	**2.964**	**3.250**	**4.547**	**3.451**	**3.207**	**0.325**	**0.164**	**0.122**	**0.164**	**0.162**	**0.122**					**0.166**
diesel oil	0.127	0.127	0.085		0.042					0.042									0.042
RFO	3.126	1.543	1.340	2.964	3.207	4.547	3.451	3.207	0.325	0.122	0.122	0.122	0.162	0.122					0.081
other kerosene	0.389	0.389	0.259																
other liquid												0.042							0.042
coal				**0.028**	**0.028**														
natural gas	**0.423**	**0.492**	**0.414**	**0.643**	**0.693**	**1.091**	**0.703**	**0.304**	**0.302**	**0.366**	**0.318**	**0.270**	**0.279**	**0.309**	**0.406**	**0.443**	**0.480**	**0.381**	**0.514**
Biomass				**0.004**	**0.007**	**0.007**	**0.013**	**0.020**	**0.020**	**0.054**	**0.047**	**0.046**	**0.029**	**0.019**	**0.047**	**0.029**	**0.058**	**0.073**	**0.188**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
solid biomass				0.004	0.007	0.007	0.013	0.020	0.020	0.054	0.047	0.046	0.029	0.019	0.047	0.029	0.056	0.072	0.187
liquid biomass																	0.002	0.001	0.001
1.A.2.d Pulp, Paper and Print																			
RFO	0.203	0.162	0.122	0.122	0.041	0.081													
coal	0.028	0.028	0.028	0.114	0.057	0.057	0.057	0.057	0.028	0.028		0.028	0.028	0.026	0.026	0.026	0.026		
natural gas	2.701	2.614	2.412	0.654	0.044	0.101	0.119	0.105	0.095	0.101	0.101	0.135	0.134	0.168	0.168	0.202	0.235	0.201	0.201
solid biomass				0.065	0.188	0.087	0.020	0.020	0.020	0.040	0.023	0.013	0.020	0.020	0.020	0.027	0.020	0.016	0.007
1.A.2.e Food Processing, Beverages and Tobacco																			
Liquid fuels	10.547	7.700	7.045	6.807	4.419	4.694	5.429	5.205	5.239	4.133	2.971	1.650	1.483	1.122	0.960	0.999	1.003	0.788	0.536
diesel oil	3.229	3.229	3.102	3.229	0.765	0.552	0.510	0.807	0.722	0.552	0.552	0.467	0.340	0.340	0.340	0.297	0.255	0.212	0.212
RFO	7.105	4.425	3.898	3.532	3.654	4.060	4.791	4.222	4.385	3.492	1.746	0.974	0.893	0.609	0.406	0.406	0.447	0.329	0.122
LPG	0.046	0.046	0.046	0.046				0.046	0.046	0.046		0.046	0.046	0.046	0.046	0.046	0.091	0.091	0.046
jet fuel							0.043	0.086	0.043										
other kerosene							0.043	0.043	0.043	0.043	0.043								
other liquid	0.167					0.042	0.042					0.084	0.126	0.088	0.130	0.171	0.171	0.117	0.117
shale oil						0.039					0.630	0.079	0.079	0.039	0.039	0.079	0.039	0.039	0.039
Solid fuels	1.069	0.598	0.655	0.593	0.581	0.309	0.309	0.267	0.184	0.239	0.140	0.140	0.141	0.158	0.105	0.132	0.105	0.079	0.079
coal	0.911	0.598	0.655	0.541	0.512	0.256	0.256	0.199	0.142	0.171	0.114	0.114	0.114	0.131	0.105	0.105	0.079	0.079	0.079
coke	0.158			0.053	0.053	0.053	0.053	0.053	0.026	0.053	0.026	0.026	0.027	0.027		0.027	0.027		
peat briquettes					0.015			0.015	0.015	0.015									
natural gas	3.149	2.698	2.511	3.500	2.831	3.066	3.282	3.042	2.723	2.606	2.613	2.781	2.989	2.765	3.242	3.154	3.254	2.688	2.373
solid biomass	0.228	0.231	0.230	0.238	0.316	0.327	0.330	0.325	0.328	0.349	0.450	0.800	0.842	0.719	0.916	1.034	0.772	0.701	0.394
1.A.2.F Other																			
Liquid fuels	12.513	7.832	6.427	5.934	7.400	6.314	6.316	6.113	6.017	5.730	3.230	1.953	1.806	1.578	1.519	1.575	1.688	2.167	1.733
gasoline	0.880	0.220	0.220	0.220	0.132	0.044	0.132	0.088	0.088	0.044	0.044	0.044	0.088	0.044	0.088	0.088	0.088	0.088	0.088
diesel oil	2.167	2.210	0.807	0.552	0.765	0.935	0.807	0.935	0.935	0.935	0.892	0.850	0.892	0.850	1.020	1.062	1.275	1.785	1.402
RFO	9.297	5.359	5.400	5.075	6.415	5.116	5.197	4.913	4.994	4.588	1.462	0.447	0.122	0.081	0.041	0.122	0.081	0.122	0.041
LPG					0.046	0.091	0.137	0.091		0.046	0.046				0.046	0.046	0.046	0.046	0.046
jet fuel																			
other kerosene	0.043	0.043		0.086	0.043	0.086	0.043	0.086											
other liquid	0.126					0.042						0.377	0.586	0.485	0.246	0.217	0.159	0.088	0.117
shale oil										0.118	0.787	0.236	0.118	0.118	0.079	0.039	0.039	0.039	0.039
Solid fuels	0.448	0.276	0.295	0.878	0.795	0.300	0.243	0.152	0.209	0.171	0.114	0.085	0.085	0.079	0.089	0.787	1.232	1.940	1.918
coal	0.369	0.256	0.285	0.825	0.768	0.285	0.228	0.142	0.199	0.171	0.114	0.085	0.085	0.079	0.079	0.787	1.232	1.940	1.918
coke	0.079			0.053	0.026														
peat briquettes						0.015	0.015												
peat		0.020	0.010					0.010	0.010						0.010				
natural gas	15.099	13.997	10.243	4.741	3.083	3.371	3.260	2.141	2.581	2.074	2.745	4.157	5.274	5.212	4.977	5.419	4.992	5.286	4.825
solid biomass	0.389	0.372	0.386	1.472	1.590	1.993	2.301	2.375	2.820	2.737	2.176	2.997	2.502	2.551	3.723	4.445	5.578	4.598	5.209
used tires										0.037	0.131	0.245	0.332	0.291	0.314	0.183	0.131	0.210	0.210

Only liquid fuels and natural gas consumption have decreased in 1990-2008 when liquid fuels had the biggest decrease in time period – 88.43% (Table 3.2.23, Figure 3.2.4). 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. Decrease of natural gas reflects the total decrease of industrial production if comparing with 1990.

After the crisis in the beginning of 90-ties natural gas consumption steadily increased with some small exceptions due to fuel switch processes and development of national economy.

Increase of solid fuels – mainly coal, consumption by 33.28% is explained with the development of mineral production sector in Latvia – cement production where coal consumption increased more than four times. Solid fuels consumption steadily were growing since 2003 – more than 400% increase. The increase of solid fuel consumption was promoted by increase of oil price in world when coal combustion was cheaper than combustion of residual fuel oil and diesel oil.

Consumption of biomass fuel has increased almost 10 times in 839.66% in 1990–2008. Solid biomass has lower cost and liquid and solid fuels were switched to biomass and natural gas. Years 2006-2008 had quite high average temperature that's why fuel consumption for autoproducers heat plants for heat production decreased as there wasn't any need of high heat production amount.

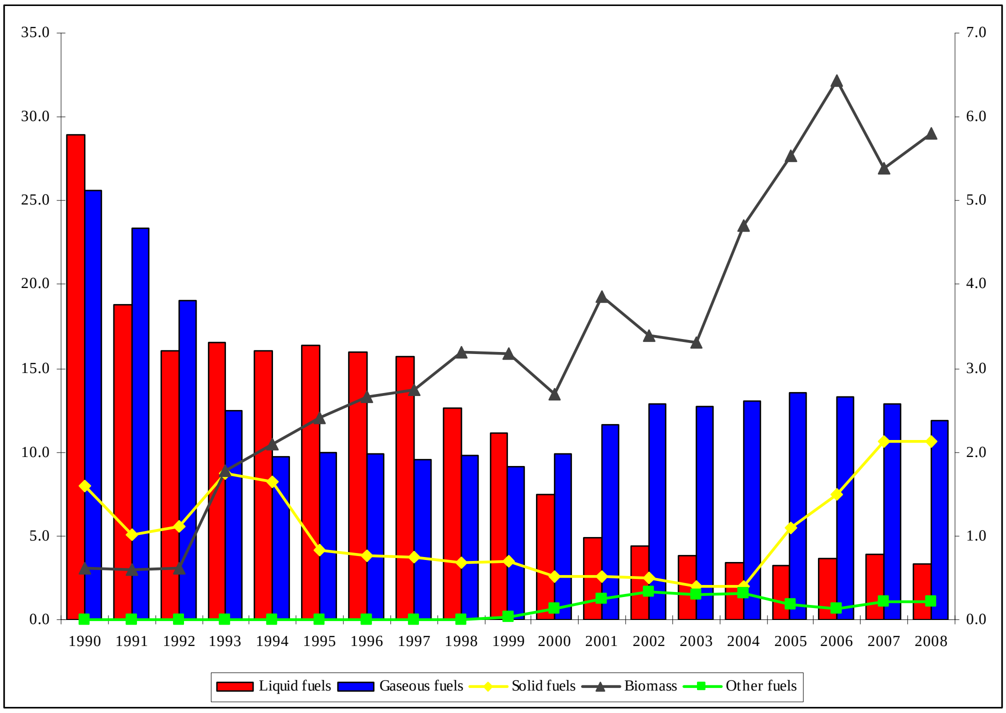


Figure 3.2.4 Fuel consumption in 1.A.2 Manufacturing industries and construction in 1990–2008 (PJ)

Consumption of used tires in Mineral production reported as Other Fuels had increased by 804.1% in 1999-2002 but then decreased by 36.72% in 2002-2008. The decrease is explained with fuel and technology switch in cement production enterprise. Still consumption of used tires had increased again in 2005-2007 due to sharp increase of cement production that was caused by increasing demand of construction materials and sharp development of construction sector.

Used tires consumption in 2001-2004 increased significantly because cement production plant was financially supported by government authorities for the tires combustion. In 2005 EU ETS began operations so the tires combustion wasn't advantageous because it's quite CO_2 non-friendly activity. Also in 2005 new technologies were introduced in cement production plant and so big sulphur amount weren't needed.

3.2.7.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in 1.A.2 sector is ±2% in 2008. CSB gives approximately 2% statistical sample error 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.

CO_2 emission factor was estimated according physical characterization of used fuels in country basing on average NCV reported by fuel consumers and carbon content so uncertainty was assigned as quite low about 10%. For combustion of solid fuels uncertainty of CO_2 emission factor was assigned higher to 15% because CO_2 emission factor of peat briquettes was taken from GHG inventories of Finland. As well as CO_2 emission factor for natural gas was assumed rather low as 5% because plant specific fuel data is used to estimate 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 1996 so uncertainty was assigned as very high about 50% according IPCC GPG 2000.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no “not estimated” sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 3.2.23 were double-checked and large fluctuations were explained.

Table 3.2.23 IEF changes higher than 10% for 1.A.2 sector

Sectors	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
1.A.2.a	Liquid Fuels/CO_2	t/TJ	2005	93.74281	2006	78.60579	-16.15%	In 2005 structure of other liquid fuels changed therefore average NCV in 2005 was lower (more light liquid fuels were used). That’s why estimated CO_2 EF and estimated carbon emission factor increased in 2005.
1.A.2.a	Liquid Fuels/CO_2	t/TJ	2004	82.07938	2005	93.74281	14.21%	
1.A.2.a	Other Liquid Fuels/CO_2	t/TJ	2005	95.11825	2006	78.60579	-17.36%	
1.A.2.a	Other Liquid Fuels/CO_2	t/TJ	2004	82.07938	2005	95.11825	15.89%	
1.A.2.e	Other Liquid Fuels/CO_2	t/TJ	2005	95.11825	2006	78.60579	-17.36%	
1.A.2.e	Other Liquid Fuels/CO_2	t/TJ	2004	82.07938	2005	95.11825	15.89%	
1.A.2.e	Solid Fuels/CH_4	kg/TJ	1999	11.29629	2000	10	-11.48%	Changes of CH_4 and N_2O emissions IEF are explained with appearance of peat briquettes consumption – peat briquettes are combusted in the sector only in 1994 and 1997-1999.
1.A.2.e	Solid Fuels/CH_4	kg/TJ	1996	10	1997	11.15835	11.58%	
1.A.2.e	Solid Fuels/N_2O	kg/TJ	1999	1.568518	2000	1.4	-10.74%	
1.A.2.e	Solid Fuels/N_2O	kg/TJ	1996	1.4	1997	1.550585	10.76%	
1.A.2.f	Solid Fuels/CH_4	kg/TJ	2004	12.26581	2005	10	-18.47%	Changes of all emissions IEF are explained with appearance of peat and peat briquettes consumption – peat is consumed in 1997-1998 and in 2004 but peat briquettes are combusted in the sector only in 1995-1996.
1.A.2.f	Solid Fuels/CH_4	kg/TJ	2003	10	2004	12.26581	22.66%	
1.A.2.f	Solid Fuels/CH_4	kg/TJ	1994	10	1995	11.03236	10.32%	
1.A.2.f	Solid Fuels/CH_4	kg/TJ	1990	10	1991	11.45526	14.55%	
1.A.2.f	Solid Fuels/N_2O	kg/TJ	2004	1.694555	2005	1.4	-17.38%	
1.A.2.f	Solid Fuels/N_2O	kg/TJ	2003	1.4	2004	1.694555	21.04%	
1.A.2.f	Solid Fuels/N_2O	kg/TJ	1990	1.4	1991	1.589183	13.51%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2007	3.947999	2008	4.436405	12.37%	CH_4 emissions from liquid fuels in this sector is influenced with the amount of gasoline consumption in off-roads as gasoline fuel only has different CH_4 EF comparing to other liquid fuels types. That’s why part of gasoline
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2006	4.50139	2007	3.947999	-12.29%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2003	3.337474	2004	4.778863	43.19%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2002	4.338637	2003	3.337474	-23.08%	

Sectors	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2001	3.08128	2002	4.338637	40.81%	fuel in total liquid fuel consumption influence average IEF of liquid fuels in the sector.
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2000	2.653783	2001	3.08128	16.11%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1999	2.368575	2000	2.653783	12.04%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1998	2.70206	1999	2.368575	-12.34%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1996	3.003178	1997	2.691002	-10.39%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1995	2.33451	1996	3.003178	28.64%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1994	2.856198	1995	2.33451	-18.27%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1993	3.779644	1994	2.856198	-24.43%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1990	5.375643	1991	3.348328	-37.71%	

3.2.7.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

3.2.7.4.1 General QA/QC checks for 1.A.1 sector

For stationary fuel combustion following QA/QC checks are performed for all parts of national inventory.

There are several steps for activity data verification:

1. Activity data check at the data providing institution:

    - CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.

2. Activity data checked at the institution responsible for the emission estimation and reporting:

    - During the activity data input in emission estimation database done by sectoral expert all the data changes are compared to previous inventory and agreed with CSB. The reasons of data changes are explained.
    - After the data is input in emission estimation database activity data is verified using diagrams that is the best way to reflect all the illogical data fluctuations.
    - The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR. Still the data reporting requirements of IPCC 1996 make difficult the activity data comparison as autoproducers have to be excluded from Energy industries sector and included in relevant sectors.

1. Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 5%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

Estimated emissions verification:

1. All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

2. Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

3.2.7.4.2 Additional QA/QC checks for Tier2 methodology

Country specific CO_2 emission factors

Mainly Tier1 methodology is reported as used in the CO_2 emission estimation but according to IPCC 2006 it would be Tier2 methodology as country or plant specific emission factors are used. Country specific emission factors are estimated using NCV values reported by CSB. CSB collects these data from fuel combustion enterprises and reports annual average number in Annual Questionnaire tables. Carbon content values of the fuels are determined in local expert's research. Detailed CO_2 emission factors estimation data is used and CO_2 emission factor is estimated to the last decimal place. Estimated CO_2 emission factors are within IPCC range. Even if the estimated CO_2 EFs are almost equal to IPCC default EFs or don't differ at all the EFs are reported as country specific.

Plant specific CO_2 emission factors and Tier2 CO_2 emission estimation methodology

Tier2 methodology is used for CO_2 emission from natural gas combustion estimation as plant specific NCVs are used in CO_2 EF estimation. The parameters are reported to LEGMC by only natural gas supplier "Latvijas Gāze" and the company confirms that the data is reasonable and useful. Natural gas supplying company measures NCV every day and reports the average annual number to LEGMC and CSB. All the measuring equipments are checked and verified. The parameters also are verified by CSB comparing the data natural gas supplier has reported within annual Energy balance surveys.

Activity data, CO_2 EF and estimated emissions of used tires are taken from cement production plant's annual GHG reports within EU ETS. The data is verified by accredited verifier and then checked and approved by Regional Environmental Boards.

3.2.7.5 Source-specific recalculations

Natural gas consumption for year 1990–2007 was recalculated as data of natural gas characterization from only natural gas provider a/s "Latvijas Gāze" was obtained – net calorific value changes year by year. CO_2 emission factor for natural gas was changed for all years according to country specific natural gas characterizations reported by natural gas provider.

NCV changed for other liquid fuels for 2000-2007 due to possibility to divide used oil consumption from total other liquid fuels. NCV changes for all years in time series for natural gas and biogas.

CO_2 emission factor for all fuel types were précised to include numbers to the last decimal places. CO2 emission factors were recalculated for some fuel types due to change of NCV in particular time period of the time series, for example for other liquid fuels, used oils, coal and coke.

Difference for submission 2009 and submission 2010 in reported GHG emissions is quite small for all years in time series 1990–2007 fluctuating from –1.94% in 2007 to 3.28% in 2004 with average difference -0.47%. (Figure .3.2.5)

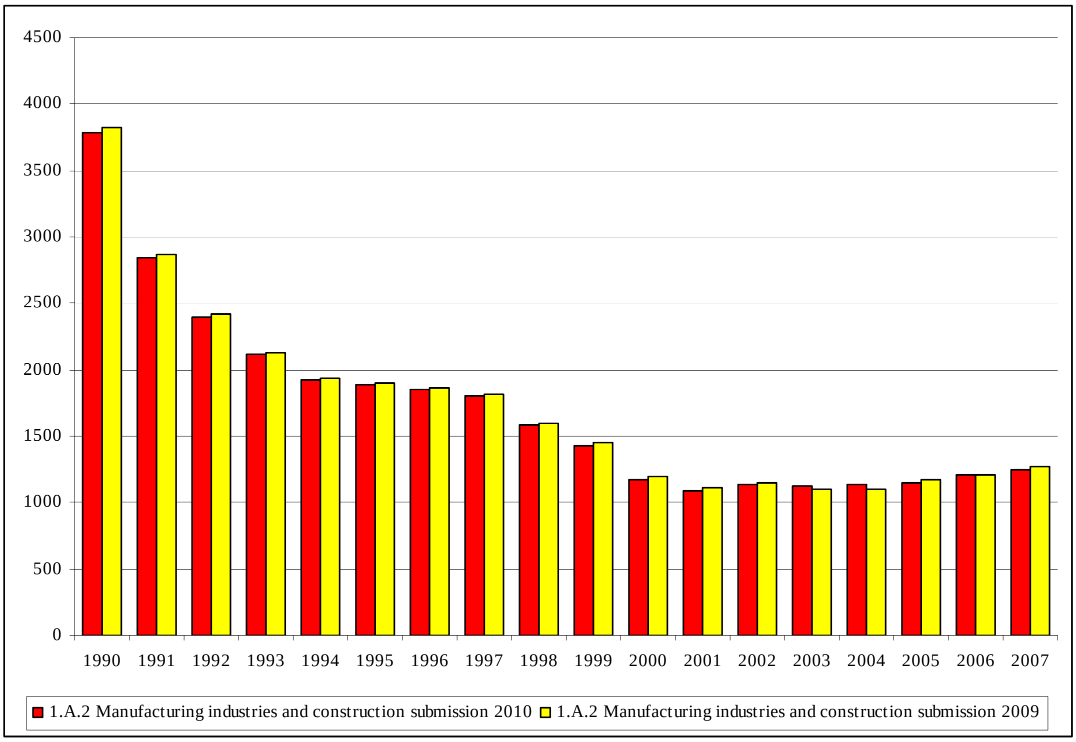


Figure 3.2.5 Comparison for GHG emissions from 1.A.2 Manufacturing industries and construction for submission 2009 and submission 2010 (Gg)

3.2.7.6 Source-specific planned improvements

The summarized necessary improvements are:

- Researches on use of the country specific emission factors for key category – CH_4 emissions from solid biomass combustion;
- Researches of possibility to use plant specific data from national database “2-AIR” where facilities that perform any of pollution activities have to report all emissions they create;
- Improving country specific CO_2 emission factors.

3.2.8 Transport (CRF 1.A 3)

3.2.8.1 Source category description

This section describes GHG emissions resulting from transport fuel combustion. In 2008, this source category was responsible for a bit more than 42.2% of GHG emissions from fuel combustion activities (this share was only 15.5% in 1990).

Total GHG emissions in the transport sector have decreased in 2008, compared to 2007 level. The main reason for this is the economic recession in Latvia during the second half of 2008, which affected the fuel consumption reduction mainly in the road transport sector.

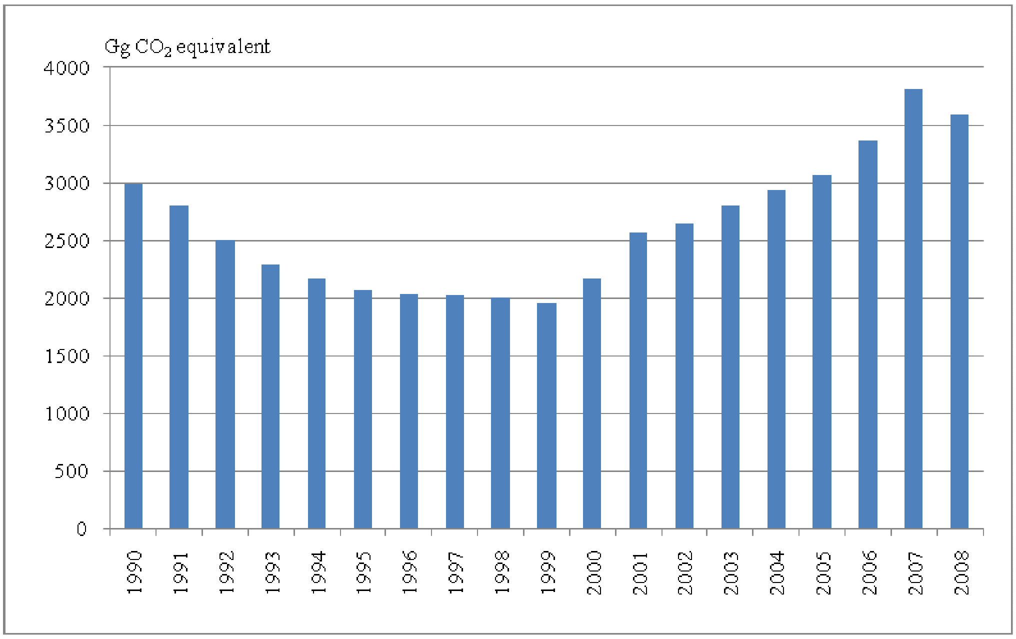


Figure 3.2.6 GHG emissions development in transport 1990 – 2008

The road transport constitutes a convincing majority of the total GHG emissions in the transport sector. In 2008, it gave 92.15 % of total emissions but the next largest emission source is a railroad - 7.6 %. (Figure 3.2.6)

CO_2 emissions constitute nearly 98% of the total GHG emissions in the transport sector and they are key sources in road transport and railway.

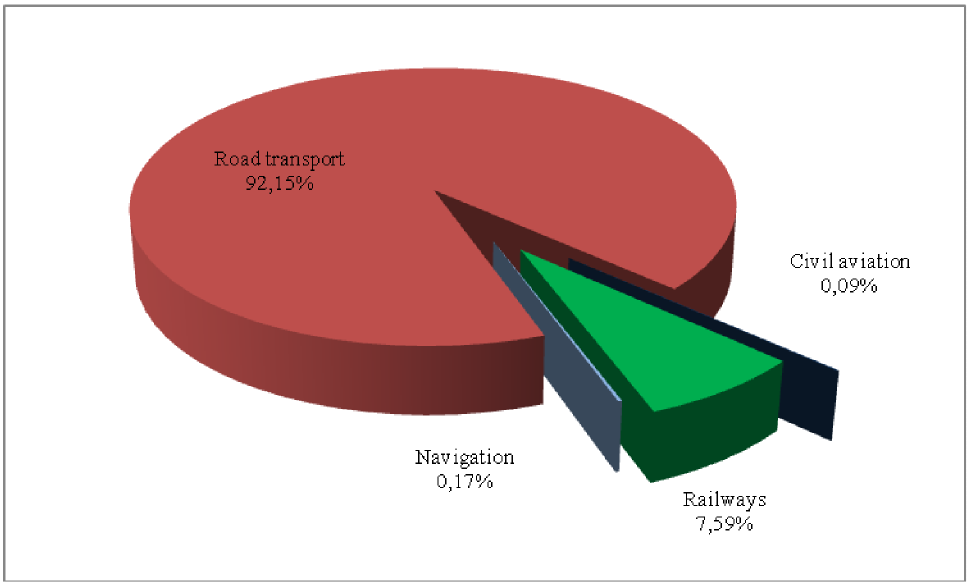


Figure 3.2.7 GHG emissions in transport by sub-sectors, year 2008

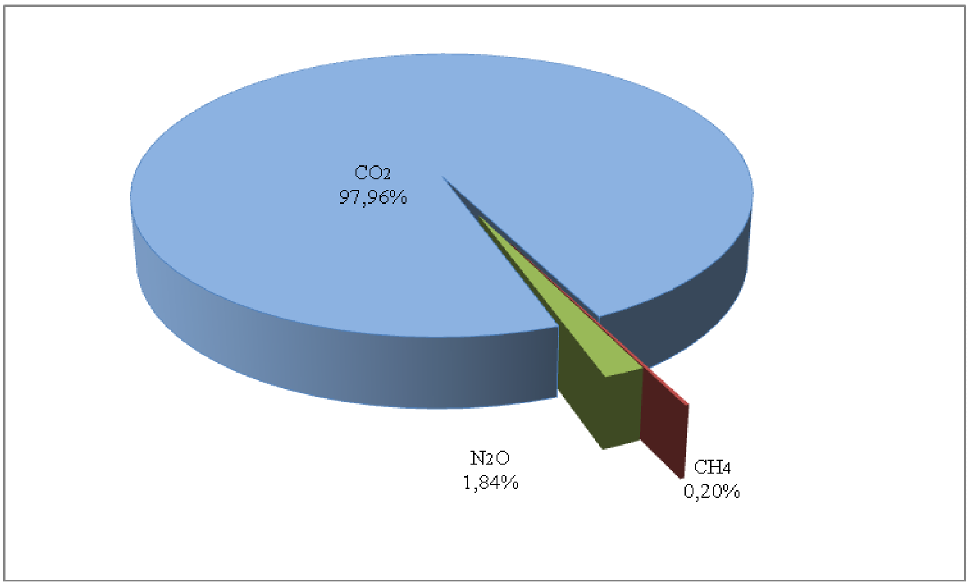


Figure 3.2.8 GHG emissions in transport sector by gases, year 2008

Determinative of the CO_2 emission changes is the changes of the fuel consumption. In 2008, total fuel consumption in the transport sector, compared to 2007 level, has decreased by 4.0 %. In different subsectors various changes have taken place in 2008. In civil and international aviation the fuel consumption has accordingly increased by 50% and 21 %, whereas in the road transport it has decreased by 6.1 %. In the railway the fuel consumption has remained constant. The road transport consumes 93 %, the railway – 6.8% and the civil aviation and navigation – the residues from the total fuel consumption in the transport sector.

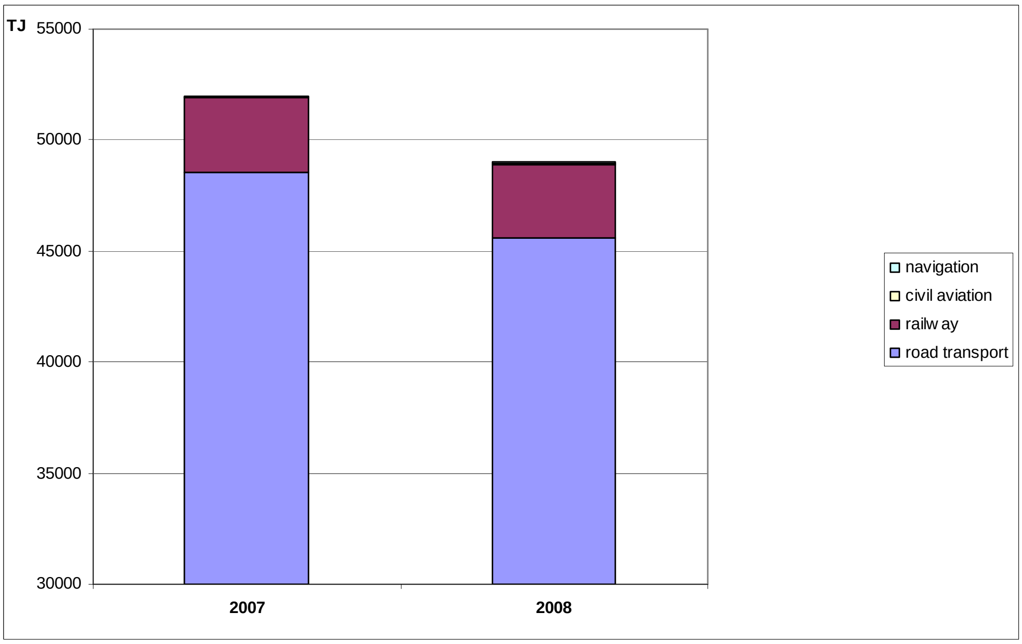


Figure 3.2.9 Fuel consumption in transport by sub-sectors, year 2008

Diesel oil is the major fuel type in the transport sector and it constitutes 59.6 %, and is followed by gasoline – 30.6 %, but jet kerosene constitutes 7.7% of the total fuel consumption in the transport sector.

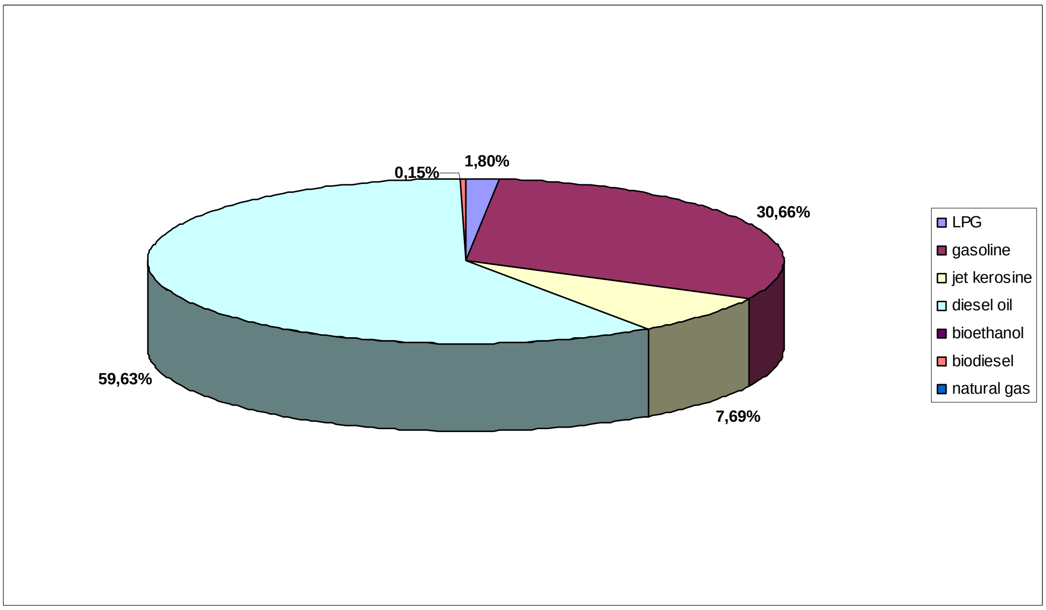


Figure 3.2.10 Fuel consumption in transport by fuel type, year 2008

3.2.8.2 Civil aviation (CRF 1.A.3.a)

In Latvia, civil aviation, excluding international flights, is really narrow. In 2008, the fuel consumption in civil aviation constituted 0.1 % of GHG emissions from the total GHG emissions in transport.

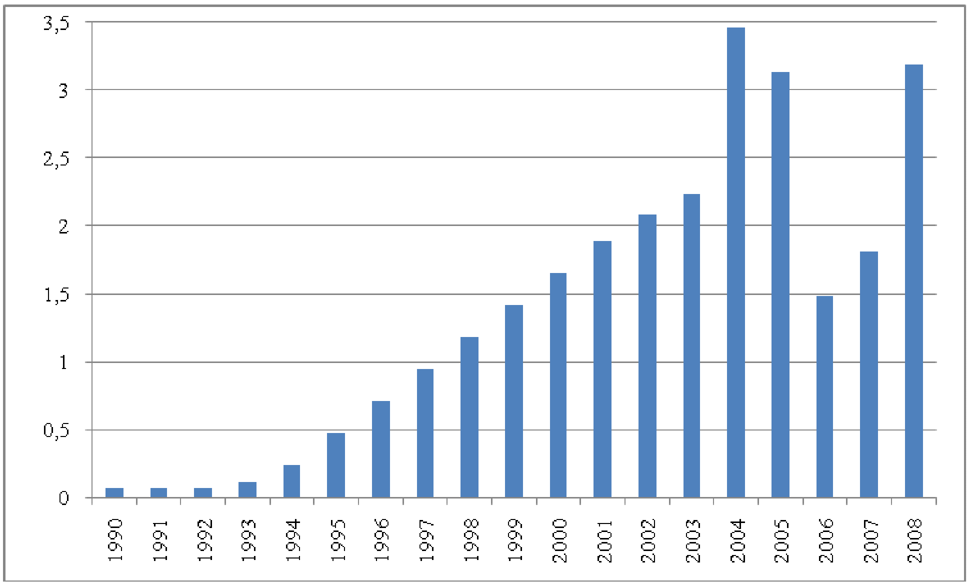


Figure 3.2.11 GHG emissions in civil aviation, Gg CO_2 eq

In Latvia, there are four airports for commercial aviation, of which the largest is the Riga International Airport. In aviation emissions are calculated for aviation gasoline and jet kerosene. The aviation gasoline is mainly used by small-sized propeller planes but jet kerosene is used by airplanes with turbo jets and turbo props engines. Considering that local commercial flights are dependent on the strategy of local airline company and demand after flights; the number of flights, fuel consumption and emission amount are quite unsteady over the years.

3.2.8.2.1 Methodological issues

Methods

EMEP/Corinair (2006) Guidelines Tier 2 and Tier 1 approaches have been applied. Tier 2 approaches have been applied for jet kerosene emission calculation for time period 2004-2008. Tier 1 approach has been applied for aviation gasoline emission calculation.

Using Tier 2 approach, emissions for LTO (landing/take off) and cruise are calculated individually. Prior to the emission calculation, representative aircraft type was chosen, for which the fuel consumption and emission data exist in the EMEP/CORINAIR databank.

Activity data

The data about fuel consumption in aviation is derived from the CSB. CSB has started to collect data as of year 2006. For the time period 1990 – 2005 and for aviation gasoline consumption the data is used from the study (FEI, 2004[12]). For 2004 onwards, the air flight statistics is provided by the Riga Airport.

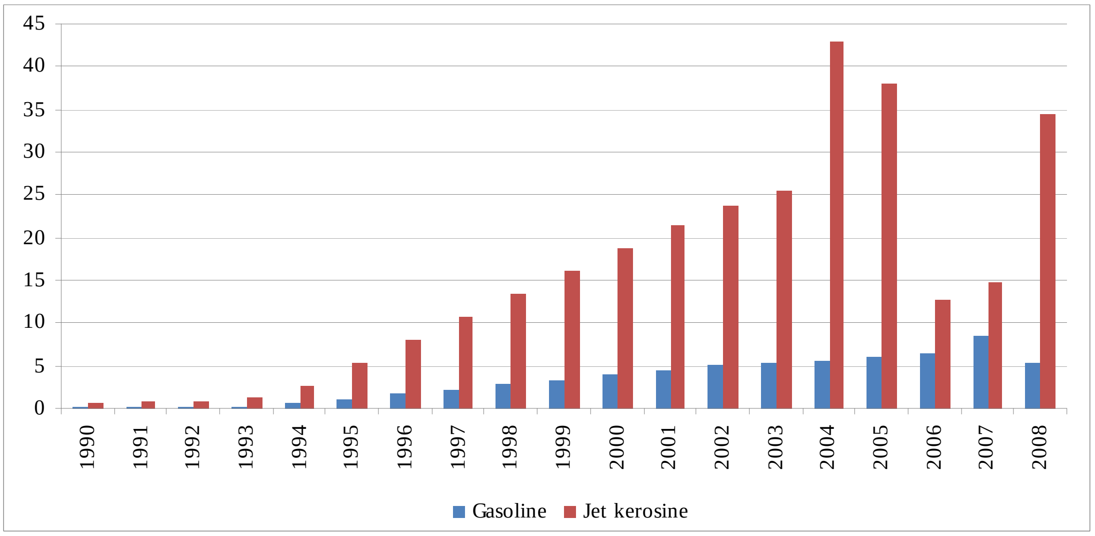


Figure 3.2.12 Fuel consumption in civil aviation (TJ)

Table 3.2.24 Fuel consumption in civil aviation (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Jet kerosene	0.76	0.78	0.81	1.34	2.68	5.35	8.04	10.72	13.4	16.07	18.76	21.44	23.73	25.46	43	38	12.75	14.82	34.52
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	5.7	6	6.4	8.4	5.4

Emission factors

Default EFs of LTO and cruise (jet kerosine) for civil aviation is used (EMEP/CORINAIR 2006):

Table 3.2.25 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
Aviation gasoline	70.2	0.0005	0.002	0.25	0.1	0.05	0.02293

[12] "Research on fuel consumption by domestic aviation and private boats in domestic navigation"

Uncertainties

Uncertainty in activity data of fuel consumption in civil aviation is ±20% in 2008. CO_2 emission factor was estimated according physical characterization of used fuels in country based on average NCV reported by fuel consumers and carbon content so uncertainty was assigned as quite low about 5%. CH_4 and N_2O emission factor used in estimation of emissions was taken from EMEP/CORINAIR (2006) so uncertainty was assigned about 10 %.

3.2.8.3 Road transport (CRF 1.A.3.b)

3.2.8.3.1 Source category description

The road transport constituted 92.15 % of GHG emissions in the transport sector in 2008. After the rapid growth in the period 2000 – 2007, emissions in 2008 have decreased. The fuel consumption in the road transport in 2008 has decreased by 6.1 %, compared to 2007 level. The major reason for this tendency was recession of the national economy and decrease of the number of registered passenger cars. The road transport is widely used in the local internal transportation and also for providing cross-border transportation. The freight road transport approximately constitutes 44% of the total freight in the country. In the freight road transport the inland freight constitutes approximately 90% of gross – timber products, food products, household goods and building materials are dominant. Wherewith the inland consumption reduction in 2008 defined the fuel consumption reduction for the freight transport.

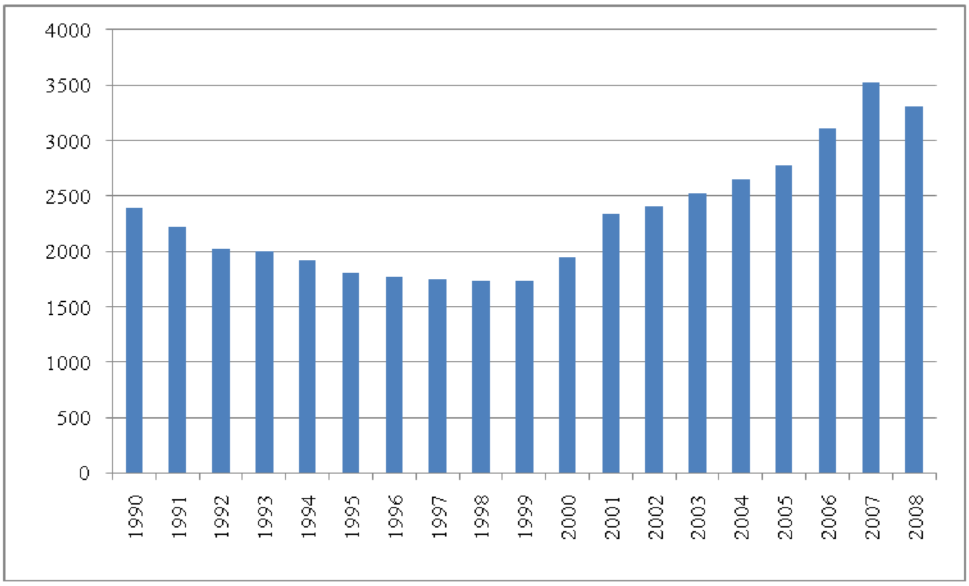


Figure 3.2.13 GHG emissions in road transport (Gg CO_2 eq)

In time period 1990–2008, essential changes have taken place in the structure of GHG emissions created by the road transport. (Table 3.2.26) In 2008, the gasoline consumption emissions created by passenger cars were approximately of 1990 level, while the diesel oil fuel consumption created by the emissions of passenger cars have increased several times. The emissions of Light-duty vehicles (LDV) and heavy-duty vehicles (HDV) gasoline consumption have decreased but the emissions of diesel oil fuel consumption have essentially increased.

Road transport related fuel consumption is key sources for CO_2 emissions.

Table 3.2.26 GHG emissions in road transport by vehicle types (Gg CO_2 eq.)

	Passenger Cars		LDV		HDV	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
1990	1093.70	41.74	160.47	55.04	418.79	449.12
1991	991.13	38.96	162.75	60.89	375.78	427.56
1992	1024.13	26.56	142.36	40.08	286.87	353.98
1993	1023.13	33.48	139.49	42.54	250.28	355.68
1994	979.49	33.47	142.81	43.64	208.92	352.23
1995	905.60	34.16	91.10	38.85	206.57	360.27
1996	862.44	42.77	103.58	36.24	205.93	351.77
1997	819.70	75.41	85.08	42.61	172.41	370.57
1998	801.51	119.84	71.28	49.65	167.19	393.21
1999	780.85	126.37	65.05	50.96	157.48	443.15
2000	831.29	114.25	44.17	77.91	129.28	581.76
2001	916.27	248.76	40.37	101.86	104.67	714.81
2002	922.42	307.51	34.47	117.43	85.65	733.44
2003	939.34	381.74	30.10	122.22	76.32	756.92
2004	966.17	470.59	26.88	126.35	61.34	797.10
2005	956.45	511.42	23.17	131.60	52.85	871.24
2006	1069.25	617.08	22.82	149.09	49.11	970.63
2007	1177.49	770.20	21.87	180.80	44.86	1100.66
2008	1088.15	763.19	19.37	181.17	23.02	1004.83
Trend 2008/1990 (%)	**-0.51**	**1728.66**	**-87.93**	**229.17**	**-94.50**	**123.73**

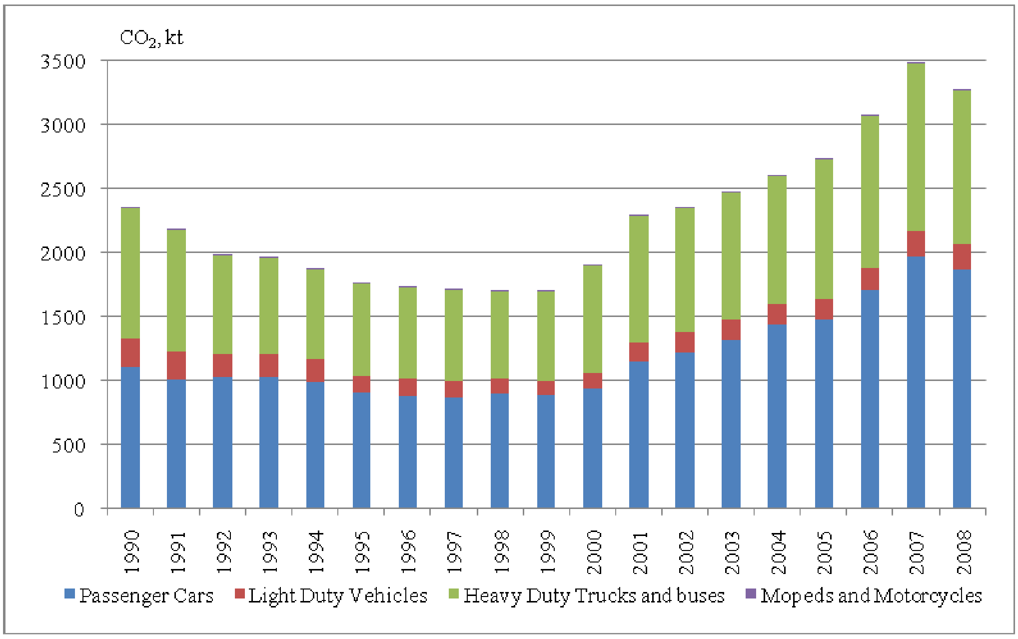


Figure 3.2.14 CO_2 emissions in road transport by vehicle types

CO_2 emissions are directly fuel-use dependent and, in this way, the development in the emissions reflects a trend in the fuel consumption. As shown in Figure 3.2.14, the most important emissions source for the road transport is passenger cars and a part of them has decreased in the time period 1990-2008. The next more important emission source is HDV vehicles followed by LDV.

Table 3.2.27 CO_2 emissions in road transport by fuel, year 2008

	Diesel oil	Gasoline	LPG, natural gas, biomass
Share of CO_2 emissions, %	63.9	34.1	2

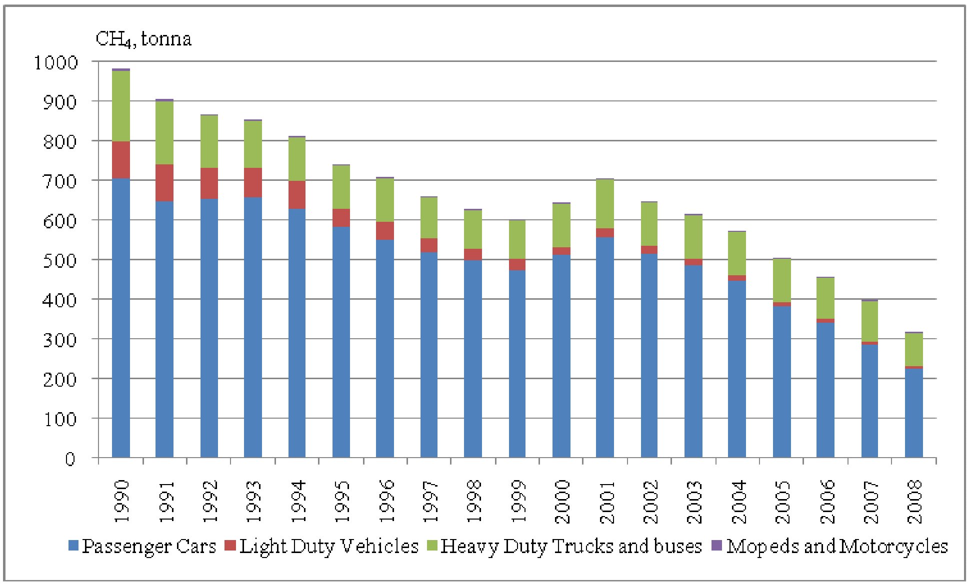


Figure 3.2.15 CH_4 emissions in road transport by vehicle types

CH_4 emissions present consistent decrease trend within the whole period. The majority of CH_4 emissions from the road transport come from gasoline passenger cars. The substantial emission drop from 2001 onwards is explained by the sharp penetration of EURO 3 and EURO 4 passenger cars into the Latvia fleet.

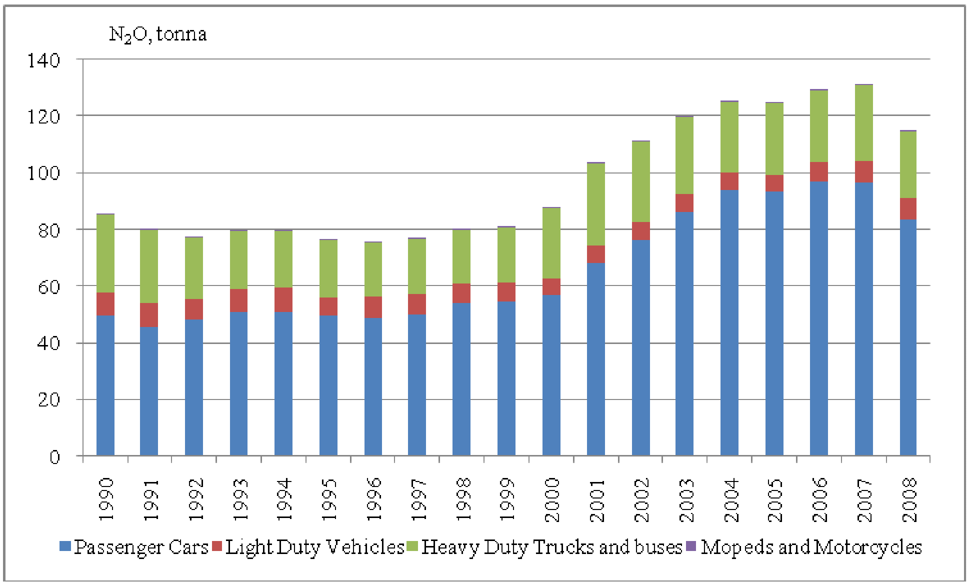


Figure 3.2.16 N_2O emissions in road transport by vehicle types

An undesirable environmental side effect of the introduction of catalyst cars is the increase in the emissions of N2O from passenger cars. Different factor interaction characterises this trend of changes. New cars' entry in the market on the one side (EURO 3 un EURO 4), on the other side – part of Latvia's passenger cars fleet constitutes secondary market cars (EURO 1 and EURO 2) that come from the EU old memberstates. Thus, N2O emission changes cannot be explained only by increase of number of one definite sub-class car but the whole passenger cars fleet in total has to be analysed.

3.2.8.3.2 Methodological issues

Methods

For road transport, the detailed methodology is used to make annual estimates of the Latvian emissions, as described in the EMEP/CORINAIR Emission Inventory Guidebook. The actual calculation is made with a COPERT IV model. COPERT IV provides factors for fuel consumption and for all exhaust emission components which are included in the national inventory. For several reasons, COPERT IV is regarded as the most appropriate source of road traffic fuel consumption and emission factors. First of all, very few Latvia emission measurements exist, so data are too scarce to support emission calculations on a national level. Secondly, the COPERT model is regularly updated with new experimental findings from European research programmes and, apart from updated fuel-use and emission factors, the use of COPERT IV by many European countries ensures a large degree of cross-national consistency in reported emission results.

In COPERT IV, fuel consumption and emission simulation can be made for operationally hot engines, taking into account gradually tighten emission standarts and emission degradation due to catalyst wear. Furthermore, the emission effects of cold-start and evaporation are simulated. 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 IV model.

Corresponding to the COPERT IV fleet classification, all vehicles in the Latvia fleet are grouped into vehicle classes, subclasses and layers. The layer classification is a further division of vehicle sub-classes into groups of vehicles with the same average fuel consumption and emission behaviour, according to EU emission legislation levels.

Trip-speed dependent basis factors for fuel consumption and emissions are implemented. The fuel consumption and emission factors used in the Latvia inventory come from the COPERT IV model.

The vehicle numbers per passenger cars sub-class and layers are shown in Figure 3.2.17, Figure 3.2.18 and Figure 3.2.19.

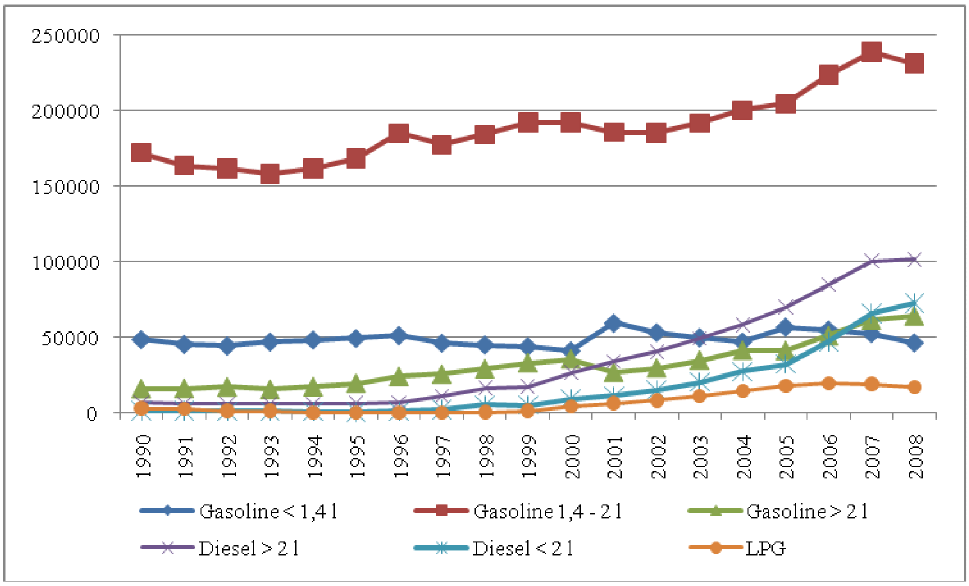


Figure 3.2.17 Distribution of passenger cars fleet by sub-classes

Annalysing the development of the passenger car fleet in the time period 1990 – 2008, following features can be noted:

- Cars with a gasoline engine of a capacity > 2.0l constitute the major part;
- Cars with a gasoline engine of a capacity < 1.4l during the whole period have small changes;
- As of 2000, the number of cars with diesel engines, both, < 2.0l and > 2.0l, grow rapidly;
- As of 2002, in the car fleet with a gasoline engine, the number of EURO 1, EIRO 2, EIRO 3 and EIRO 4 cars grow rapidly;
- As of 2003, in the car fleet with a diesel engine, the number of EURO 1, EIRO 2, EIRO 3 and EIRO 4 cars grow rapidly.

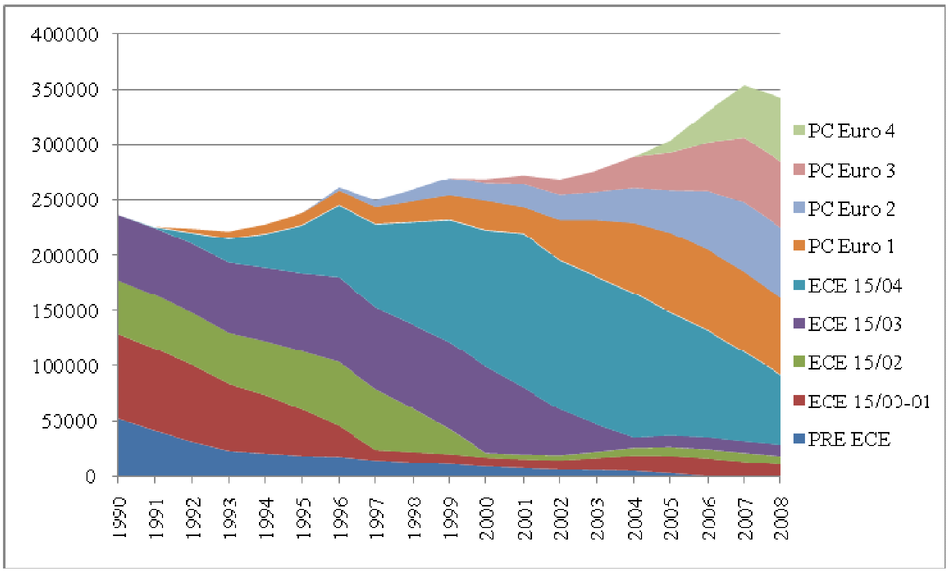


Figure 3.2.18 Distribution of gasoline passenger cars fleet by layers

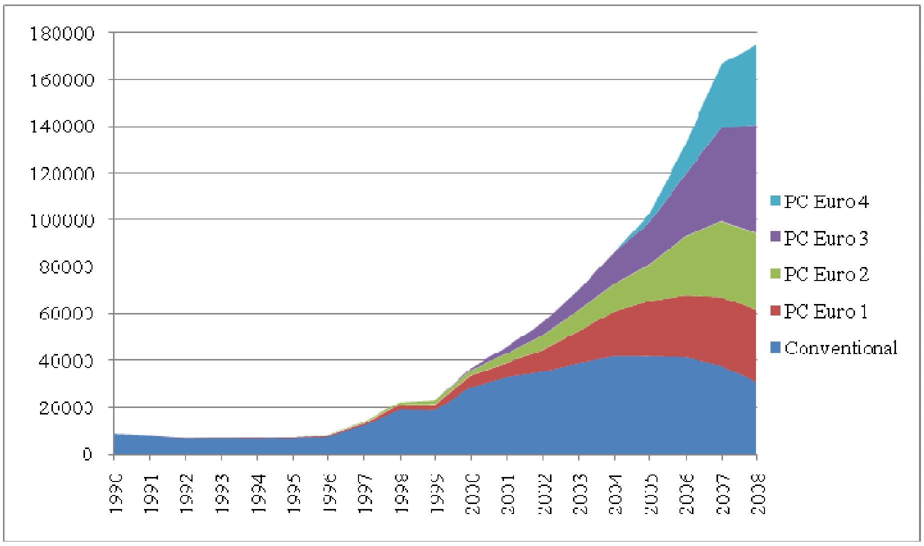


Figure 3.2.19 Distribution of diesel oil passenger cars fleet by layers

The vehicle numbers per LDV sub-class and layers are shown in Figure 3.2.19 and Figure 3.2.20.

Annalysing the development of LDV fleet in the following time period, major features can be noted as follows:

- As of 1996, the number of cars with a gasoline engine decreases;
- As of 2000, the number of cars with a diesel engine rapidly increases;
- As of 2002, the number of EURO 2 and EIRO 3 cars rapidly increases.

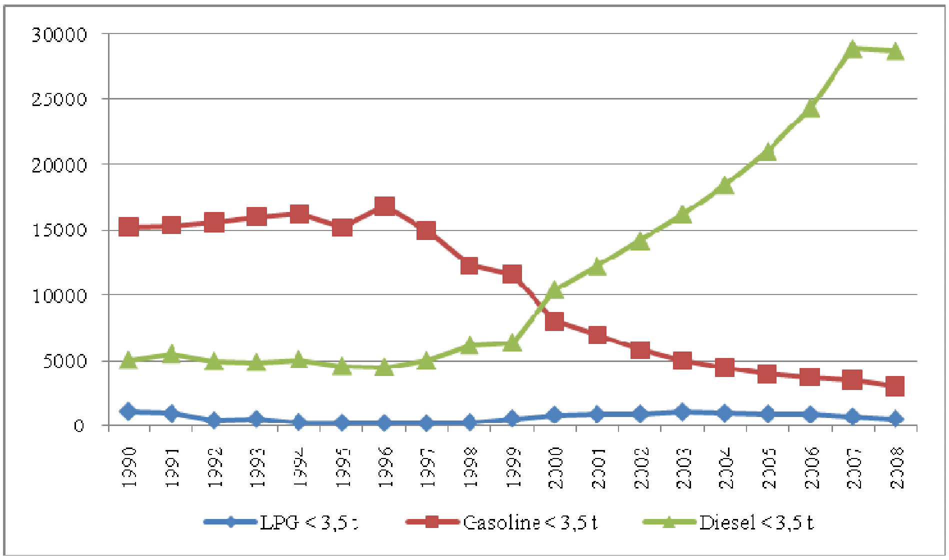


Figure 3.2.20 Distribution of light duty vehicles fleet by sub-classes

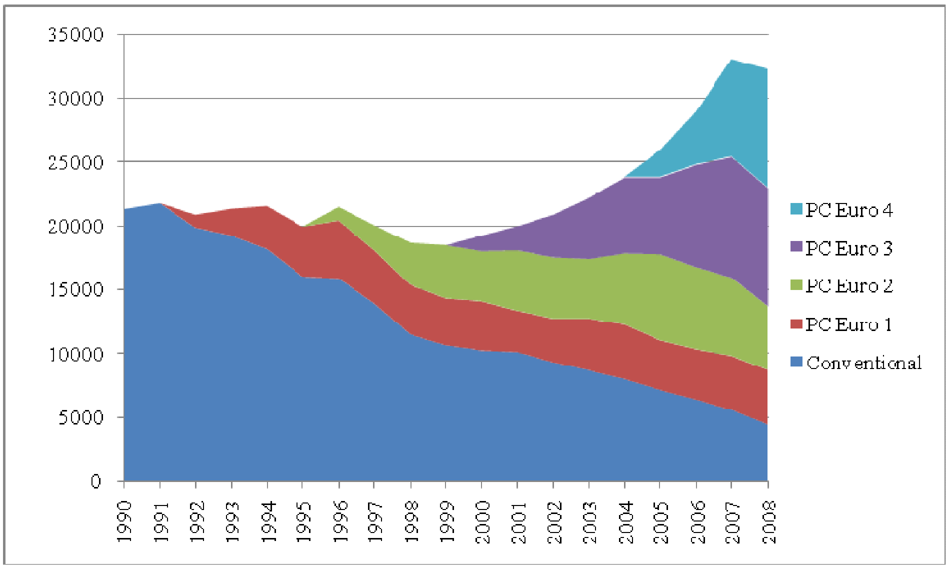


Figure 3.2.21 Distribution of light duty vehicles fleet by layers

The vehicle numbers per HDV sub-classes and layers are presented in Figure 3.2.22 and Figure 3.2.23.

Annalysing the development of HDV fleet in the following time period, major features can be noted as follows:

- As of 1999, the number of cars with a gasoline engine rapidly decreases;
- As of 1999, the number HDV cars with tonnage 14-34 t and a diesel engine starts to increase;
- As of 2000, average age reduction of cars takes place gradually.

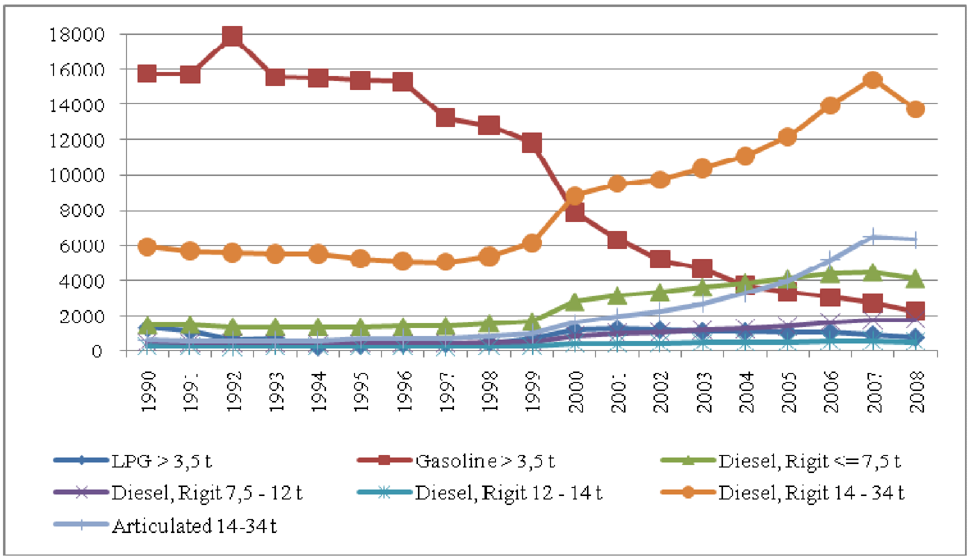


Figure 3.2.22 Distribution of heavy duty vehicles fleet by sub-classes

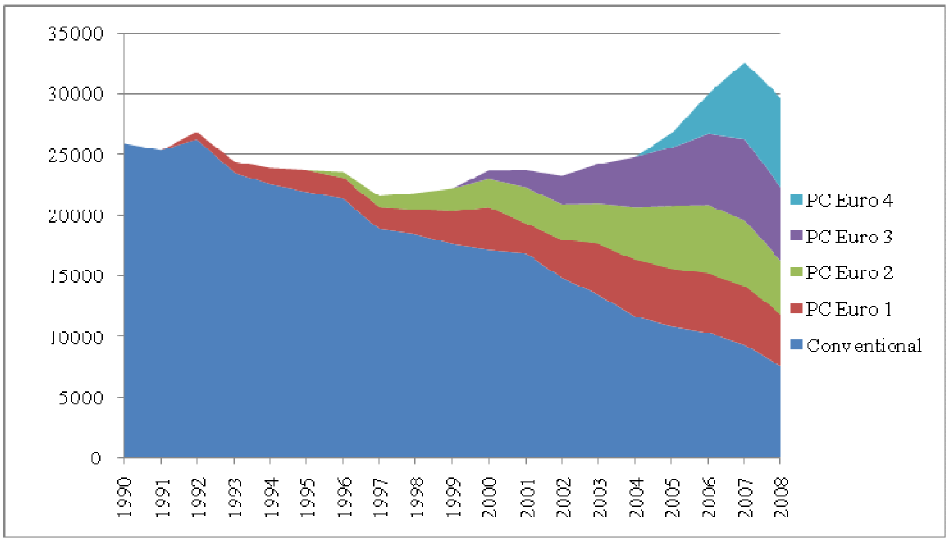


Figure 3.2.23 Distribution of heavy duty vehicles fleet by layers

Activity data

As seen in Figure 3.2.24, the fuel consumption has essentially changed in the time period 1990 – 2008. The gasoline consumption from the highest consumption in 1990 has decreased till 1999, reaching the lowest consumption and after six year stabilisation the increase was seen in 2006 and 2007. Whereas the diesel fuel consumption starting from 1997 has increased all the time till 2007 and decreased in 2008. At the end of the period the diesel fuel consumption is three times higher then in the beginning of the period.

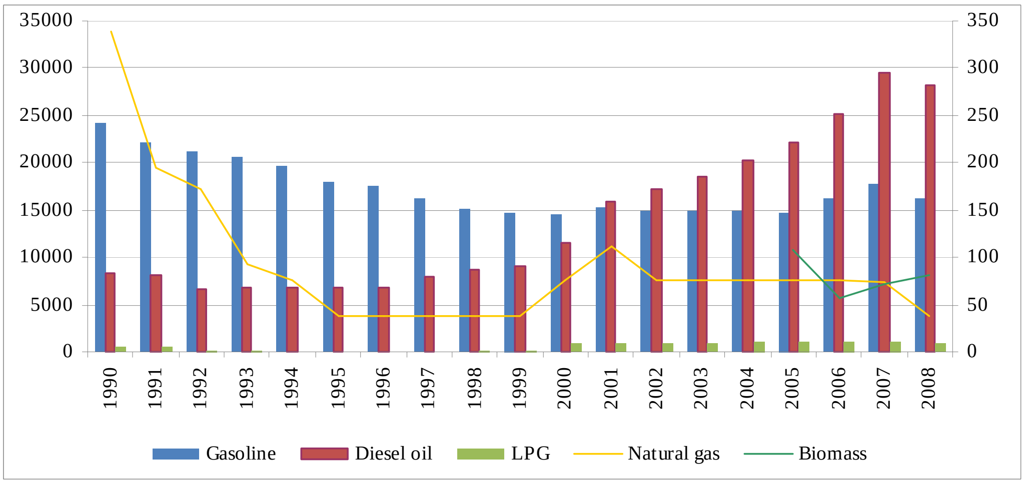


Figure 3.2.24 Development of Fuel consumption in road transport (TJ)
LPG, natural gas and biomass on right axes

As a basis for model input information, CSB data have been used considering the fuel consumption and the road transport in Latvia collected and published by LR Road Traffic Safety Directorate (RTSD) and also the assumption of experts, based on made survey. Total mileage data for passenger cars, light duty trucks, heavy duty trucks and buses produced by the RTSD is used for the years 1996-2008.

Table 3.2.28 Fuel consumption in road transport (TJ)

	Gasoline	Diesel oil	LPG	Natural gas	Biodiesel
1990	24183.5	8328.04	592.02	339	NO
1991	22160.88	8115.59	500.94	195	NO
1992	21237.51	6585.95	227.70	172	NO
1993	20621.93	6798.40	273.24	93	NO
1994	19610.62	6798.40	91.08	75	NO
1995	17983.73	6883.38	91.08	37	NO
1996	17588.00	6798.40	91.08	37	NO
1997	16180.96	7860.65	91.08	37	NO
1998	15213.62	8710.45	136.62	37	NO
1999	14685.98	9092.86	273.24	37	NO
2000	14510.10	11472.30	865.26	75	NO
2001	15257.59	15933.75	865.26	112	NO
2002	14949.80	17165.96	865.26	75	NO
2003	14949.80	18610.62	956.34	75	NO
2004	15037.74	20225.24	1047.42	75	NO
2005	14729.95	22179.78	1092.96	75	107
2006	16312.87	25239.06	1184.04	75	57
2007	17851.82	29488.06	1092.96	74	71
2008	16268.90	28255.85	956.34	37	81

Emission factors

CO_2 emissions in COPERT IV model were calculated, using country-specific CO_2 emission factor that is based on fuel standards and calculated hydrocarbon part in fuel.

Table 3.2.29 CO_2 Emission factors used in the calculation of emissions from road transport

	Gasoline	Diesel oil	LPG	Pure biodiesel
EF, Gg/PJ	68.6	74.00	62.44	70.8

For the time period 1990-1994 CO_2 EF for gasoline was 69.44 1995-1998 EF depends from the share of leaded gasoline in total gasoline consumption.

N_2O and CH_4 emission factors, as well as NO_x, CO, NMVOC come from the COPERT IV model. The SO_2 emissions factors are used consistent with sulphur content in fuel. Implemented EF for biodiesel: CH_4 = 1.10 Gg/PJ and N_2O= 1.40 Gg/PJ.

Uncertainties

Uncertainty in activity data of fuel consumption in road transport is ±5% in 2008. CSB gives approximately 2% statistical sample error for statistical data. CO_2 emission factor was estimated according physical characterization of used fuels in country based on average NCV reported by fuel consumers and carbon content so uncertainty was assigned as quite low about 5%. CH_4 and N_2O emission factor used in estimation of emissions was taken from COPERT IV model so uncertainty was assigned as very high about 40 % and 50% respectively.

3.2.8.4 Railway (CRF 1.A.3.c)

3.2.8.4.1 Source category description

In 2008, the fuel consumption in railway constituted 7.6 % of GHG emissions from the total GHG emissions in transport. The railway transport accomplishes approximately 55% of freight transport in Latvia and the transit transport traffic is dominant. In 2008, transported freight along the railway and therefore the diesel consumption has remained constant, compared to 2007 level. Railway transport includes railway transport operated by diesel locomotives. CO_2 emissions bulk up 99% from total GHG emissions in railway.

Railway related fuel consumption is key sources for CO_2 emissions.

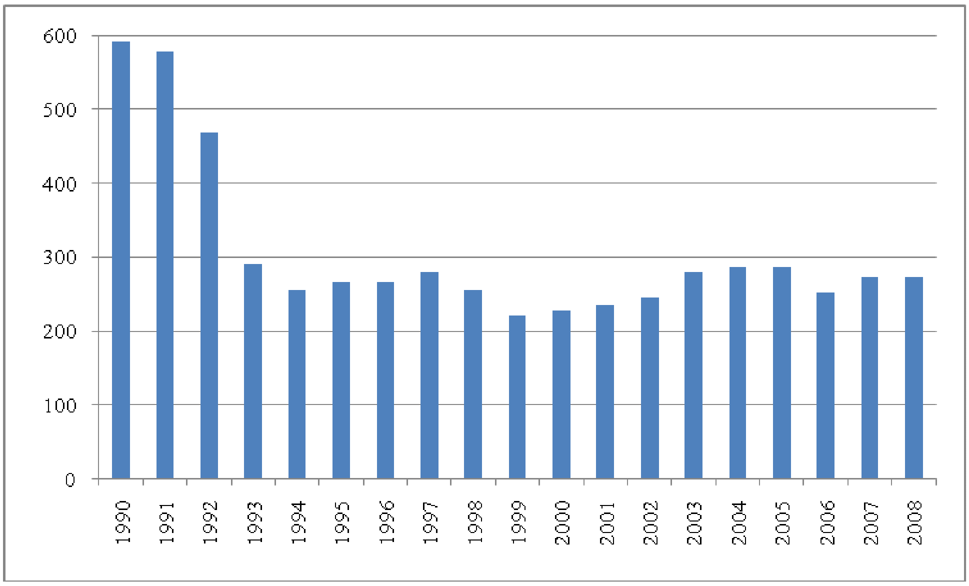


Figure 3.2.25 Development of GHG emissions in railway (Gg CO_2 eq)

3.2.8.4.1 Methodological issues

Methods

The EMEP/Corinair (2006) Guidelines Tier 1 approach has been applied.

Activity data

The data about diesel oil consumption in railway are derived from the CSB. Development of diesel oil consumption is presented in Figure 3.2.26.

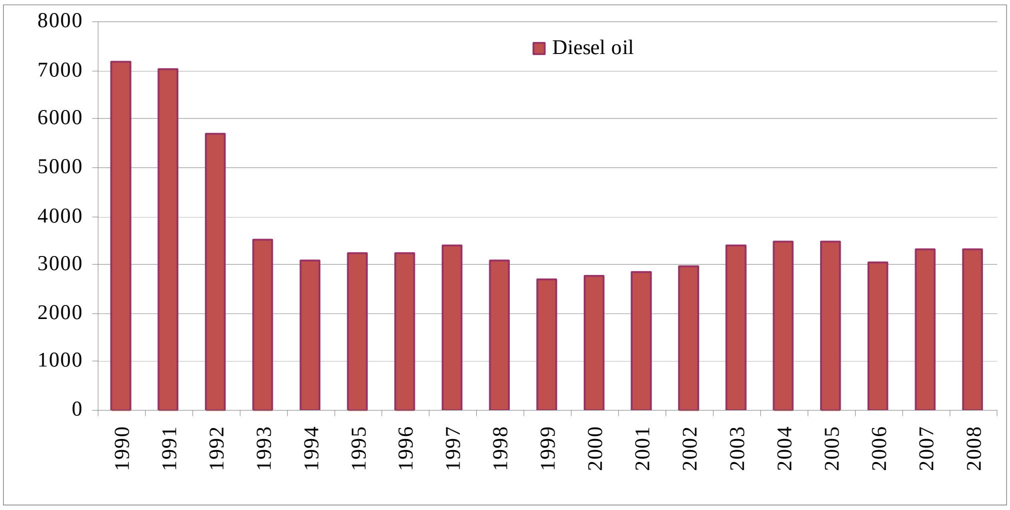


Figure 3.2.26 Development of fuel consumption in railway (TJ)

Table 3.2.30 Fuel consumption in railway (TJ)

	Diesel oil
1990	7181
1991	7011
1992	5694
1993	3527
1994	3102
1995	3229
1996	3229
1997	3399
1998	3102
1999	2677
2000	2762
2001	2847
2002	2974
2003	3399
2004	3484
2005	3484
2006	3059
2007	3314
2008	3314

Emission factors

Default EFs for railway is used (EMEP/Corinair 2006):

Table 3.2.31 Emission factors used in the calculation of emissions from railway

	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
Diesel oil	73.16	0.00423	0.02918	0.93198	0.251823	0.10943	0.0941

The SO_2 emissions factors are used consistent with sulphur content in diesel oil (0.2).

Uncertainties

Uncertainty in activity data of fuel consumption in railway is ±2% in 2008. CSB gives approximately 2% statistical sample error for statistical data. CO_2 EF was estimated according physical characterization of used fuels in country so uncertainty was assigned as quite low about 5%. CH_4 and N_2O emission factor used in estimation of emissions was taken from EMEP/CORINAIR (2006) so uncertainty was assigned 10 %.

3.2.8.5 Navigation (CRF 1.A.3.d)

3.2.8.5.1 Source category description

In 2008, the fuel consumption in navigation constituted 0.17 % GHG emissions of the total GHG emissions in transport.

Although Latvia has several ports, local navigation that could transport freight or passengers among local ports is not developed. Major activities in ports deal with international freight transport. In 2008, the diesel oil consumption increased by 61%, compared to 2007 level, and thus also the GHG emissions. Number of services in international freight mostly affects the changes in the fuel consumption. In navigation, the emissions are calculated for diesel-fuelled tugs and barges and gasoline – fuelled private boats.

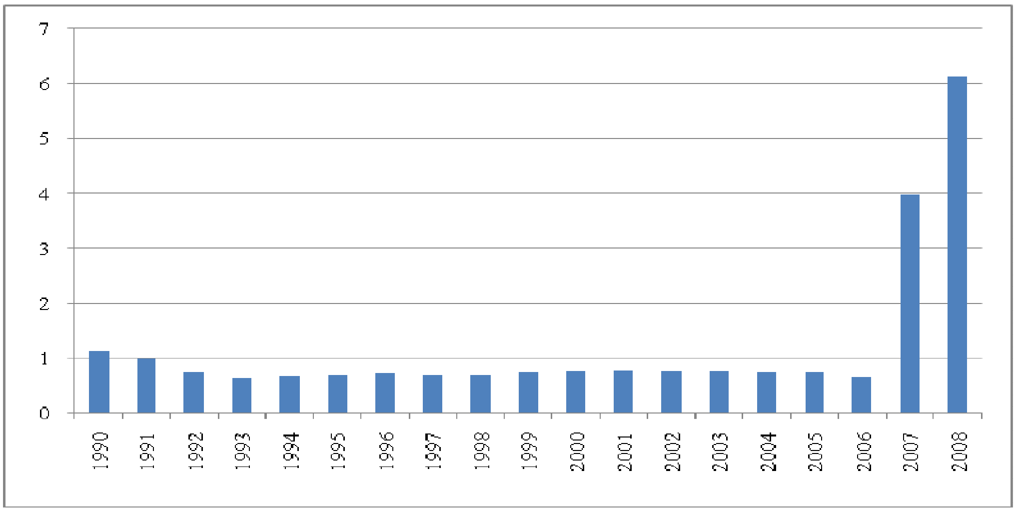


Figure 3.2.27 GHG emission development in navigation (Gg CO_2 eq)

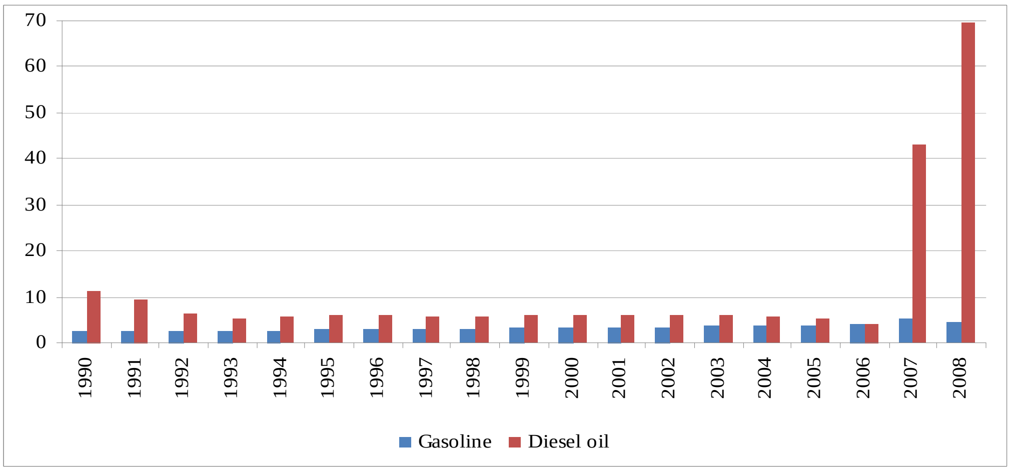
3.2.8.5.2 Methodological issues

Methods

The EMEP/Corinair (2006) Guidelines Tier 1 approach has been applied.

Activity data

The data about the diesel oil consumption in navigation is derived from the CSB. CSB has started to collect data as of year 2006. For the time period 1990–2005 and for the gasoline consumption the data is used from the study (FEI[13], 2004). Development of the fuel consumption in navigation is presented in Figure 3.2.28.



[13] "Research on fuel consumption by domestic aviation and private boats in domestic navigation"

Figure 3.2.28 Development of gasoline and diesel oil fuel consumption in navigation

Table 3.2.32 Fuel consumption in navigation (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Diesel oil	11	10	7	5	6	6	6	6	6	6	6	6	6	6	6	5	4	43	70
Gasoline	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	5	5

Emission factors

Default EFs for navigation are used (EMEP/Corinair 2006):

Table 3.2.33 Emission factors used in the calculation of emissions from navigation

	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	1.000235	0.25653	0.11108
Gasoline (from 2003)	72.708	0.047396	0.000296	0.082488	10.9526	5.30209
Gasoline (1990-2002)	72.659	0.047364	0.000295	0.082432	10.945182	5.298477

EFs for gasoline are different due to varying of NCV. The SO_2 emissions factors are used consistent with sulphur content in diesel oil and gasoline.

Uncertainties

Uncertainty in activity data of fuel consumption in navigation is high ±50% because part of data is based on evaluation and expert judgment. CSB gives data only about diesel consumption starting from year 2006. CO_2 emission factor was estimated according physical characterization of used fuels in country and average NCV reported by fuel consumers and carbon content so uncertainty was assigned as quite low about 5%. CH_4 and N_2O emission factor used in estimation of emissions was taken from EMEP/CORINAIR (2006) so uncertainty was assigned 10 %.

3.2.8.6 Source - specific QA/QC and verification

The OA/OC descriptions of the Latvia emission inventories for transport follow the general OA/OC based on the prescription given in the IPCC Good Practice Guidance and Uncertainty management in National Greenhouse gas Inventories (IPCC, 2000).

3.2.8.7 Source - specific recalculations

The following recalculations and improvements of the emission inventories have been made in the transport sector since the emission reporting in 2007.

Table 3.2.34 Recalculations for Sub-category 1.A.3 Transport

Sub-category	Recalculation	Improvements
Road transport (CRF A.3.b)	All emissions for time period 1990 – 2007 have been recalculated	COPERT IV model was implemented to calculate emissions with the same emission factors for all time period. Specific national CO_2 emission factors for gasoline and diesel all were implemented. Recalculation mainly affect CH_4, N_2O and non direct emissions
Navigation (CRF A.3.d)	All emission for diesel fuel and gasoline emission have been recalculated for time period 1990 - 2007	Fuel consumption adjustments were done (1990 – 2005) due to the last CSB data. Emission factors for gasoline were corrected (EMEP/CORINAIR).
Railway (CRF 1.A.3.c)	All emissions for time period 1990 - 2007 have been recalculated	Emission factors for diesel were corrected (EMEP/CORINAIR).
Civil aviation (CRF 1.A.3.a)	All emissions for time period 2006-2007 have been recalculated	Fuel consumption adjustments were done due to the last CSB data.

3.2.8.8 Source - specific - planned improvements

Considering potential contribution in calculation improvement of GHG emissions and available resources for their effective implementation, the following advancement is planned in the transport sector.

Table 3.2.35 Planned improvements for Sub-category A.3. Transport

Sub-category	Planned improvements
Road transport (CRF A.3.b)	Refine activity data for LPG fuel cars to improve time series consistency
Civil aviation (CRF A.3.a)	Revise and expand activity data for time period 2002-2005

3.2.9 Other Sectors (CRF 1.A.4)

3.2.9.1 Source category description

1.A.4 Other Sectors include 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. Also emissions from autoproducers are included in relevant sectors of CRF 1.A.4 as it is stated that emissions have to be reported in sector they are created.

Table 3.2.36 Emissions from 1.A.4 Other Sectors in 1990–2008 (Gg)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	5562.6449	11.1984	0.1641	9.2686	239.3504	49.0048	38.6728
1991	5694.2028	12.7143	0.1787	9.8255	206.9325	25.7225	36.0828
1992	4016.4288	11.5001	0.1666	7.9444	197.8608	24.7863	29.1174
1993	3332.1797	12.1510	0.1683	7.3862	202.2783	25.4092	23.3569
1994	2312.5370	12.0370	0.1600	6.2002	200.9200	24.9942	17.8470
1995	1555.4769	12.5555	0.1697	5.7003	208.9694	26.0330	9.4704
1996	1573.9534	12.9169	0.1751	5.8424	218.0919	26.9169	10.1967
1997	1326.8336	12.2190	0.1655	5.3896	206.6971	25.5833	7.5860
1998	1152.6498	11.3595	0.1557	4.9958	192.3450	23.4360	5.5565
1999	1135.1793	11.1535	0.1531	4.9443	189.7520	23.0475	4.0706
2000	1051.6987	10.4721	0.1436	4.6349	188.2796	21.9735	2.9548
2001	1203.3439	11.5523	0.1560	5.0793	202.1673	23.0339	3.3884
2002	1173.0071	11.3056	0.1536	4.9825	198.1860	22.6762	2.6829
2003	1282.2146	11.8658	0.1617	5.2919	208.9107	24.5463	2.0992
2004	1336.1098	12.2195	0.1664	5.4600	214.6730	25.2390	1.8614
2005	1316.5240	12.2523	0.1661	5.4373	221.2034	25.4123	1.7335
2006	1390.4879	11.8893	0.1620	5.4193	218.9038	24.8342	1.4713
2007	1389.5697	11.8868	0.1616	5.3888	218.7898	24.8209	1.1746
2008	1313.6556	11.6443	0.1579	5.2169	213.2753	23.5882	0.9738
share of total 2008 emissions	**15.83%**	**12.21%**	**2.91%**	**13.76%**	**78.74%**	**43.70%**	**34.66%**

Decrease of CO_2 emissions from 1.A.4 Other Sectors in 1991-2000 can be observed and it is explained with changes and redistribution of structure of national economy. (Table 3.2.36) Increase of CO_2 emissions in 2000–2006 is explained with development of national economy and well-being of population. CO_2 emission is also affected by increase of individual heating supply consumers in 1.A.4.b Residential sector. Increase of gaseous fuels consumption, steady biomass fuel consumption and increase of peat consumption caused the decrease of CO_2 emissions and increase of CH_4 emissions. That’s why methane emissions from 1.A.4 Other sectors had increased for 13.51% in 2000–2007. Total GHG emissions from 1.A.4 Other Sectors increased in 2000 – 2007 by 22.11%. It can be explained with development of 1.A.4.a Commercial / Institutional sector where fuel consumption increased by 38.68% in 2000-2007 and 1.A.4.c Agriculture / Forestry and Fisheries sector in second place where fuel consumption increased by 23.78% in 2000-2007. Decrease of central heating system role in residential households increase emissions from 1.A.4.b sector.

Due to high costs of liquid fuels and increase of natural gas prices in Latvia CO_2 emissions have decreased by 5.46% in 2007-2008 when previously used fuel had switched to biomass. Biomass and natural gas consumption have smallest decrease with 1.93% and 1% when liquid fuels consumption has decreased by 9.79% in 2007-2008. That's why CO_2 emissions have decreased by 5.46% although total fuel consumption has decreased only by 2.93%. In 2007-2008 GHG emissions from 1.A.4 sector decreased by 4.86% as in other stationary fuel combustion sector due to decrease of necessity for produced heat (because of warm winters) and due to recession of national economy caused by world financial crisis.

Also indirect GHG emissions from Other Sectors were estimated. SO_2 had biggest decrease by 97.48% in 1990–2008. It is explained with fuel switching to natural gas and biomass from what sulphur dioxide emissions aren't emitted. Also other indirect GHG emissions in 2007–2008 decreased that is explained with the decrease of total fuel consumption combusted in stationary combustion installations.

3.2.9.2 Methodological issues

Methods

IPCC 1996 Tier1 Sectoral approach was used to calculate GHG emissions from the 1.A.4 sector. IPCC GPG 2000 Tier2 method was used to estimate CO_2 emissions from natural gas and landfill gas combustion as country specific parameters were used to estimate CO_2 emission factor of natural gas and plants specific emission parameters were used to calculate CO_2 emission factors for landfill gas combustion.

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

The general method for preparing inventory data was used:

$$\boxed{Em = EF \times B_q}$$

where:
Em – total emissions (Gg)
EF – estimated or default emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

Emission factors and other parameters

The main sources for emission factors are:

- National studies for country specific parameters and emission factors;
- Plants' data of used fuels physical characteristics;
- IPCC 1996;
- IPCC 2006;

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

CO_2 emission factors

CO_2 emission factors for 1.A.4 Other sectors are estimated with the same equations and using same method as for 1.A.1 Energy industries sector with the exception for landfill gas CO_2 emission factor that is estimated with the same equation as sludge gas CO_2 emission factor but using other parameters.

Landfill gas

There are four landfills in Latvia that are collecting biogas from landfills – one landfill is collecting and combusting biogas since 2002, second from 2003, third from 2004, but fourth landfill started to combust biogas with energy recovery only in 2008. As these landfills are quite large and have modern measurement equipment NCV for biogas collected in landfills are known

As landfills weren't able to provide the information of carbon content percentage in working mass of fuel that's why constant methane value was used estimated basing on moll mass of components. Following equation was used to calculate this methane number:

$$C^{d} = \frac{M_C}{(M_C + M_H)} \times 100$$

C^d – carbon content in fuel (%)
Mc – molecule weight for C – 12,011 (g/mcl)
M_H – H molecule weight (1.008 g/mcl)
100 – estimation of percentage

For calculation of CO_2 emission factor of sludge gas same equation as for natural gas was used.

NCV for all years sludge gas that is combusted with energy recovery was obtained from wastewater treatment plant. (Table 3.2.37)

Table 3.2.37 Characteristics of sludge gas and estimated CO_2 emission factors

	Carbon content in working mass of fuel (C^d) %	NCV (Q_z^d) TJ/1000m3	Oxidation factor (p)	Natural gas density (ρ) t/1000m3	Emission factor with oxidation factor (EF CO_2) kg/GJ
			1st landfill		
2002	74.8675	35.80	0.995	0.717	54.6667
2003	74.8675	35.80	0.995	0.717	54.6690
2004	74.8675	35.80	0.995	0.717	54.6690
2005	74.8675	35.80	0.995	0.717	54.6679
2006	74.8675	35.80	0.995	0.717	54.6689
2007	74.8675	35.80	0.995	0.717	54.6680
2008	74.8675	35.80	0.995	0.717	54.6677
			2nd landfill		
2004	74.8675	33.96	0.995	0.717	57.6248
2005	74.8675	35.29	0.995	0.717	55.4503
2006	74.8675	36.00	0.995	0.717	54.3630
2007	74.8675	36.00	0.995	0.717	54.3630
2008	74.8675	36.00	0.995	0.717	54.3630
			3rd landfill		
2005	74.8675	34.62	0.995	0.717	56.5375
2006	74.8675	37.50	0.995	0.717	52.1885
2007	74.8675	33.96	0.995	0.717	57.6248
2008	74.8675	35.29	0.995	0.717	55.4503

SO_2 emissions factors

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. Percentage amount of sulphur content in used fuels is taken from national database "2-AIR" where polluters report the sulphur content data for certain types of fuels. (Annex 2)

Emission factors for SO_2 are calculated by using following equation.

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

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

Other emission factors

The default CH_4, N_2O, NO_x, CO, NMVOC emission factors used in estimation of emission were taken from IPCC 1996. (Table 3.2.38) Emission factors for sludge gas were equalled to natural gas emission factors due to unavailability of particular emission factors for sludge gas.

Table 3.2.38 CO_2, CH_4, N_2O, NO_x, CO, NMVOC emission factors (Gg/PJ)

	CH_4	N_2O	NO_x	CO	NMVOC
1.A.4.a Commercial/Institutional					
gasoline	0.05	0.002	0.21	27	1
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	0.2
coke	0.01	0.0014	0.3	0.15	0.02
peat briquettes	0.3	0.004	0.1	5	0.6
peat	0.3	0.004	0.1	5	0.6
natural gas	0.005	0.0001	0.05	0.05	0.005
solid biomass	0.005	0.0001	0.05	0.05	0.005
Landfil gas	0.001	0.0001	0.050	0.050	0.005
1.A.4.b Residential and Agriculture/Forestry/Fishery					
gasoline	0.05	0.002	0.21	27	1
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	0.2
coke	0.3	0.0014	0.3	0.15	0.02
peat briquettes	0.3	0.004	0.1	5	0.6
peat	0.3	0.004	0.1	5	0.6
natural gas	0.005	0.0001	0.05	0.05	0.005
solid biomass	0.005	0.0001	0.05	0.05	0.005

SO_2 emission factors for fuel combustion are presented in Annex 2.

Activity data

Emissions from 1.A.4 sector are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2008 sent to EUROSTAT. The data collection system for 1.A.4 sector is the same as for 1.A.1 and 1.A.2 sectors. (Table 3.2.39) Data for 1.A.4.b sector is obtained by CSB with household surveys done once in 5 years and using extrapolation for the years in between.

Autoproducers data prepared by CSB are taken into account into the calculation of the emissions from 1.A.4 sector according to IPCC 1996.

Table 3.2.39 Fuel consumption in 1.A.4 Other sectors in 1990–2008 (PJ)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
1.A.4 Other Sectors																			
Liquid fuels	29.452	34.043	25.645	21.848	14.536	9.139	9.082	8.001	7.148	7.552	6.890	7.485	6.950	7.881	7.939	7.720	8.571	7.880	7.108
Solid fuels	23.526	20.774	16.882	13.965	9.879	5.570	6.028	4.997	3.596	2.884	2.204	3.004	2.391	2.213	2.150	2.065	2.007	1.949	1.814
Gaseous fuels	24.144	24.475	11.806	9.396	7.032	7.180	6.825	5.513	5.755	5.954	6.269	7.080	8.118	8.803	9.748	9.795	10.150	11.064	10.954
Biomass	26.448	31.060	30.873	33.210	33.737	38.643	39.743	37.983	36.257	35.902	33.809	36.562	36.295	38.320	39.573	39.522	38.380	38.372	37.654
1.A.4.a Commercial/Institutional																			
Liquid fuels	**15.077**	**18.184**	**13.331**	**11.085**	**5.835**	**3.210**	**3.080**	**2.612**	**2.217**	**2.460**	**1.717**	**2.062**	**1.866**	**2.201**	**2.170**	**1.773**	**2.404**	**1.893**	**1.591**
gasoline	0.044	0.044	0.044	0.044	0.220		0.088	0.088	0.044	0.088	0.088	0.088	0.044	0.044	0.044	0.044	0.044	0.044	0.044
diesel oil	8.116	11.515	7.436	7.478	1.530	1.190	1.147	0.552	0.340	0.935	1.020	1.190	1.243	1.465	1.546	1.198	1.626	1.643	1.339
RFO	6.577	6.496	5.765	3.207	3.776	1.583	1.665	1.746	1.380	1.218	0.609	0.609	0.325	0.284	0.284	0.365	0.365	0.041	0.087
LPG	0.046			0.182	0.137	0.091	0.137	0.182	0.410	0.091		0.091	0.046	0.182	0.137	0.137	0.137	0.137	0.091
other kerosene	0.043	0.130	0.086	0.173	0.173	0.346	0.043	0.043	0.043	0.086							0.173		
other liquid	0.251									0.041		0.084	0.209	0.226	0.159	0.029	0.058	0.029	0.029
Shale oil											0.79					0.039			
Solid fuels	**15.585**	**11.930**	**11.492**	**8.143**	**4.623**	**3.015**	**3.523**	**2.895**	**2.490**	**2.065**	**1.596**	**1.552**	**1.423**	**1.347**	**1.285**	**1.069**	**1.141**	**1.084**	**0.949**
coal	14.913	11.412	10.872	7.855	4.297	2.903	3.273	2.732	2.419	2.049	1.565	1.537	1.423	1.337	1.285	1.049	1.101	1.023	0.918
peat briquettes	0.511	0.356	0.449	0.248	0.155	0.062	0.139	0.093	0.031	0.015	0.031	0.015						0.001	0.001
peat	0.161	0.161	0.171	0.040	0.171	0.050	0.111	0.070	0.040					0.010		0.020	0.040	0.060	0.030
natural gas	6.101	6.411	5.521	3.635	1.932	2.356	2.319	1.849	2.222	2.590	3.098	3.359	4.117	4.286	4.768	4.754	5.010	5.704	5.666
Biomass	**5.218**	**5.162**	**5.282**	**5.508**	**5.630**	**8.282**	**8.029**	**7.636**	**5.615**	**6.179**	**4.991**	**5.497**	**5.709**	**5.964**	**6.893**	**6.736**	**6.651**	**7.241**	**7.162**
solid biomass	5.218	5.162	5.282	5.508	5.630	8.282	8.029	7.636	5.615	6.179	4.991	5.497	5.663	5.803	6.652	6.485	6.392	6.971	6.873
landfill gas													0.046	0.161	0.241	0.251	0.259	0.270	0.289
1.A.4.b. Residential																			
Liquid fuels	**4.908**	**5.672**	**5.003**	**4.011**	**2.848**	**1.403**	**1.272**	**1.363**	**1.454**	**1.406**	**1.444**	**1.440**	**1.440**	**1.398**	**1.443**	**1.577**	**1.621**	**1.439**	**1.393**
gasoline											0.132	0.132	0.132	0.132	0.132	0.220	0.264	0.264	0.264
diesel oil	1.912	2.762	2.592	1.827	0.892	0.127	0.042	0.042	0.042	0.085	0.127	0.170	0.170	0.127	0.127	0.127	0.127	0.127	0.127
RFO	0.041																		
LPG	2.869	2.823	2.368	2.140	1.913	1.275	1.230	1.321	1.412	1.321	1.184	1.139	1.139	1.139	1.184	1.230	1.230	1.047	1.002
other kerosene	0.086	0.086	0.043	0.043	0.043														
Solid fuels	**6.828**	**7.874**	**4.818**	**5.295**	**4.555**	**2.074**	**2.205**	**1.887**	**0.992**	**0.734**	**0.522**	**1.338**	**0.854**	**0.787**	**0.787**	**0.944**	**0.813**	**0.813**	**0.813**
coal	6.404	7.542	4.440	5.037	4.411	1.821	1.964	1.708	0.797	0.683	0.512	1.338	0.854	0.787	0.787	0.944	0.813	0.813	0.813
peat briquettes	0.294	0.201	0.248	0.248	0.124	0.232	0.201	0.139	0.155	0.031									
peat	0.131	0.131	0.131	0.010	0.020	0.020	0.040	0.040	0.040	0.020	0.010								
natural gas	**3.970**	**4.238**	**4.905**	**5.090**	**4.361**	**4.182**	**3.799**	**3.093**	**2.927**	**2.859**	**2.665**	**3.007**	**3.298**	**3.667**	**3.964**	**4.199**	**4.333**	**4.595**	**4.700**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
solid biomass	**20.010**	**24.669**	**24.320**	**26.396**	**26.800**	**30.003**	**31.349**	**29.730**	**29.994**	**29.058**	**28.228**	**30.519**	**30.078**	**31.850**	**32.073**	**32.234**	**31.195**	**30.418**	**30.168**
1.A.4.c. Agriculture/Forestry/Fisheries																			
Liquid fuels	**9.468**	**10.187**	**7.311**	**6.753**	**5.853**	**4.527**	**4.730**	**4.026**	**3.476**	**3.687**	**3.729**	**3.983**	**3.643**	**4.282**	**4.326**	**4.370**	**4.546**	**4.548**	**4.125**
gasoline	1.628	0.132	0.132	0.132	0.132	0.088	0.088	0.088	0.044	0.044	0.044			0.044	0.044	0.044	0.044	0.044	
diesel oil	6.161	8.583	6.161	5.269	4.419	3.952	3.909	3.654	3.229	3.399	3.442	3.739	3.399	3.994	4.079	4.164	4.461	4.504	4.079
RFO	1.421	1.340	0.974	1.218	1.259	0.487	0.690	0.284	0.203	0.244	0.244	0.244	0.244	0.244	0.203	0.162	0.041		
LPG	0.046	0.046		0.091															0.046
other kerosene	0.086	0.086	0.043	0.043	0.043		0.043												
other liquid	0.126																		
Solid fuels	**1.112**	**0.970**	**0.572**	**0.527**	**0.700**	**0.481**	**0.300**	**0.215**	**0.114**	**0.085**	**0.085**	**0.114**	**0.114**	**0.079**	**0.079**	**0.052**	**0.052**	**0.052**	**0.052**
coal	1.081	0.939	0.541	0.455	0.655	0.455	0.285	0.199	0.114	0.085	0.085	0.114	0.114	0.079	0.079	0.052	0.052	0.052	0.052
peat briquettes	0.031	0.031	0.031	0.031	0.015	0.015	0.015	0.015											
peat				0.040	0.030	0.010													
natural gas	**14.073**	**13.825**	**1.380**	**0.671**	**0.739**	**0.641**	**0.706**	**0.572**	**0.606**	**0.505**	**0.506**	**0.713**	**0.703**	**0.850**	**1.016**	**0.842**	**0.807**	**0.765**	**0.588**
solid biomass	**1.220**	**1.229**	**1.271**	**1.306**	**1.307**	**0.358**	**0.365**	**0.617**	**0.648**	**0.665**	**0.590**	**0.546**	**0.508**	**0.506**	**0.607**	**0.552**	**0.534**	**0.713**	**0.324**

The biggest decrease in 1990-2008 was for solid fuel consumption – 92.29%, and liquid fuels consumption – 75.86%. (Table 3.2.32) It is explained with fuel switching processes when solid and 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.

Since 1992, biomass as fuel dominates in Other Sectors. Biggest part of solid biomass consumption goes to Residential sector where biomass is main fuel in small capacity burning installations. Consumption of biomass fuel has increased by 42.37% in 1990–2008. Since 1997 gaseous fuel consumption is constantly increasing. These are types of fuels with lower cost to whom liquid and solid fuels were switched. Fuel consumption increase in Other sectors is strongly linked to fuel consumption decrease in Energy industries when central heating supply consumers switched to individual heating supply.

Due to crisis that started in second part of 2008 and strongly influences Latvia's national economy total fuel consumption in 1.A.4 sector has decreased by almost 3% in 2007-2008.

The biggest decrease was in 1.A.4.a Commercial / Institutional sector – almost 40%, because crisis and sharp increase of inflation mostly influenced small enterprises. Structural changes made to decrease influence of world crisis also affected amount and capacity of business institutions.

3.2.9.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in 1.A.4 sector is ±2% in 2008. CSB gives approximately 2% statistical sample error 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 biogas stationary combusted in enterprises covered by 1.A.4.a Commercial / Institutional sector was assumed rather low – 2% because the combusted fuel amount is obtained directly from wastewater treatment plant that has precise measurement equipment for accounting of combusted fuel. Still the methane percentage amount in combusted sludge gas is given approximate by the wastewater treatment plant that's why final uncertainty of combusted sludge gas is assumed as 20%.

CO_2 emission factor was estimated according physical characterization of used fuels in country basing on average NCV reported by fuel consumers and determined carbon content so uncertainty was assigned as quite low about 10%. For combustion of solid fuels uncertainty of CO_2 emission factor was assigned higher to 15% because CO_2 emission factor of peat briquettes was taken from GHG inventories of Finland. As well as CO_2 emission factor for natural gas was assumed rather low as 5% because plant specific fuel data is used to estimate emission factor. CO_2 emission factor for landfill gas was assigned as 10% because constant carbon content was used in emission estimation but plant specific NCV value is used. 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 1996 so uncertainty was assigned as very high about 50% according IPCC GPG 2000.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no “not estimated” sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 3.2.40 were double-checked and large fluctuations were explained.

Table 3.2.40 IEF changes higher than 10% for 1.A.4 sector

Sectors	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	1995	10	1996	11.14299	11.43%	Gasoline consumption fluctuations and the part of gasoline consumption in total amount of liquid fuels consumption In 1995 no gasoline was used in off-roads. Only CH_4 EF of gasoline differs from other liquid fuels.
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	1994	11.50818	1995	10	-13.11%	
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	1993	10.15878	1994	11.50818	13.28%	
1.A.4.a	Other Liquid Fuels/CO_2	t/TJ	2005	95.11825	2006	78.60579	-17.36%	In 2005 structure of other liquid fuels changed therefore average NCV in 2005 was lower (more light liquid fuels were used). That’s why estimated CO_2 EF and estimated carbon emission factor increased in 2005.
1.A.4.a	Other Liquid Fuels/CO_2	t/TJ	2004	82.07938	2005	95.11825	15.89%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2007	26.42254	2008	19.60947	-25.79%	Changes of CH_4 IEF are explained with appearance and fluctuation of peat and peat briquettes consumption.
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2006	20.21341	2007	26.42254	30.72%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2005	15.45327	2006	20.21341	30.80%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2004	10	2005	15.45327	54.53%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2003	12.16326	2004	10	-17.79%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2002	10	2003	12.16326	21.63%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2001	12.89378	2002	10	-22.44%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2000	15.62821	2001	12.89378	-17.50%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1999	12.17576	2000	15.62821	28.36%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1998	18.28911	1999	12.17576	-33.43%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1997	26.35466	1998	18.28911	-30.60%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1996	30.57658	1997	26.35466	-13.81%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1995	20.79254	1996	30.57658	47.06%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1994	30.43331	1995	20.79254	-31.68%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1993	20.25809	1994	30.43331	50.23%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1992	25.64748	1993	20.25809	-21.01%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1991	22.56967	1992	25.64748	13.64%	
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	2005	25.3361	2006	27.90409	10.14%	CH_4 and N_2Oemissions from liquid fuels in this sector is influenced with the amount of gasoline consumption in off-roads as
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	2004	20.05258	2005	25.3361	26.35%	
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	1999	10	2000	20.05881	100.59%	

Sectors	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
1.A.4.b	Liquid Fuels/N_2O	kg/TJ	1999	0.6	2000	0.728021	21.34%	gasoline fuel only has different CH_4 EF comparing to other liquid fuels types. That's why part of gasoline fuel in total liquid fuel consumption influence average IEF of liquid fuels in the sector.
1.A.4.c	Liquid Fuels/CH_4	kg/TJ	1990	22.03688	1991	10.90706	-50.51%	
1.A.4.c	Liquid Fuels/N2O	kg/TJ	1990	0.840738	1991	0.618141	-26.48%	
1.A.4.b	Solid Fuels/N_2O	kg/TJ	1998	1.911361	1999	1.580908	-17.29%	Changes of N_2O IEF are explained with appearance and fluctuation of peat and peat briquettes consumption.
1.A.4.b	Solid Fuels/N_2O	kg/TJ	1997	1.647448	1998	1.911361	16.02%	
1.A.4.b	Solid Fuels/N_2O	kg/TJ	1994	1.482201	1995	1.716492	15.81%	
1.A.4.c	Solid Fuels/N_2O	kg/TJ	1997	1.587574	1998	1.4	-11.82%	
1.A.4.c	Solid Fuels/N_2O	kg/TJ	1993	1.751479	1994	1.569467	-10.39%	
1.A.4.c	Solid Fuels/N_2O	kg/TJ	1992	1.540887	1993	1.751479	13.67%	

3.2.9.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

3.2.9.4.1 General QA/QC checks for 1.A.1 sector

For stationary fuel combustion following QA/QC checks are performed for all parts of national inventory.

There are several steps for activity data verification:

1. Activity data check at the data providing institution:
    - CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.
2. Activity data checked at the institution responsible for the emission estimation and reporting:
    - During the activity data input in emission estimation database done by sectoral expert all the data changes are compared to previous inventory and agreed with CSB. The reasons of data changes are explained.
    - After the data is input in emission estimation database activity data is verified using diagrams that is the best way to reflect all the illogical data fluctuations.
    - The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR. Still the data reporting requirements of IPCC 1996 make difficult the activity data comparison as autoproducers have to be excluded from Energy industries sector and included in relevant sectors.
3. Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 5%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

Estimated emissions verification:

1. All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

2. Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

3.2.9.4.2 Additional QA/QC checks for Tier2 methodology

Country specific CO_2 emission factors

Mainly Tier1 methodology is reported as used in the CO_2 emission estimation but according to IPCC 2006 it would be Tier2 methodology as country or plant specific emission factors are used. Country specific emission factors are estimated using NCV values reported by CSB. CSB collects these data from fuel combustion enterprises and reports annual average number in Annual Questionnaire tables. Carbon content values of the fuels are determined in local expert's research. Detailed CO_2 emission factors estimation data is used and CO_2 emission factor is estimated to the last decimal place. Estimated CO_2 emission factors are within IPCC range. Even if the estimated CO_2 EFs are almost equal to IPCC default EFs or don't differ at all the EFs are reported as country specific.

Plant specific CO_2 emission factors and Tier2 CO_2 emission estimation methodology

Tier2 methodology is used for CO_2 emission from natural gas and landfill gas combustion estimation as plant specific NCVs are used in CO_2 EF estimation. The parameters are reported to LEGMC by only natural gas supplier "Latvijas Gāze" and 3 landfills and the companies confirm that the data is reasonable and useful.

Natural gas supplying company measures NCV every day and reports the average annual number to LEGMC and CSB. All the measuring equipments are checked and verified.

The parameters also are verified by CSB comparing the data natural gas supplier and landfill gas collecting plants has reported within annual Energy balance surveys.

Also CO_2 emission estimation methodology differs from IPCC default because only methane obtained from sludge gas only is taken into account.

3.2.9.5 Source-specific recalculations

Natural gas consumption for year 1990–2007 was recalculated as data of natural gas characterization from only natural gas provider a/s "Latvijas Gāze" was obtained – net calorific value changes year by year. CO_2 emission factor for natural gas was changed for all years according to country specific natural gas characterizations reported by natural gas provider.

Landfill gas activity data were changed due to updated information received from Latvia's landfills. CO_2 emission factor for biomass also was changed according to landfills and these are plant specific emission factors.

NCV changed for other liquid fuels for 2000-2007 due to possibility to divide used oil consumption from total other liquid fuels. NCV changes for all years in time series for natural gas and biogas.

Diesel oil consumption in military ships was excluded from 1.A.4.a Commercial / Institutional sector and included in 1.A.5.b sector.

CO_2 emission factor for all fuel types were précised to include numbers to the last decimal places. CO2 emission factors were recalculated for some fuel types due to change of NCV in particular time period of the time series, for example for other liquid fuels, used oils, coal and coke.

Difference for submission 2009 and submission 2010 in reported GHG emissions is quite small for all years in time series 1990–2007 fluctuating from –2.27% in 1993 to 1.33% in 2007 with average difference –0.71%. (Figure 3.2.29)

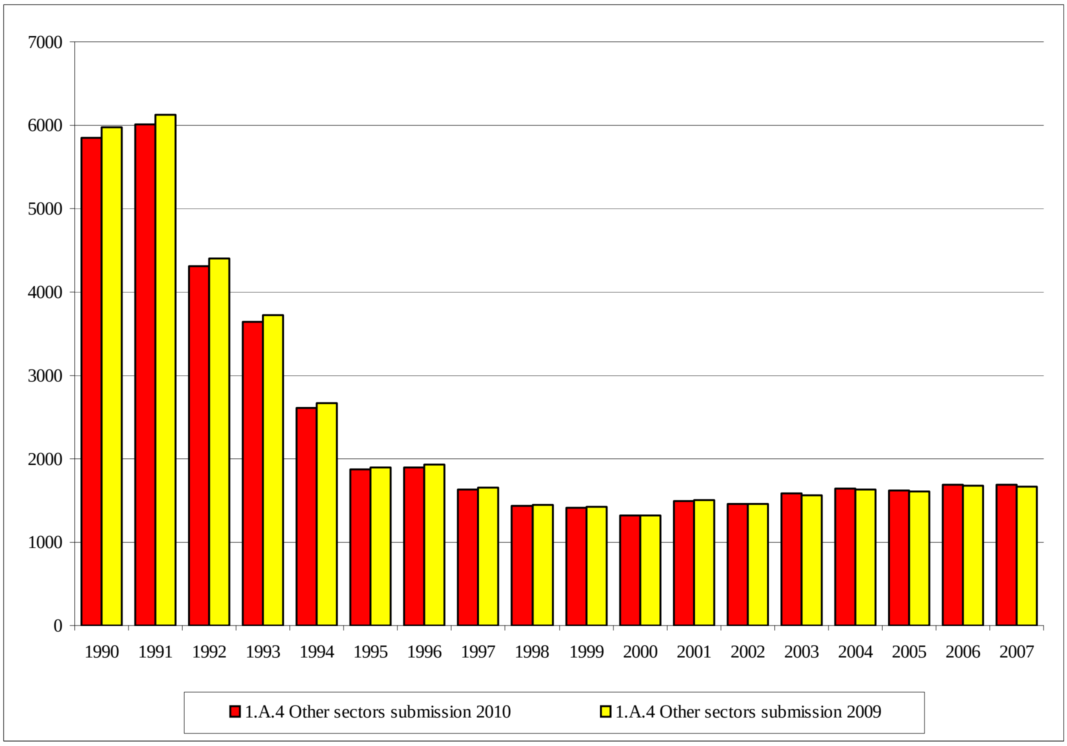


Figure 3.2.29 Comparison for GHG emissions from 1.A.4 Other sectors for submission 2009 and submission 2010 (Gg)

3.2.9.6 Source-specific planned improvements

The summarized necessary improvements are:

- Researches on use of the country specific emission factors for key category – CH_4 emissions from solid biomass combustion;
- Researches of possibility to use plant specific data from national database "2-AIR" where facilities that perform any of pollution activities have to report all emissions they create;
- Improving country specific CO_2 emission factors.

3.2.10 Other sources (CRF 1.A.5.b)

3.2.10.1 Source category description

Under the CRF 1.A.5.b Other Mobile sources emissions from liquid fuels – aviation gasoline, diesel oil and jet kerosene, used in military aircrafts and ships are reported. These emissions appear since 1995. (Table 3.2.41)

Table 3.2.41 Emissions from 1.A.5 Other sources in 1995–2008 (Gg)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1995	6.1223	0.00004	0.00017	0.0259	0.0086	0.0043	0.0020
1996	3.2525	0.00002	0.00009	0.0136	0.0046	0.0023	0.0011
1997	12.3403	0.00009	0.00035	0.0522	0.0174	0.0087	0.0040
1998	3.2525	0.00002	0.00009	0.0136	0.0046	0.0023	0.0011
1999	9.3347	0.00007	0.00026	0.0394	0.0132	0.0066	0.0030
2000	0.1358	0.00000	0.00000	0.0005	0.0002	0.0001	0.0000
2001	0.1667	0.00000	0.00000	0.0006	0.0002	0.0001	0.0001
2002	6.8660	0.00038	0.00008	0.1175	0.0765	0.0159	0.0019

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2003	6.3312	0.00033	0.00008	0.1032	0.0667	0.0140	0.0018
2004	9.6105	0.00056	0.00011	0.1722	0.1129	0.0232	0.0027
2005	7.5973	0.00040	0.00010	0.1236	0.0798	0.0168	0.0022
2006	7.4935	0.00038	0.00010	0.1182	0.0761	0.0161	0.0021
2007	2.8574	0.00008	0.00006	0.0290	0.0168	0.0041	0.0009
2008	3.3928	0.00012	0.00007	0.0386	0.0233	0.0054	0.0010
share of total 2008 emissions	**0.04%**	**0.0001%**	**0.0012%**	**0.102%**	**0.009%**	**0.01%**	**0.04%**

Emissions from this sector aren't influenced by the changes in national economy or in the economy of Latvia's trade partners.

CO_2 emissions from Other sectors (military aircrafts and navigation) have increased in 2007-2008 by 18.74% that is explained with increase of military activities and increase of the financing of these activities. Still CO_2 emissions from military activities have decreased by 61.87% in 2006-2007.

3.2.10.2 Methodological issues

Methods

IPCC 1996 Tier1 Sectoral approach was used to calculate GHG emissions from the 1.A.5.b Other Mobile source. Calculation of all emissions from fuel combustion is done with Excel databases developed by experts from LEGMC. CRF Reporter software developed by experts from UNFCCC was used to report emission data.

The general method for preparing inventory data was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (Gg)
EF – estimated or default emission factor (t/TJ)
B_q – amount of fuel in thermal units (TJ)

Emission factors and other parameters

Default emission factors for Military aircrafts are taken from IPCC 1996. (Table 3.2.42)

Table 3.2.42 Emission factors for the calculation of emissions from 1.A.5 Other sources

	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**
aviation gasoline	70.20	0.0005	0.002	0.25	0.1	0.05	0.023
diesel oil	74.0	0.005	0.0006	1.5	1	0.2	0.02
Jet fuel	70.86	0.0005	0.002	0.3	0.10	0.05	0.023

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. (Chapter 3.2.6.2) SO_2 emission factors for fuel combustion are presented in Annex 2.

Activity data

Emissions from 1.A.2 sector are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2008 sent to EUROSTAT. The data collection system for 1.A.2 sector is the same as for 1.A.1 sector. (Table 3.2.43)

Table 3.2.43 Fuel consumption in 1.A.5 Other sources in 1995−2008 (TJ)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1.A.5.b Other mobile sources														
Liquid fuels	**0.086**	**0.046**	**0.174**	**0.046**	**0.132**	**0.002**	**0.002**	**0.094**	**0.087**	**0.131**	**0.104**	**0.103**	**0.040**	**0.047**
aviation gasoline		0.003	0.001	0.003	0.002	0.002	0.002	0.002	0.005	0.003	0.002	0.006	0.001	0.005
diesel oil								0.075	0.065	0.111	0.077	0.073	0.014	0.021
jet fuel	0.086	0.043	0.173	0.043	0.130			0.017	0.017	0.017	0.024	0.024	0.024	0.021

3.2.10.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.5.b is ±2% in 2008 because official statistical information from CSB is used. Still for some years there are gaps in activity data time series obtained by CSB and these data has to be précised. That's why activity data for the sector is assumed as quite high – 50%.

Emission factors used in estimation of emissions were taken from IPCC Guidelines so uncertainty was assigned as very high about 50% according IPCC GPG 2000.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 3.2.44 were double-checked and large fluctuations were explained.

Table 3.2.44 IEF changes higher than 10% for 1.A.5.b sector

Sectors	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2007	2.118225	2008	2.476498	16.91%	All changes of IEFs are explained with structure of liquid fuels and part of total liquid fuels amount that particular fuel
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2006	3.708385	2007	2.118225	-42.88%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2004	4.318608	2005	3.842649	-11.02%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2003	3.856397	2004	4.318608	11.99%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2001	0.5	2002	4.084906	716.98%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2006	1.001836	2007	1.496552	49.38%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2004	0.811989	2005	0.960065	18.24%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2003	0.955788	2004	0.811989	-15.05%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2001	2	2002	0.884696	-55.77%	

3.2.10.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

3.2.10.4.1 General QA/QC checks for 1.A.1 sector

For stationary fuel combustion following QA/QC checks are performed for all parts of national inventory.

There are several steps for activity data verification:

1. Activity data check at the data providing institution:
    - CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.
2. Activity data checked at the institution responsible for the emission estimation and reporting:

- During the activity data input in emission estimation database done by sectoral expert all the data changes are compared to previous inventory and agreed with CSB. The reasons of data changes are explained.
- After the data is input in emission estimation database activity data is verified using diagrams that is the best way to reflect all the illogical data fluctuations.
- The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR. Still the data reporting requirements of IPCC 1996 make difficult the activity data comparison as autoproducers have to be excluded from Energy industries sector and included in relevant sectors.

3. Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 5%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

Estimated emissions verification:

1. All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.
2. Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

3.2.10.4.2 Additional QA/QC checks for Tier2 methodology

Country specific CO_2 emission factors

Mainly Tier1 methodology is reported as used in the CO_2 emission estimation but according to IPCC 2006 it would be Tier2 methodology as country or plant specific emission factors are used. Country specific emission factors are estimated using NCV values reported by CSB. CSB collects these data from fuel combustion enterprises and reports annual average number in Annual Questionnaire tables. Carbon content values of the fuels are determined in local expert's research. Detailed CO_2 emission factors estimation data is used and CO_2 emission factor is estimated to the last decimal place. Estimated CO_2 emission factors are within IPCC range. Even if the estimated CO_2 EFs are almost equal to IPCC default EFs or don't differ at all the EFs are reported as country specific.

3.2.10.5 Source-specific recalculations

Aviation gasoline and diesel oil consumption in military navigation was reported for the first time as more detailed data was received from CSB. Diesel oil consumption in military ships was excluded from 1.A.4.a Commercial / Institutional sector and included in 1.A.5.b sector.

Difference for submission 2009 and submission 2010 in reported GHG emissions is quite significant in 1995–2007 fluctuating from –0.09% in 1999 to 100% in 2000-2003 and 2005 with average difference 64.97%. (Figure 3.2.30)

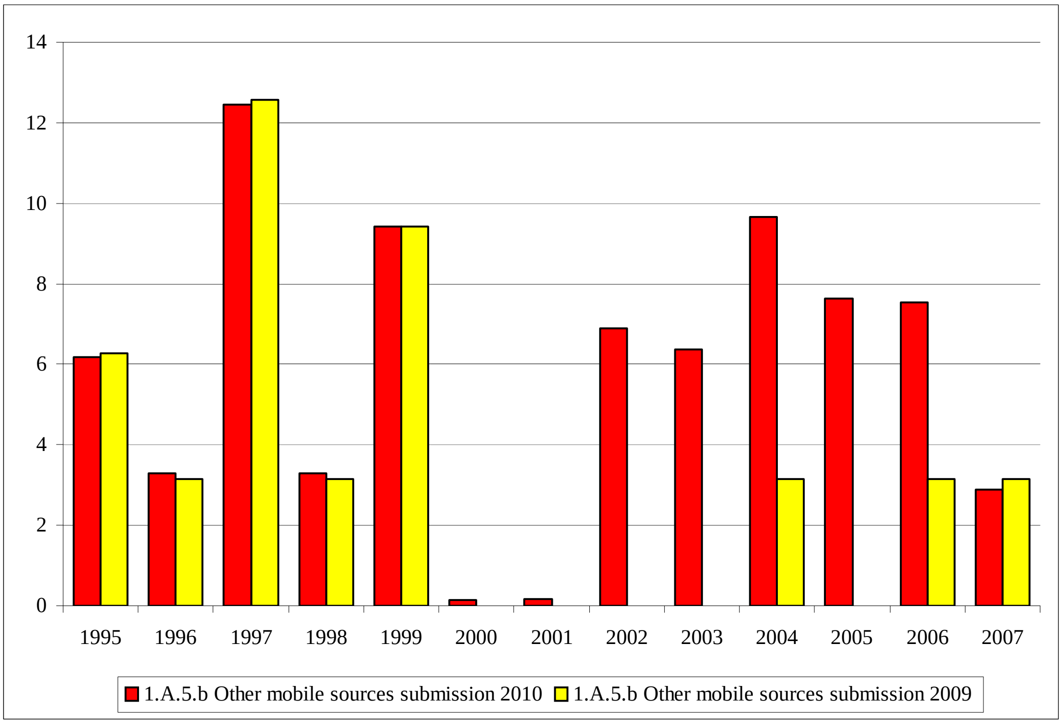


Figure 3.2.30 Comparison for GHG emissions from 1.A.5 Other sources for submission 2009 and submission 2010 (Gg)

3.2.10.6 Source-specific planned improvements

It is necessary to obtain more precise data of fuel consumption in military mobile equipment as for now available data could be inaccurate.

3.3 FUGITIVE EMISSIONS FROM SOLID FUELS AND OIL AND NATURAL GAS (CRF 1.B)

Under the 1.B Fugitive emissions category CH_4, NO_x and CO emissions (for several years) from operations with natural gas and NMVOC emissions from operations with gasoline are reported.

Table 3.3.1 Reported emissions from fuel combustion in Latvia in 2008

Source	Emissions						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1.B.1 Solid Fuels							
1.B.1.a Coal Mining and Handling	NO	NO	NO	NO	NO	NO	NO
1.B.1.b Solid Fuels Transformation	NO	NO	NO	NO	NO	NO	NO
1.B.1.c Others	NO	NO	NO	NO	NO	NO	NO
1.B.2 Oil and Natural Gas							
1.B.a Oil	NO	NO	NO	NO	NO	√	NO
1.B.2.b Natural Gas	NO	√	NA	NO	NO	NO	NO
1.B.2.c Venting and Flaring	NO	NO	NO	NO	NO	NO	NO
1.B.2.d Other	NO	√	NO	NO	NO	NO	NO

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. Only particulate matters emissions are estimated from coal transportation in Latvia.

There are lasting peat mining and manufacturing traditions in Latvia. It would be possible to estimate leaking CH_4 emissions from peat bog manufacturing. Still, since there are no methodology and emission factors for estimations, these emissions are not estimated.

3.3.1 Fugitive emission from oil (CRF 1.B.2.A)

3.3.1.1 Source category description

1.B.2 Fugitive emission from oil and natural gas includes NMVOC emissions from category 1.B.2.a. Oil storage.

There are no oil refineries in Latvia; therefore NMVOC emissions from gasoline distribution (Table 3.3.2) were only calculated for 1990–2001. For 1990–1999 it was impossible to acquire precise data on fuel storage technologies, 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.

Table 3.3.2 Fugitive NMVOC emissions from oil products 1990–2008 (Gg)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2.98	2.53	2.41	2.34	2.24	2.02	1.99	1.83	1.72	1.66	1.32	1.39	1.35	1.32	1.41	0.86	0.64	0.63	0.50

For 2002–2008 fugitive NMVOC emission from oil products storage and distribution in oil terminals and pump stations was taken from statistical database "2-AIR" where operators have to report fugitive NMVOC emissions from activities with oil products.

Decrease of NMVOC emissions in 2004-2005 by 39% is explained with the strong legislation rules set in the country for operation with liquid fuels.

3.3.1.2 Methodological issues

Methods

EMEP/CORINAIR methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in 1990–2001. For time period 2002–2008 NMVOC emission data are taken from operator's reported in database "2-AIR" so this is bottom-up reporting.

Emission factors

NMVOC emission factor for emission from gasoline transportation and storage estimation in 1990–2000 were taken from the local expert research and is based on the expert's judgment. Emission factor for 2000-2001 is taken from EMEP/CORINAIR as default emission factor for gasoline distribution. (Table 3.3.3)

Table 3.3.3 NMVOC emission factors (g/kg)

1990-1999	2000-2001
4.9	3.93

Activity data

Activity data for NMVOC emission calculation was used from CSB Energy Balance. (Table 3.3.4) Activity data for 2002–2008 isn't obtained because final emission data was taken from operator's reports to database "2-AIR". This emission data is reported by the petrol stations and oil terminals and verified by Regional Environment State Bureau. Mostly these emissions are obtained by using measurement or estimated using mass balance method.

Table 3.3.4 Activity data used for NMVOC emission calculation in 1990–2001 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Gasoline	26.75	22.75	21.65	21.03	20.11	18.13	17.91	16.46	15.40	14.87	14.83	15.53

3.3.1.3 Uncertainties and time series consistency

Activity data for fugitive emissions for 1990–2001 from operations with gasoline were taken from CSB and uncertainty was assumed as very low for about 2% as statistical frame mistake. Reported NMVOC emissions for 2002-2008 from operations with oil products are assumed as 50% because emission data are taken from database "2-AIR" where enterprises report their emission data. Operators mostly estimate NMVOC emissions by using mass balance method or emissions are measured. Environment State Bureau checks and verifies all reports.

Time series of the NMVOC emissions are consistent for 1990–2001 where emissions are estimated by using emission factor method that is top-down method as well as NMVOC emissions from oil terminals aren't taken into account. For 2002-2008 NMVOC emissions data are taken from enterprises – petrol stations and oil terminals that is bottom-up method.

Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

3.3.1.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

There are several steps for activity data used in emission estimation in 1990-2001 verification:

1. Activity data check at the data providing institution:
    - CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.
2. Activity data checked at the institution responsible for the emission estimation and reporting:
    - During the activity data input in emission estimation database done by sectoral expert all the data changes are compared to previous inventory and agreed with CSB. The reasons of data changes are explained.
    - After the data is input in emission estimation database activity data is verified using diagrams that is the best way to reflect all the illogical data fluctuations.
    - The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR. Still the data reporting requirements of IPCC 1996 make difficult the activity data comparison as autoproducers have to be excluded from Energy industries sector and included in relevant sectors.

NMVOC emissions reported for 2002-2008 are taken from national database "2-Air". The data input by companies' is verified and approved by Regional Environmental Boards.

3.3.1.5 Source-specific recalculations

No recalculations have been done for the specific sector.

3.3.1.6 Source-specific planned improvements

It would be possible to estimate fugitive emissions from crude oil transportation via pipelines that occurred in the beginning of 90ties if activity data would be possible to obtain. For now only light liquid fuels are transported via pipelines as it was reported from pipelines infrastructure company.

3.3.2 Fugitive emissions from natural gas (CRF 1.B.2.B, CRF 1.B.2.D)

3.3.2.1 Source category description

CH_4 emissions from operations with natural gas are reported in following sub-sectors of 1.B.2 Oil and Natural gas sector:

- 1.B.2.b.3 Transmission;
- 1.B.2.b.4 Distribution;
- 1.B.2.b.5 Other leakage – including leakage at industrial plants and power stations and leakage at residential and commercial sectors;
- 1.B.2.d Other – including leakage at underground natural gas storage facility.

Table 3.3.5 Fugitive CH_4 emissions from natural gas 1990-2008 (Gg)

	CH_4	NO_x	CO
1990	13,05	NO	NO
1991	12,57	NO	NO
1992	11,46	NO	NO
1993	10,96	NO	NO
1994	10,71	NO	NO
1995	10,43	NO	NO
1996	10,05	NO	NO
1997	9,38	NO	NO
1998	9	NO	NO
1999	8,581	NO	NO
2000	7,94	NO	NO
2001	7,7	0,0000013	0,0000046
2002	8,03	0,0000013	0,0000046
2003	6,281	NO	NO
2004	6,213	0,0000013	0,0000046
2005	6,944	NO	NO
2006	5,035	NO	NO
2007	5,164	NO	NO
2008	5,302	NO	NO
share of total 2008 emissions	**4,64%**	**NO**	**NO**

Fugitive CH_4 emissions decreases comparing with 1990–2001, only started from 2002 it fluctuates and continues to decrease. (Table 3.3.5) 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. CH_4 emission increase in 2005 is explained with transmission pipeline accident in Valmieras district in April 2005 when significant amount of natural gas leaked.

3.3.2.2 Methodological issues

Methods

LEGMC are receiving data about CH_4 emissions from the natural gas holding company "Latvijas Gāze" for the time period 1990–2008. Consequently company "Latvijas Gāze" calculates emissions by itself.

LEGMC 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.

Emission factors and other parameters

CH_4 emission calculation from natural gas is described above.

Activity data

CH_4 emissions are obtained from the holding company "Latvijas Gāze" and activity data for this sector is confidential according to national legislation as "Latvijas Gāze" is only natural gas supplier and distributor in Latvia.

3.3.2.3 Uncertainties and time series consistency

Uncertainty of methane emission from natural gas consumption is assigned as quite low – 5%, as emissions were measured and estimated by only enterprise operated with natural gas in Latvia – “Latvijas Gāze” by methodology developed for enterprise. So activity data and emission factor is very precise.

Time series of the CH_4 emission is consistent and complete because the same methodology, emission factors and data sources are used for all years in time series.

Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no “not estimated” sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

3.3.2.4 Source-specific QA/QC and verification

“Latvijas Gāze”, that reports fugitive CH_4 emissions from the operations with natural gas, estimates CH_4 emissions according to methodology prepared especially of the organization that is internationally verified and approved by the Environment State Bureau and Ministry of Environment. Underground storage “Inčukalns” from what CH_4 emissions are reported in CRF 1.B.2.D has ISO standard and all the information obtaining procedures are controlled and verified.

“Latvijas Gāze” reports same emissions for national database “2-AIR” where reported emissions are verified and approved by the particular Regional Environment Board as the emissions are linked to natural taxes that company has to pay..

3.3.2.5 Source-specific recalculations

No recalculations have been done for the specific sector.

3.3.2.6 Source-specific planned improvements

According to Expert Review Team recommendation it is necessary to translate CH_4 estimation methodology and include it in the annexes of the NIR but due to lack of finances it will be done for the further inventories.

CHAPTER 4: INDUSTRIAL PROCESSES (CRF 2)

4.1 OVERVIEW OF SECTOR

4.1.1 Quantitative overview

Sources of emissions from Industrial Processes are:

- Mineral products (CRF 2.A):
  - cement production (clinker production),
  - lime production,
  - asphalt roofing,
  - road paving with asphalt,
  - other – use of mineral products in glass, ceramics and metal production;
- Metal production (CRF 2.C):
  - CO_2 emissions from use of crude iron as raw material,
  - CH_4 emissions from total iron and steel production;
- Other production (CRF 2.D):
  - NMVOC emissions from food and drink production,
  - SO_2 emissions from Pulp and Paper production for time period 1990 – 1996;
- Actual emissions from consumption of HFCs halocarbons and SF_6 (CRF 2.F):
  - refrigerators and air conditioners,
  - foam blowing,
  - fire extinguishers,
  - medical aerosols,
  - electric equipment,
  - other – HFC-134a from shoes;
- Potential emissions from consumption of HFCs halocarbons and SF_6 (CRF 2.F.P).

Emissions from the Chemical Industry (CRF 2.B), Production of Halocarbons and SF_6 (CRF 2.E) and Other (CRF 2.G) sectors are not occurring in Latvia.

Table 4.1.1 Reported emissions from Industrial Processes in Latvia in 2008

Source	Emissions												
	CO_2	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
2.A Mineral Products													
1. Cement Production	√	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	√
2. Lime Production	√	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Limestone and Dolomite Use	√	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Soda Ash Production and Use	√	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Asphalt Roofing	√	NA	NA	NA	NA	NA	NA	NA	NA	NA	√	√	NA
6. Road Paving with Asphalt	√	NA	NA	NA	NA	NA	NA	NA	NA	NE	NE	√	NE
7. Other													
Cement production (NOx and NMVOC)		IE	IE	IE	IE	IE	IE	IE	IE	√	NA	√	IE
Production of Bricks	√	NE	NE	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE
Production of Glass (Use of fluorspar)	√	NE	NE	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE
Production of Glass (Use of potash)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Production of Glass Fibre	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Production of Tiles	√	NE	NE	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE
B. Chemical Industry													
1. Ammonia Production	NO	NO	NO	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
2. Nitric Acid Production	NA	NA	NO	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA
3. Adipic Acid Production	NO	NA	NO	NA	NA	NA	NA	NA	NA	NO	NO	NO	NA

Source	Emissions												
	CO_2	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
4. Carbide Production	NO	NO	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
5. Other													
Carbon Black	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene	NO	NO	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dichloroethylene	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methanol	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Metal Production													
1. Iron and Steel Production	NO	NO	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
2. Ferroalloys Production	NO	NO	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
3. Aluminium Production	NO	NO	NA	NA	NA	NA	NO	NA	NA	NO	NO	NO	NO
4. SF_6 Used in Aluminium and Magnesium Foundries	NA	NA	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA	NA
5. Other													
Other non-specified	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production													
1. Pulp and Paper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
2. Food and Drink(2)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	√	NA
E. Production of Halocarbons and SF_6													
1. By-product Emissions													
Production of HCFC-22	NA	NA	NA	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA
Other	NA	NA	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA	NA
2. Fugitive Emissions	NA	NA	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA	NA
3. Other													
Other non-specified	NA	NA	NA	NA	NO	NA	NO	NA	NO	NA	NA	NA	NA
F. Consumption of Halocarbons and SF_6													
1. Refrigeration and Air Conditioning Equipment	NA	NA	NA	√	√	NO	NO	NO	NO	NA	NA	NA	NA
2. Foam Blowing	NA	NA	NA	√	NE	NO	NO	NO	NO	NA	NA	NA	NA
3. Fire Extinguishers	NA	NA	NA	√	√	NO	NO	NO	NO	NA	NA	NA	NA
4. Aerosols/ Metered Dose Inhalers	NA	NA	NA	√	√	NO	NO	NO	NO	NA	NA	NA	NA
5. Solvents	NA	NA	NA	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA
6. Other applications using ODS(3) substitutes	NA	NA	NA	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA
7. Semiconductor Manufacture	NA	NA	NA	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA
8. Electrical Equipment	NA	NA	NA	NO	NO	NO	NO	√	√	NA	NA	NA	NA
9. Other *(as specified in table 2(II)*													
Production of shoes	NA	NA	NA	√	√	NO	NO	NO	NO	NA	NA	NA	NA
G. Other *(as specified in tables 2(I).A-G and 2(II))*													
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

4.1.2 Description

Industrial processes GHG emissions contribute 2.8% of the total anthropogenic GHG emissions in Latvia in 2008 (Table 4.1.2). The most important emission source of the Industrial Processes in 2008 is CO_2 emissions from Mineral products with the 2.95% from total CO_2 emissions, CO_2 emissions from Metal production with 0.1% from total CO_2 emissions. F-gases contribute 0.65% of the total GHG emissions.

Table 4.1.2 Greenhouse gas emission trend in 1990–2008 (Gg CO_2 eq.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial Processes total -	576.78	508.55	226.82	51.09	**134.85**	**150.32**	**150.18**	**157.34**	**163.46**	**195.35**	**151.88**	**171.41**	**188.52**	**205.34**	**218.14**	**245.44**	**271.42**	**335.40**	**343.91**
2.A Mineral Products																			
CO_2	563.89	499.80	221.06	44.05	128.26	144.96	145.50	147.55	151.81	183.48	137.29	153.74	167.41	175.74	181.60	198.40	203.04	244.91	245.00
2.C Metal Production																			
CO_2	12.83	8.71	5.73	7.01	6.55	4.43	3.49	8.00	8.50	7.71	8.43	8.04	7.60	12.16	12.92	12.36	12.57	14.57	8.67
CH_4	0.09	0.06	0.04	0.05	0.05	0.04	0.05	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.08

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2.F HFCs actual emissions	IE,NA, NE,NO	IE,NA, NE,NO	IE,NA, NE,NO	IE,NA, NE,NO	IE,NA, NE,NO	0.65	0.88	1.24	2.38	3.14	4.83	7.60	10.08	12.97	18.19	27.09	48.62	67.26	80.10
2.F HFCs potential emissions	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0.47	0.50	0.56	0.95	1.29	2.32	32.20	32.77	33.16	125.30	132.95	161.71	166.24	196.43
2.F.P HFCs	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	125.30	132.95	161.71	166.24	196.43
2.F SF6 actual emissions	NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO	0.25	0.29	0.51	0.71	0.98	1.28	1.98	3.38	4.41	5.37	7.53	7.12	8.60	10.08
2.F SF6 potential emissions	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	16.16	17.06	22.56	27.58	34.24	41.65	59.13	94.11	120.28	144.06	198.96	189.73	226.47	264.61

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 4.1.1), when industry was going through a crisis.

It has to be noted that in the beginning of 90ties during the countrywide change in government system and national economy statistics was not well kept. Therefore there is lack of statistical data regarding industry during this time period or they are vague. The data extrapolation was carried out for the sectors where possible although the extrapolation is almost impossible to do due to national circumstances – changes and total restructuring of national economy when industrial development wasn't predictable and explainable.

Since year 2000 and after the crisis in national economy of Russian Federation in 1999-2000 with whom Latvia has strength economic relations, GHG emissions from Industrial Processes sector have increased by 55.848% in 2000-2008. It is explained with sharp development of Latvian industry when amount of construction activities increased and industrial production of building materials also increased.

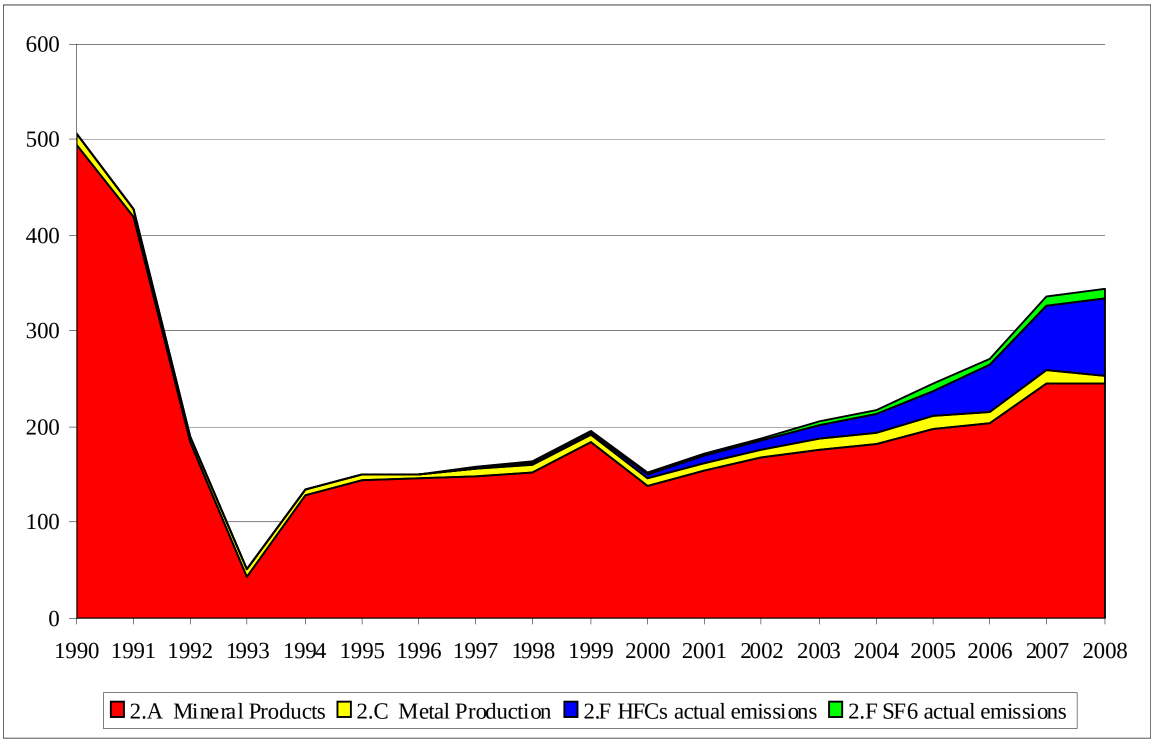


Figure 4.1.1 GHG emissions from Industrial Processes in 1990–2008 (Gg CO_2 eq.)

Key categories

Key categories reported in the Table 4.1.3 is estimated without taking into account LULUCF sector by using Tier1 estimation level.

CO_2 emission from 2.A.1 Cement production sector is key source category with respect to Level assessment without LULUCF sector with 1%.

HFCs emissions from consumption of f-gases are a key source category in 2008 with respect to Trend Assessment without LULUCF sector with 1%. (Table 4.1.3)

Table 4.1.3 Key categories of Industrial Processes sector in 2008

Source category	Emission	Identification criteria	Percentage
Cement production	CO_2	L	1%
Emissions from Consumption of HFCs	HFCs	T	1%

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 71.24% 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.

CO_2 emissions are strongly influenced by economic situation in country. Emission curve reflects economic crisis in time period 1991–1993 after changes in national economy in country when significant amount of industrial producers stop their activities and large former Soviet Union market broke down (Table 4.2.1). Also radical decrease of CO_2 emissions from 1999 to 2000 are influenced by economical crisis in neighbourhood Russian Federation whom Latvia had strong foreign trade linkage.

Table 4.2.1 Emissions from 2.A Mineral Products in 1990–2008 (Gg)

	CO_2								NO_x	CO	NMVOC	SO_2
	2.A	2.A.1	2.A.2	2.A.3	2.A.4	2.A.5	2.A.6	2.A.7				
1990	563.89	366.12	NO	118.97	NO	0.01	9.6	69.18	0.9	0.0002	3.36	0.22
1991	499.8	327.14	NO	89.34	NO	0.00	3.2	80.13	0.83	0.0001	1.21	0.22
1992	221.06	149.18	NO	33.27	NO	0.00	0.49	38.11	0.38	0.00	0.23	0.1
1993	44.05	16.74	NO	16.54	NO	0.00	0.98	9.79	0.04	0.00	0.34	0.03
1994	128.26	81.11	NO	35.81	NO	0.00	3.2	8.14	0.2	0.0001	1.1	0.07
1995	144.96	95.42	NO	34.36	NO	0.00	4.19	10.98	0.24	0.0001	1.44	0.06
1996	145.5	96.16	NO	33.05	NO	0.00	5.17	11.11	0.27	0.0001	1.77	0.1
1997	147.55	97.82	NO	28.58	NO	0.01	9.61	11.54	0.27	0.0002	3.25	0.07
1998	151.81	95.09	NO	30.04	NO	0.01	12.06	14.61	0.26	0.0002	4.07	0.11
1999	183.48	125.48	NO	28.3	NO	0.01	13.79	15.89	0.36	0.0002	4.66	0.09
2000	137.29	79.98	NO	29.78	1.12	0.01	11.82	14.59	0.23	0.0002	3.98	0.07
2001	153.74	99.08	NO	29.3	1.05	0.01	8.86	15.44	0.27	0.0001	3.01	0.07
2002	167.41	106.37	NO	30.36	1.72	0.01	12.31	16.64	0.3	0.0002	4.16	0.08
2003	175.74	117.44	NO	29.13	1.48	0.01	12.81	14.87	0.33	0.0002	4.33	0.09
2004	181.6	124.14	NO	28.82	1.25	0.01	11.82	15.57	0.35	0.0002	4	0.09
2005	198.4	120.49	13.42	30.26	1.3	0.01	14.78	18.14	0.36	0.0002	4.99	0.11
2006	203.04	133.4	9.23	23.28	0.36	0.02	18.22	18.53	0.45	0.0003	6.16	0.14
2007	244.91	171.81	10.16	24.39	NO	0.02	19.7	18.84	0.46	0.0003	6.65	0.16
2008	245	168.69	11.65	20.76	NO	0.02	21.18	22.7	0.45	0.0004	7.14	0.15
share of total 2008 emissions	**2.95%**	**2.03%**	**0.14%**	**0.25%**	**NO**	**0.00002%**	**0.26%**	**0.27%**	**1.19%**	**0.0001%**	**13.23%**	**5.34%**

The NMVOC emissions from road paving and asphalt roofing are included as well as NMVOC emissions from glass fibre production. 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 when it is not possible to report NO_x and CO emissions in 2.A.1 Cement Production sector.

4.2.2 Cement Production (CRF 2.A.1)

4.2.2.1 Source category description

CO_2, NOx, NMVOC and SO_2 emissions are estimated for Cement production sector. The emission curve represent the total situation in national economy when the big decrease happened in the beginning of the 90ties due to changes in national economy, domestic market and production demand. CO_2 emissions had decreased by 95.43% in 1990-1993. Increase of emissions in 2000-2007 represents the development of construction sector and development of external market. CO_2 emissions had decreased by 114.813% in 2000-2007. In 2007-2008 situation changed when mineral products producers had to deal with the increase of costs, inflation and first signs of crisis of national economy. That's why CO_2 emissions had decreased by 1.82% in 2007-2008. (Figure 4.2.1)

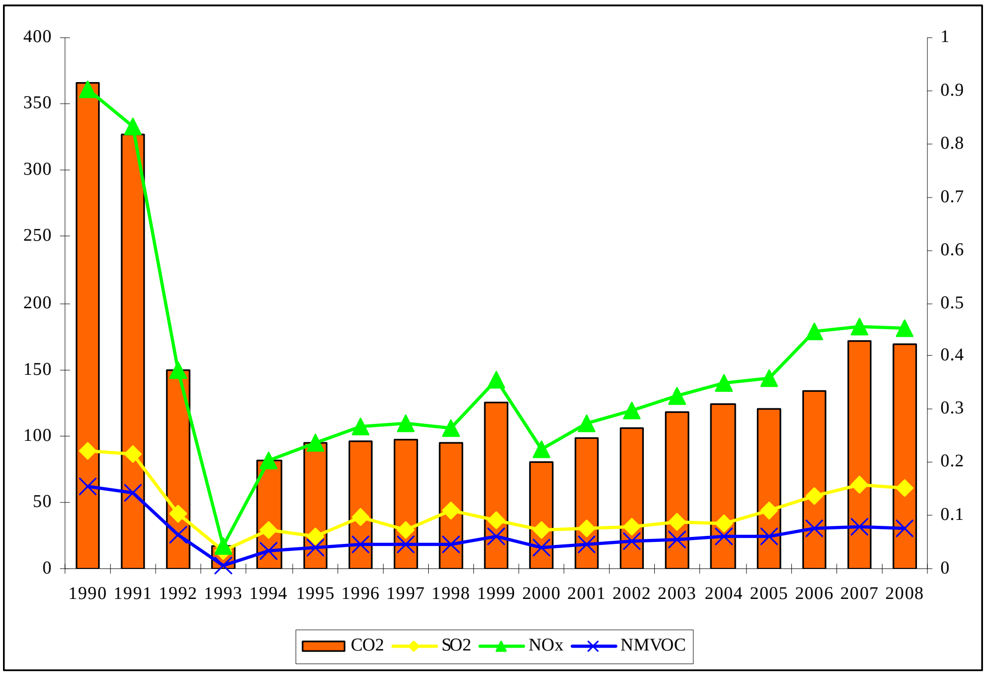


Figure 4.2.1 Emissions from Cement production in 1990–2008 (Gg)[14]

4.2.2.2 Methodological issues

Methods

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. The produced clinker is not weighed in cement production plant but clinker production is estimated from final cement type by multiplying it with cement/clinker ration according to cement producer GHG report

It is not a good practice still activity data calculation is based on final cement production data (imported cement amount is not taken into account) due to unavailability of statistics of produced clinker amount. So activity data is estimated by using Tier1 method from IPCC GPG but for CO_2 emission factor as well as emission estimations IPCC GPG Tier2 method is used.

CO_2 emissions from clinker production are estimated using following equation from IPCC GPG 2000:[15]

$$\text{Emissions} = EF_{clinker} \times \text{Clinker Production} \times \text{CKD Correction Factor}$$

[14] SOx, NOx and NMVOC emissions on secondary axis

[15] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p3.10

For SO_x, NO_x and NMVOC emissions from cement clinker production EMEP/CORINAIR Guidebook methodology was used.

Emission factors

CO_2 emission factor is calculated for all years in time series 1990 – 2008 according to CaO content in used limestone that is measured in laboratory of cement production facility (Table 4.2.2). 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 equation from IPCC GPG 2000:[16]

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

Table 4.2.2 Average CaO content in used limestone (%) and average CO_2 emission factor in 1990 – 2008 (t CO_2 / t clinker)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Average CaO content	64.6	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	64.06	64.06
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	0.400	0.503	0.503
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	0.454	0.403	0.508	0.504

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 that average CaO content of years where data is available could be used was received.

As it can be seen in Table 4.2.3 the plant specific data resulted in a higher CKD ratio (26.25%) in 1990, while the CKD in 2008 is much lower (0.296%). 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) although it again increased to 64.06 in 2007 and 2008. 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, Latvia uses 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 4.2.3 CKD correction factor in 1990 – 2008

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Produced clinker (Gg)	668.5	617.6	278.0	30.8	150.0	175.7	198.0	201.7	195.7	263.0	167.2	203.2	221.0	241.1	260.0	265.4	330.6	338.3	334.5
Produced cement kiln dust (CKD) (Gg)	175.5	27.0	20.0	5.0	15.0	15.0	15.0	15.0	15.0	15.0	10.0	18.2	14.6	19.1	15.0	1.5	2.9	3.35	0.99
CKD / clinker ratio (%)	26.25	4.37	7.19	16.26	10	8.54	7.57	7.44	7.67	5.70	5.98	8.94	6.61	7.9	5.77	0.58	0.87	0.99	0.296
Corrected CKD / clinker ratio (%)	8.0	4.4	7.2	8.0	8.0	8.0	7.6	7.4	7.7	5.7	6.0	8.0	6.6	7.9	5.8	0.6	0.9	0.99	0.296
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	1.01	1.003

[16] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p3.12

4.2.2.3 Uncertainties and time series consistency

Uncertainty of cement production data is assumed as 10% as clinker production data is estimated from final cement production data because produced clinker is not weighed separately before the final cement mixture is produced.

CO_2 emission factor for 2.A.1 sector is estimated based on plant specific data of used limestone characterizations so average uncertainty of 5% is assumed.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. GHG emissions from the sector are estimated or reported as not occurring / not applicable therefore there are no “not estimated” sectors.

All industrial production data used in emission estimation from 2.A Mineral Products sector is taken from the annual GHG reports that industrial producers submit within EU ETS. According to EU ETS legislation all GHG reports have to be verified by the ISO accredited verifiers that checks that all reported information – activity data, CO_2 emission factors, estimated emissions as well as estimation methodology, is correct and corresponds to certain requirements from the legislation. Cement and lime production facilities certify that all additional information for CO_2 emission estimation is true. Regional Environment State Bureau also checks the annual GHG reports and compares the data in the reports with the data reported by the enterprise to database “2-AIR” and to CSB.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 4.2.4 were double-checked and large fluctuations were explained.

Table 4.2.4 IEF changes higher than 10% for 2.A.1 sector

<table>
<tr><th>Source</th><th>GHG</th><th>Unit</th><th>Year</th><th>First Year</th><th>Year</th><th>Second Year</th><th>Difference</th><th>Comments</th></tr>
<tr><td>2.A.1</td><td>CO_2</td><td>t/t</td><td>2006</td><td>0.403451</td><td>2007</td><td>0.507849</td><td>25.88%</td><td rowspan="3">In 2005 cement production plant changed used production technology and clinker kilns from previously used old installations to newer and more modern ones and due to that amount of produced clinker dust decreased by 89.8% in 2004-2005. Also CaO content in used limestone for years 1996-2005 wasn't possible to obtain as the cement production plant was going through restructurization and data was lost. That's why average CaO content estimated from 1995 and 2006 data was used. For years 2006-2008 actual data was used. For year 2006 CaO content was the lowest in time period 1990-2008. The data was reported by cement production plant and there was no reason to object the data.</td></tr>
<tr><td>2.A.1</td><td>CO_2</td><td>t/t</td><td>2005</td><td>0.454012</td><td>2006</td><td>0.403451</td><td>-11.14%</td></tr>
<tr><td>2.A.1</td><td>CO_2</td><td>t/t</td><td>1995</td><td>0.543101</td><td>1996</td><td>0.485608</td><td>-10.59%</td></tr>
</table>

4.2.2.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia’s national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

Plant specific CO_2 emission factors and Tier2 CO_2 emission estimation methodology

Tier2 methodology is used to estimate CO_2 emissions from cement production using plant specific data of CaO content in used limestone and Tier2 methodology from IPCC GPG.

Cement, cement kiln dust production data and estimated clinker production data is taken from plant's annual GHG reports within EU ETS. According to legislation the GHG reports are verified by accredited verifiers and then checked and approved by Regional Environmental Boards. The data reported in CRF tables and in NIR is also verified by CSB.

CaO content data is reported to LEGMC by cement production plant and is determined in plant's laboratory according to plant's internal procedures.

CO_2 emission is estimated according to IPCC GPG and the Tier2 methodology was verified by ERT during two in-country reviews in 2007 and 2009 and accepted as correct.

4.2.2.5 Source-specific recalculations

No recalculation was done for 2.A.1 Cement production sector.

4.2.2.6 Source-specific planned improvements

According to Expert Review Team recommendations it is necessary to obtain more precise activity data for the years where CKD / clinker ratio exceeded 8% as this ratio could reach up to 26% that is not reliable.

4.2.3 Lime Production (CRF 2.A.2)

4.2.3.1 Source category description

Under this sector CO_2 emissions from lime production in Iron & Steel production are reported as these emissions are estimated based on total produced lime data.

Two lime production plants estimate their CO_2 emissions basing on used carbonates – dolomite and limestone, data. These emissions are reported under 4.2.3 section of this report. Nor IPCC 1996 nor IPCC GPG 2000 does not allow the report of CO_2 emissions from lime production estimated from used carbonates under 2.A.2 Sector. Only in IPCC 2006 this type of estimation is assumed as Tier3 and these emissions will be reported within this sector.

Steel production plant reported their non-market lime production data for 2005-2008 is participant of ETS so the estimated emissions as well as used activity data and emission factor are taken from plant's annual GHG report within GHG. (Table 4.2.5)

Table 4.2.5 CO_2 emission from lime production in steel production in 2005–2008 (Gg)

	2005	2006	2007	2008
CO_2 emissions form lime production	13.42086	9.229952	10.15719	11.65128

4.2.3.2 Methodological issues

Methods

CO_2 emissions from lime production in steel production plant are estimated with Tier1 method based on total produced lime data and default emission factor.

$$CO_2 = EF \times AD$$

where:
CO_2 – CO_2 emissions from lime production (Gg)
EF – default emission factor according to IPCC GPG 2000 (tCO_2/t lime)
AD – lime production data (Gg)

Emission factors

Default CO_2 emission factor from IPCC 1996 was used by steel production plant as per tonne of high calcium quicklime – 0.785 tCO_2/t lime. Lime in the particular plant is produced only from limestone.

Activity data

Activity data of produced lime in steel production company is taken from plant's GHG reports within ETS. (Table 4.2.6)

Table 4.2.6 Amount of produced lime in steel production in 2005–2008 (Gg)

	2005	2006	2007	2008
Produced lime	17.0966	11.7579	12.9391	14.8424

4.2.3.3 Uncertainties and time series consistency

The uncertainty of activity data for 2.A.3 sector is assumed as 2% as only one plant specific data verified by accredited verifier and approved by Environment State Boards is used.

As default emission factors for lime production from MRG are used the uncertainty is assumed 50%.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. All other GHG emissions except CO_2 emission are not relevant and could not be reported in CRF.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are one issue. (Table 4.2.7)

4.2.3.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS.

According to EU ETS legislation all GHG reports have to be verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation. Steel production facility certifies that all additional information for CO_2 emission estimation is true. Regional Environmental Boards also checks the annual GHG reports and approves the report if everything reported is correct.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

4.2.3.5 Source-specific recalculations

According to recommendation of Industrial processes expert within In-country review 2009 the CO_2 emissions from lime production were reallocated. For submission 2010, CO_2 emissions from lime production reported by steel production plant is reported under 2.A.2 sector as CO_2 emissions are estimated by taking into account final lime production data and default EF for high calcium quicklime. Other two only lime producers estimated their CO_2 emissions by taking into account used carbonates – dolomite and limestone, and plant specific EF for one plant and default IPCC 1996 emission factor for lime use for other plant.

4.2.3.6 Source-specific planned improvements

No improvements are planned for the sector.

4.2.4 Limestone, Dolomite and Soda Ash Use (CRF 2.A.3, 2.A.4)

4.2.4.1 Source category description

Limestone, dolomite and soda ash are used in glass production plants, steel production plant and lime production plants. All these plants are participants in ETS so the detailed information of used technologies, raw materials as well as emission factors are available as plants report their annual GHG reports to LEGMC.

It's believable that the emissions in early 90ties are much higher because one glass production plant and steel production plant are into business since 1963 and the beginning of 20th century respectively. The storage of data in production plants wasn't effective (the information after particular period was transferred to local archive and wasn't stored in plants) and during the changes in national economy, social and political structure biggest part of the data was lost.

The sharp decrease of limestone use in glass production plant in 1996-1997 is explained with changed in plant's structure as since 1997 the plant is Joint Stock Company and overall changes in production technology. (Figure 4.2.2)

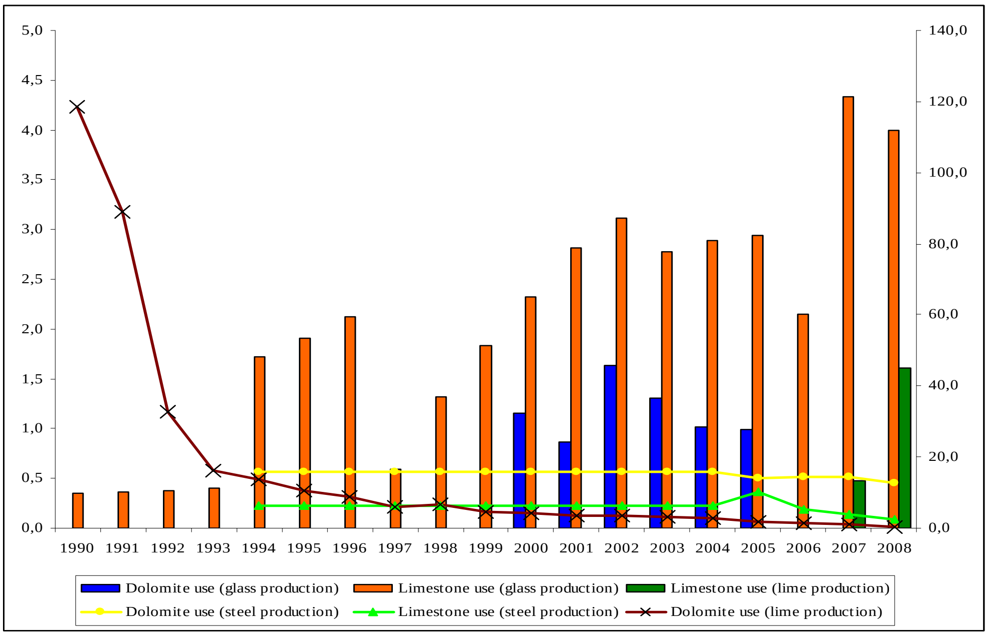


Figure 4.2.2 CO_2 emission from limestone, dolomite and soda ash use in 1990–2008 (Gg)[17]

4.2.4.2 Methodological issues

Methods

CO_2 emissions from Limestone and Dolomite Use in Glass and Metal industry and Soda Ash Use in Glass Production are estimated with Tier2 method based on plant specific activity data and default IPCC 1996 emission factors.

CO_2 emissions from Lime production are calculated based on data of carbonates – dolomite and limestone use. Purity factor from IPCC GPG 2000 was taken into account in estimation of CO_2 emissions from dolomite use in lime production calculation. CO_2 emissions from limestone use in lime production processes are estimated with Tier2 method based on plant specific active/ity data and default IPCC 1996 emission factors.

[17] dolomite use (steel production), limestone use (steel production), dolomite use (lime production) on secondary axis

Emission factors

Emission factors of limestone and dolomite use in production of glass and steel as well soda ash use in glass production are default ones taken from IPCC 1996. CO_2 emission factor for limestone use in lime production also is taken from IPCC 1996. Emission factors used in Mineral Production sub-sector are shown in Table 4.2.7.

Table 4.2.7 CO_2 emission factors for limestone, dolomite and soda ash use (t CO_2/t raw material)

	1990–2008
Limestone use in glass, steel and lime production	0.44
Dolomite use in glass and steel production	0.477
Soda use in glass production	0.415

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%;
- average content of water in produced lime is 0%;
- average content of CO2 in lime is 16.99%;
- average 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 $_{kg\ CO2}$

CO_2 emissions (1 tonne complete decomposition) pullulate:

$$216.10_{\text{ kg CO2}} + 201.82_{\text{ kg CO2}} - 108.41_{\text{ kg MgO}} = 309.51_{\text{ kg CO2}}$$

$0.3095_{\text{ t CO2}}$ proceed from practical decomposition of 1 tonne of dolomite.

Average content of water (5.24%) in used dolomite is taken into account when CO_2 emission factor is estimated:

CO_2 EF $_{\text{dolomite use in lime production}}$ = $309.51_{\text{ kg CO2}}$ × 94.76% = **0.29329167** t CO_2 / t dolomite.

Activity data

Latvia has simpler situation in activity data of this sector because there are two facilities of lime production, two facilities of glass production (one plant after 2005) and one plant of steel production. (Table 4.2.8)

Activity data were taken from industrial production plants. Industrial producers are participants of the ETS the GHG reports of these enterprises have to be freely available according to EU ETS regulations. The GHG reports of ETS operators are published on LEGMC home page.

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 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.

Unfortunately activity data is not complete for 1990-1993 due to lack of data from glass and steel production plants. Changes of national economy and whole data exchange system in early 90ties were the reason why many data is lost even in production plants.

Table 4.2.8 Limestone, dolomite and soda ash use data (t CO_2/t raw material)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Limestone and Dolomite Use (total)	405.24	304.18	113.01	55.95	97.60	87.17	82.45	68.95	73.08	66.59	69.62	68.06	70.31	66.63	65.81	68.21	51.84	54.13	45.30
Dolomite use (glass production)											2.43	1.81	3.41	2.73	2.14	2.09			
Limestone use (glass production)	0.80	0.83	0.87	0.90	3.90	4.34	4.81	1.34	3.00	4.17	5.28	6.39	7.09	6.31	6.56	6.69	4.87	9.86	9.07
Dolomite use (steel production)					33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	29.71	30.49	30.40	26.25
Limestone use (steel production)					14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	14.30	23.42	12.02	9.02	5.38
Dolomite use (lime production)	404.44	303.35	112.14	55.05	46.41	35.54	30.34	20.31	22.78	15.13	14.60	12.56	12.50	10.29	9.81	6.30	4.45	3.78	0.95
Limestone use (lime production)																		1.08	3.65

Activity data fluctuates in whole time series. Biggest decrease occurs in the beginning of 1990ties as a consequence of changes in structure of country's national economy. Dolomite use in glass production ended in 2005 as glass production plant stopped its activity. Although total used raw materials increased in 2004-2007 due to development of national economy and in particular construction sector in 2007-2008 activity data decrease by 16.3% due to decline of national economy in the end of 2008 that was caused also by global financial crisis.

4.2.4.3 Uncertainties and time series consistency

The uncertainty of activity data for 2.A.3 and 2.A.4 sectors is assumed as 2%. The activity data reported in production plants' annual GHG reports within ETS is verified by accredited verifiers and Latvia's Regional Environment Boards so the activity data is adequately verified.

As default emission factors for limestone, dolomite and soda ash use are used (with except of dolomite use in lime production) the uncertainty is assumed 50% for 2.A.3 and 2.A.4 sectors. The average uncertainty of CO_2 emission factor for lime production from dolomite is assumed as 5% as plant specific emission factor is estimated according to laboratory measurements of used dolomite.

As default emission factors for lime production from MRG are used the uncertainty is assumed 50%.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sector for all years in time series. All other GHG emissions except CO_2 emission are not relevant and could not be reported in CRF.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 4.2.9 were double-checked and large fluctuations were explained.

Table 4.2.9 IEF changes higher than 10% for 2.A.3 sector

Source	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
2.A.3	CO_2	t/t	1993	0.295644	1994	0.380624	28.74%	In 1990-1993 CO_2 emissions from dolomite use in one Lime production company is only reported. According to recommendations of ERT the dolomite use in Lime production processes was reallocate from sector 2A2 to 2A3 as CO_2 emissions from Lime production is based on used raw material data. In year 1994 data of limestone and dolomite use in glass and steel production is available - steel and glass production companies in their annual GHG reports report the use of default CO_2 emission from IPCC 1996 and MRG that's why EF since 1994 increase.

4.2.3.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data, CO_2 emission factors and estimated emissions from glass and steel production plants as well as lime production plants are taken from the annual GHG reports that plants submit within EU ETS. All GHG reports are verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation. Regional Environmental Boards also checks the annual GHG reports and approves the report if everything reported is correct.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

Tier3 methodology is used for CO_2 emission estimation from dolomite use in lime production as CO2 emission factor for dolomite use is estimated based on dolomite characteristics determined in plant's laboratory according to laboratory measurements. CO_2 emission factor estimation methodology is verified by accredited verifiers and approved in LEGMC. All information of CO_2 emission factor estimation is given in NIR.

4.2.3.5 Source-specific recalculations

According to recommendation of Industrial processes expert within In-country review 2009 the CO_2 emissions from lime production were reallocated. For submission 2010 CO_2 emissions from lime production reported by steel production plant is reported under 2.A.2 sector as there CO_2 emissions are estimated by taking into account final lime production data and default emission factor for high calcium quicklime. Other two lime production plants (lime production is main activity for these two plants) estimated their CO_2 emissions by taking into account used carbonates – dolomite and limestone, and plant specific emission factor for one plant and default IPCC 1996 emission factor for lime use for other plant.

For year 2007 the CO_2 emissions from lime production changed as new lime production plant went into business but the plant's data wasn't taken into account for submission 2009. The average water content data for lime production from dolomite was corrected as previously the water content for hydraulic lime was used but the lime in particular plant is produced only from dolomite. The water content percentage data is available from lime producer plant according to its laboratory measurements.

4.2.3.6 Source-specific planned improvements

No specific improvements are planned for these two sectors.

4.2.5 Asphalt Roofing and Road Paving with Asphalt (CRF 2.A.5, 2.A.6)

4.2.5.1 Source category description

In this sector emissions from construction materials production as well as road paving activities are reported.

Due to development of national economy emissions from these two sectors are constantly increasing since 2004. Also the lifetime of road paving is reached in many sections of roads. Due to Latvia is participant in EU since 2004 financial resources from EU projects are available for national infrastructure projects. This is also reflected in curve of emissions from road paving and asphalt roofing. (Figure 4.2.3)

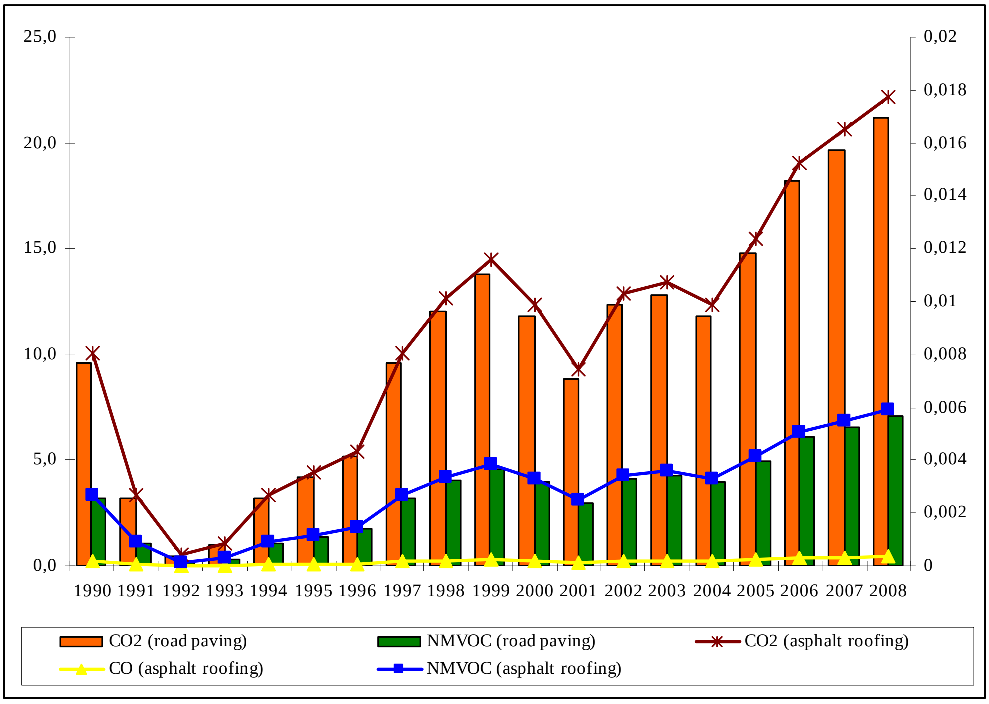


Figure 4.2.3 Emissions from asphalt roofing and road paving in 1990 – 2008 (Gg)[18]

[18] Emissions from asphalt roofing on secondary axis

4.2.5.2 Methodological issues

Methods

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 4.2.8).

Emission factors

Default CO and NMVOC emission factors are taken from EMEP/CORINAIR.[19,20] During centralized review it was recommended to estimate CO_2 emissions that are converting from NMVOC emissions by multiplying NMVOC emissions with conversion factor 3. (Table 4.2.8)

Table 4.2.10 Emission factors for asphalt roofing and road paving in 1990 – 2008 (t emissions/t raw material)

	CO_2	CO	NMVOC
Asphalt Roofing	3.0	0.0000095	0.00016
Road Paving with Asphalt	3.0		0.32

Activity data

The activity data to calculate NMVOC emissions from road paving and asphalt roofing are taken from the CSB (Table 4.2.9). Since 2005, strong increase of amount of used bitumen is observed due to development of construction sector and improvement of total situation in national infrastructure.

Table 4.2.11 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
2007	80.00	45.6	20.52	34.4
2008	86.00	49.02	22.059	36.98

4.2.5.3 Uncertainties and time series consistency

Uncertainty of activity data for estimations of CO_2 emissions from 2.A.5 Asphalt roofing sector and 2.A.6 Road Paving with Asphalt sector is assumed rather high 70% because default methodology is used in estimations and default percentage for used bitumen is used.

The CO_2 emission factors for 2.A.5 and 2.A.6 sectors are assumed as high as 70% because default emission factors are used and CO_2 emissions are estimated from NMVOC emissions. The uncertainty of indirect emission factors for these two sectors taken from EMEP/CORINAIR is assumed as high as 50% as the default emission factors are used.

[19] http://www.eea.europa.eu/publications/EMEPCORINAIR3/B4610vs2.1.pdf
[20] http://www.eea.europa.eu/publications/EMEPCORINAIR3/B4611vs1.3.pdf

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. NO_x, CO and SO_2 emissions are not estimated due to lack of estimation methodology and official emission factors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

4.2.5.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data used in NMVOC and CO_2 emissions from asphalt roofing and road paving with asphalt was reported by CSB in Annual Questionnaire tables. Bitumen data used in emission estimation and reported in NIR are verified by CSB. Data also is compared to the data reported in 1A(d) sector.

CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment.

The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

4.2.5.5 Source-specific recalculations

No recalculation has been made for these sectors.

4.2.5.6 Source-specific planned improvements

No improvements are planned for these two sectors.

4.2.6 Raw material use in Glass Production (CRF 2.A.7)

4.2.6.1 Source category description

In this sector CO_2 emissions from use of two additional raw materials used in glass production plants – fluorspar and potash, are reported.

Use of potash and butilacetate finished in 2005 when the glass production plant ended its activity although the use of raw materials in last years of this glass production plant increased sharply. (Figure 4.2.4)

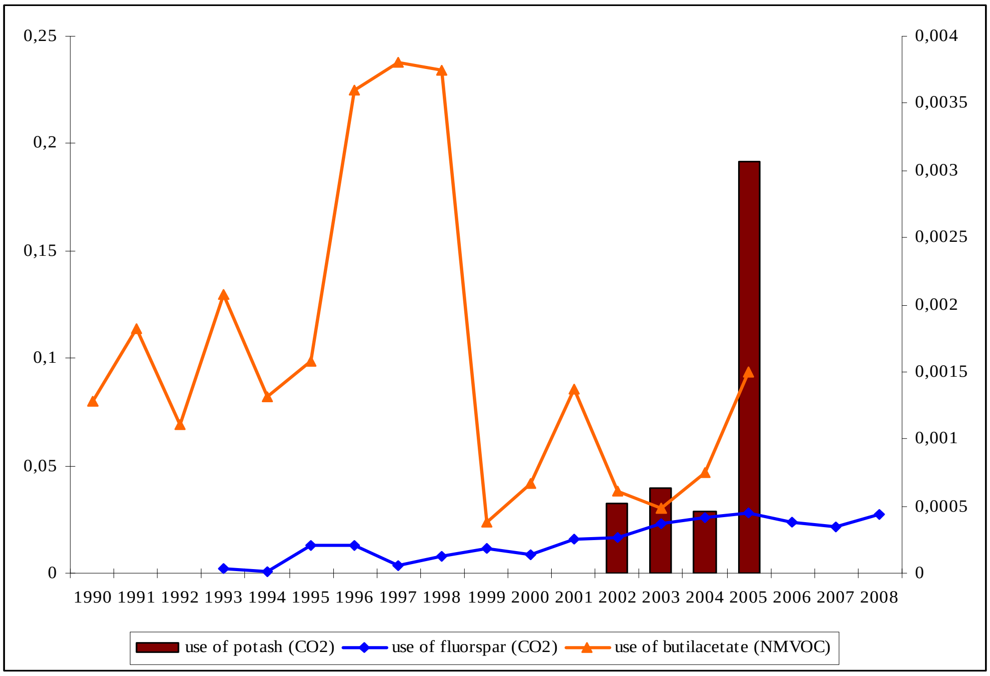


Figure 4.2.4 Emissions from raw materials use in glass production 1990-2008 (Gg)[21]

4.2.6.2. Methodological issues

Default methodology was used to estimate emissions when activity data is multiplied with emission factor but the CO_2 and NMVOC emission factors used to estimate emissions from raw materials use in glass production are plant specific and taken from plants' annual GHG reports within ETS. (Table 4.2.10)

Table 4.2.10 Emission factors for materials use in glass production (t emissions / t product or raw material)

	1990 – 2008
Fluorspar use	0.0017
Potash use	0.32
Butilacetate use (NMVOC)	1.0

Amount of raw materials used in glass production is quite small as fluctuates in whole time series. Although use of potash increased sharply in 2004-2005 the use stopped in 2005 due to closure of glass production plant. (Table 4.2.12)

Table 4.2.12 Activity data for raw materials use in glass production 1990-2008 (Gg)

	Use of potash	Use of fluorspar	Use of butilacetate
1990			0.001
1991			0.002
1992			0.001
1993		0.020	0.002
1994		0.010	0.001
1995		0.120	0.002
1996		0.120	0.004
1997		0.033	0.004
1998		0.074	0.004
1999		0.107	0.000
2000		0.084	0.001
2001		0.152	0.001
2002	0.100	0.158	0.001
2003	0.123	0.216	0.000

[21] Emissions from use of fluorspar and butilacetate on secondary axis

	Use of potash	Use of fluorspar	Use of butilacetate
2004	0.090	0.246	0.001
2005	0.600	0.265	0.001
2006		0.222	
2007		0.201	
2008		0.255	

4.2.6.3 Uncertainties and time series consistency

The uncertainty of activity data for this sector is assumed as 2% as plant specific reported data is used. Accredited verifiers and Latvia's Regional Environment Boards verify the activity data reported in production plant's annual GHG reports within ETS so the activity data is adequately verified.

CO_2 emission factor for this sector are taken from glass production plant so the uncertainty could be assumed as quite low. Still the estimation of the emission factor can't be adequately verified so the uncertainty is assumed as quite high – 70%.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. All emissions with exception of CO_2 emissions for use of fluorspar and potash as well as NMVOC emissions for glass fibre production are not estimated due to lack of estimation methodology.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

4.2.6.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data, CO_2 emission factors and estimated emissions from glass production plants are taken from the annual GHG reports that plants submit within EU ETS. All GHG reports are verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation. Regional Environmental Boards also checks the annual GHG reports and approves the report if everything reported is correct.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

4.2.6.5 Source-specific recalculations

No recalculation has been done for the sector.

4.2.6.6 Source-specific planned improvements

No improvements are planned.

4.2.7 Bricks Production (CRF 2.A.7)

4.2.7.1 Source category description

Bricks production has strong traditions in Latvia as production plants operate many decades, for example in bricks production plant "LODE" the brick production was started in 1964.

4.2.7.2 Methodological issues

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.

For year 1990-1992 no plant specific data is available from bricks production plants so CO_2 emission estimation for these 3 years is done based on final produced bricks amount if average weight of one brick is known.

According to statistical information average weight of one brick is 3.9kg and according to plant data average produced bricks / used clay ratio is 1.25.

Then is final amount of produced bricks is know it is possible to determine approximate clay consumption. (Table 4.2.13) In CO_2 emission estimation emission factor 0.047 tCO_2/t used clay is used.

Table 4.2.13 Data and assumptions used for CO_2 emission estimation for 1990-1992

	1990	1991	1992
produced bricks (piece)	471800000	546423000	259918000
average weight of one brick (kg)	3.9	3.9	3.9
produced bricks (tonnes)	1840020	2131049.7	1013680.2
average produced bricks / used clay ratio	1.25	1.25	1.25
used clay (Gg)	**1472.016**	**1704.84**	**810.9442**
CO_2 emission factor of used clay tCO_2/t used clay	0.047	0.047	0.047
CO_2 emissions (Gg)	69.1848	80.1275	38.1144

CO_2 emissions are estimated differently in Latvia's five bricks production plants as well as estimation methodology differs because it was possible to use higher tier of emission estimation in last years due to availability of necessary activity data and laboratory measures of used raw materials.

<u>4.2.7.2.1 1st bricks production plant</u>

CO_2 emission for time period 1993-2004 was estimated by using used clay as an activity data and CO_2 emission factor for used clay – 0.047 tCO_2/t used clay. The particular emission factor is determined for total used clay data when clay characterizations are not known. CO_2 emissions are determined by ignition loses of clay: in 1000° C – 4.7% of instant CO_2 is emitted)

Since 2005 the plant is using Monitoring Reporting Guidelines within EU Emission Trading Scheme[22] (MRG).

For European Union Emission Trading Scheme period (2005-2007) the plant is using calculation method B – alkali earth oxides, from the MRG when calculation is based on the content of the CaO, MgO and other (earth) alkali.

Emission factor is estimated by equation:

$$R\left[tCO_2 / t_{izejv}\right] = MgO_R \times \left(S_1 / 100\right) + CaO_R \times \left(S_2 / 100\right)$$

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 (%)

[22] European Commission Decision of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council

Following data are used in emission estimation:

1) For 2005:

- MgO content in raw material (carbonates) – 4.9% and emission factor is 1.092 t CO_2/t MgO;
- CaO content in raw materials – 11.6% and emission factor is 0.785 tCO_2/t CaO.

2) For 2006 and 2007:

- MgO content in raw material (carbonates) – 2.9% and emission factor is 1.092 t CO_2/t MgO;
- CaO content in raw materials – 10.23% and emission factor is 0.785 tCO_2/t CaO.

For year 2008 plant is using the calculation method A – carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. Tier 1 emission factors from the MRG corresponding particular method are used when conservative value of 0.2 tonnes $CaCO_3$ (0.08794 tonnes of CO_2) per tonne of dry clay is applied for the calculation of the emission factor instead of results of analyses.

First bricks production plant's used methodology for CO_2 emission estimation in whole time series is inconsistent as methodology is changed twice and for 2008 estimation methodology is again switched from Tier2 to Tier1 and default average CO_2 emission factor is used.

So to make emission estimation more or less consistent CO_2 emission for year 2008 was recalculate by using same MgO and CaO content data as was used for year 2006 and 2007. Amount of dry clay was taken as activity data. The same was done for time series 1993-2004 when MgO and CaO content data of 2005 was taken into account (Table 4.2.14).

Table 4.2.14 Data and assumptions used for CO_2 emission estimation from first bricks production plant

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Use of clay (Gg)	2.000	2.400	2.700	3.000	3.600	4.000	4.400	4.800	4.800	4.800	6.500	6.500	5.257	6.245	7.745	3.880
MgO content (%)	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	4.90%	2.90%	2.90%	2.90%
CaO content (%)	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	11.60%	10.26%	10.26%	10.26%
MgO amount (Gg)	0.098	0.118	0.132	0.147	0.176	0.196	0.216	0.235	0.235	0.235	0.319	0.319	0.258	0.181	0.225	0.113
CaO amount (Gg)	0.232	0.278	0.313	0.348	0.418	0.464	0.510	0.557	0.557	0.557	0.754	0.754	0.610	0.641	0.795	0.398
MgO CO_2 EF (t CO_2/t oxide)	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092
CaO CO_2 EF (t CO_2/t oxide)	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785
CO_2 emissions (Gg)	0.29	0.35	0.39	0.43	0.52	0.58	0.64	0.69	0.69	0.69	0.94	0.94	0.760	0.701	0.869	0.435
Average CO2 EF (t CO_2/t oxides)	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.876	0.853	0.853	0.853

4.2.7.2.2 2nd bricks production plant

The second bricks production plant for time period 1999-2007 is using the calculation method A – carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. The content of $CaCO_3$ and $MgCO_3$ are determined in plant laboratories or stated in mineral deposits passport. Default CO_2 emission factors from the MRG for the $CaCO_3$ and $MgCO_3$ are used. The following equation is used to estimate emissions:

$$CO_2 emission(tCO_2) = \left(\sum\{AD_{carbonate} \times EF\} + \sum\{AD_{relishes} \times EF\}\right) \times \text{conversion factor}$$

CO_2 emission factor for $CaCO_3$ is 0.44 tCO_2/t $CaCO_3$ and CO_2 emission factor for $MgCO_3$ is 0.522 tCO_2/t $MgCO_3$.

General (average) CO_2 emission factor is estimated with the equation:

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

where:
X = alkali earth or alkali metal
Mx = molecular weight of X in (g/mol)
MCO_2 = molecular weight of CO_2 = 44 (g/mol)
MCO_3^{-2} = 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 year 2008 plant is using the same calculation method A – carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. Tier 1 emission factors from the MRG corresponding particular method are used when conservative value of 0.2 tonnes $CaCO_3$ (0.08794 tonnes of CO_2) per tonne of dry clay is applied for the calculation of the emission factor instead of results of analyses.

The plant's used methodology for CO_2 emission estimation in whole time series is inconsistent as methodology is changed from higher tier to lower tier in last year of time period when default average CO_2 emission factor is used.

So to make emission estimation more consistent CO_2 emission for year 2008 was recalculated by using approximately the same $CaCO_3$ and $MgCO_3$ content data as was used for year 2007. Amount of dry clay was taken as activity data (Table 4.2.15).

Table 4.2.15 Data and assumptions used for CO_2 emission estimation from second bricks production plant

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Use of clay (Gg)	11.750	16.370	17.637	20.610	23.055	21.648	22.983	28.559	37.203	13.975
$MgCO_3$ content (%)	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	10.98%	9.56%	9.52%	9.50%
$CaCO_3$ content (%)	9.00%	9.00%	9.00%	9.00%	9.00%	9.00%	13.06%	13.15%	13.10%	13.10%
$MgCO_3$ amount (Gg)	0.588	0.819	0.882	1.031	1.153	1.082	2.523	2.729	3.542	1.328
$CaCO_3$ amount (Gg)	1.058	1.473	1.587	1.855	2.075	1.948	3.002	3.756	4.874	1.831
$MgCO_3$ CO_2 EF (tCO2/t oxide)	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.522
$CaCO_3$ CO_2 EF (tCO2/t oxide)	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440
CO_2 emissions (Gg)	0.772	1.076	1.159	1.354	1.515	1.422	2.638	3.077	3.993	1.50
Average CO_2 EF (tCO2/t oxides)	0.469	0.469	0.469	0.469	0.469	0.469	0.477	0.475	0.475	0.474

4.2.7.2.3 3rd bricks production plant

For 1998-2004 the plant is using calculation method B – alkali earth oxides, from the MRG when calculation is based on the content of the CaO, MgO and other (earth) alkali.

Emission factor is estimated by equation:

$$R[tCO_2 / t_{izejv}] = MgO_R \times (S_1/100) + CaO_R \times (S_2/100)$$

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 (%)

Following data are used in emission estimation (according to natural resources passport of the quarry "Progress" of State Geology Service):

- MgO content in raw material (carbonates) – 8.03% and emission factor is 1.092 t CO_2/t MgO;
- CaO content in raw materials – 3.02% and emission factor is 0.785 tCO_2/t CaO.

The plant for time period 2005-2007 is using the calculation method A – carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. The content of $CaCO_3$ and $MgCO_3$ are determined in plant laboratories or stated in mineral deposits passport. Default CO_2 emission factors from the MRG for the $CaCO_3$ and $MgCO_3$ are used. The following equation is used to estimate emissions:

$$CO_2 emission(tCO_2) = \left(\sum \{AD_{carbonate} \times EF\} + \sum \{AD_{relishes} \times EF\}\right) \times \text{conversion factor}$$

CO_2 emission factor for $CaCO_3$ is 0.44 tCO_2/t $CaCO_3$ and CO_2 emission factor for $MgCO_3$ is 0.522 tCO_2/t $MgCO_3$.

General (average) CO_2 emission factor is estimated with the equation:

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

where:
X = alkali earth or alkali metal
Mx = molecular weight of X in (g/mol)
MCO_2 = molecular weight of CO_2 = 44 (g/mol)
MCO_3^{-2} = 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 year 2008 plant is using the same calculation method A – carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. Tier 1 emission factors from the MRG corresponding particular method are used when conservative value of 0.2 tonnes $CaCO_3$ (0.08794 tonnes of CO_2) per tonne of dry clay is applied for the calculation of the emission factor instead of results of analyses.

The plant's used methodology for CO_2 emission estimation in time series is inconsistent as methodology is changed from higher tier to lower tier in last year of time period when default average CO_2 emission factor is used.

So to make emission estimation more consistent CO_2 emission for year 2008 was recalculate by using the $CaCO_3$ and $MgCO_3$ content data as was used for years 2005-2007. Amount of dry clay was taken as activity data. (Table 4.2.16)

Table 4.2.16 Data and assumptions used for CO_2 emission estimation from third bricks production plant

	1998	1999	2000	2001	2002	2003	2004
Use of clay (Gg)	7.47	9.656	10.250	10.375	11.237	10.963	11.600
MgO content (%)	8.03%	8.03%	8.03%	8.03%	8.03%	8.03%	8.03%
CaO content (%)	3.02%	3.02%	3.02%	3.02%	3.02%	3.02%	3.02%
MgO amount (Gg)	0.600	0.775	0.823	0.833	0.902	0.880	0.931
CaO amount (Gg)	0.226	0.292	0.310	0.313	0.339	0.331	0.350
MgO CO_2 EF (tCO2/t oxide)	1.092	1.092	1.092	1.092	1.092	1.092	1.092
CaO CO_2 EF (tCO2/t oxide)	0.785	0.785	0.785	0.785	0.785	0.785	0.785
CO_2 emissions (Gg)	0.83	1.08	1.14	1.16	1.25	1.22	1.29
Average CO_2 EF (tCO2/t oxides)	1.008	1.008	1.008	1.008	1.008	1.008	1.008

	2005	2006	2007	2008
Use of clay (Gg)	29.891	22.316	23.854	77.687
$MgCO_3$ content (%)	10.75%	10.75%	10.75%	10.75%
$CaCO_3$ content (%)	12.79%	12.79%	12.79%	12.79%
$MgCO_3$ amount (Gg)	3.213	2.399	2.564	8.351
$CaCO_3$ amount (Gg)	3.823	2.854	3.051	9.936
$MgCO_3$ CO_2 EF (tCO2/t oxide)	0.522	0.522	0.522	0.522
$CaCO_3$ CO_2 EF (tCO2/t oxide)	0.440	0.440	0.440	0.440
CO_2 emissions (Gg)	3.359	2.508	2.681	8.73
Average CO_2 EF (tCO2/t oxides)	0.477	0.477	0.477	0.477

4.2.7.2.4 4th bricks production plant

CO_2 emission for time period 2000-2004 was estimated by using used clay (with moisture content 23%) as an activity data and CO_2 emission factor for used clay – 0.0658 tCO_2/t used clay. It is possible to estimate CO_2 emission factor for dray clay for the plant when emission factor is reduced by 23% that gives emission factor – 0.050666 tCO_2/t used clay.

The plant reported that amount of carbonates (dolomite) in used clay is estimated according to chemical content of clay that was determined in Institute of Silicate Materials:

- $CaCO_3$ – 11.48%;
- $MgCO_3$ – 1.8%;
- Other carbonates – 0.7%.
- That gives approximately 14% of carbonates in used clay.

The CO_2 emitted during the carbonization of dolomite is estimated using the molar mass:

$$\frac{MgCO_3}{84} = MgO + \frac{CO_2}{44}$$
$$\frac{CaCO_3}{100} = CaO + \frac{CO_2}{44}$$
$$M184g = 96g + 88g$$

According to equation 88g CO_2 is emitted when 184g of dolomite is fully combusted.

$$100\,\text{g of dolomite}_{\text{combusting}} = \frac{88 \times 100}{184} = 47.826g\ \text{CO}_2$$

So 1 tonne of dolomite (carbonates) is emitting approximately 0.47 tonne of CO_2.

So:

$$EF_{CO_2} = 0.47 \times 0.14 = 0.0658$$

$$CO_{2\,clay} = m \times 0.77 \times 0.47 \times 0.14$$

where:
m – used clay (t)
0.77 – moisture coefficient (moisture content in used clay – 23%)
0.47 – amount of CO2 from one tonne of dolomite (carbonates)
0.14 – content of carbonates in used clay according to the results of clay chemical analyses.

The plant for year 2005 is using the calculation method A – carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. The content of $CaCO_3$ and $MgCO_3$ are determined in plant laboratories or stated in mineral deposits passport. Default CO_2 emission factors from the MRG for the $CaCO_3$ and $MgCO_3$ are used. The following equation is used to estimate emissions:

$$CO_2 emission(tCO_2) = \left(\sum\{AD_{carbonate} \times EF\} + \sum\{AD_{relishes} \times EF\}\right) \times \text{conversion factor}$$

CO_2 emission factor for $CaCO_3$ is 0.44 tCO_2/t $CaCO_3$ and CO_2 emission factor for $MgCO_3$ is 0.522 tCO_2/t $MgCO_3$.

General (average) CO_2 emission factor is estimated with the equation:

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

where:
X = alkali earth or alkali metal
Mx = molecular weight of X in (g/mol)
MCO_2 = molecular weight of CO_2 = 44 (g/mol)
MCO_3^{-2} = 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 years 2006 and 2007 the plant is using calculation method B – alkali earth oxides, from the MRG when calculation is based on the content of the CaO, MgO and other (earth) alkali.

Emission factor is estimated by equation:

$$R[tCO_2 / t_{izejv}] = MgO_R \times (S_1 / 100) + CaO_R \times (S_2 / 100)$$

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 (%)

For year 2008 plant is using the same calculation method A as for year 2005– carbon input, from the MRG when calculation is based on the carbon input on each of the relevant raw materials. Still Tier 1 emission factors from the MRG corresponding particular method are used when conservative value of 0.2 tonnes $CaCO_3$ (0.08794 tonnes of CO_2) per tonne of dry clay is applied for the calculation of the emission factor instead of results of analyses.

The plant's used methodology for CO_2 emission estimation in time series is inconsistent as methodology is changed four times during whole time series.

So to make emission estimation more consistent CO_2 emissions for years 2000-2004 were recalculate by using the $CaCO_3$ and $MgCO_3$ content data reported by plant in its CO2 emission factor estimation - $CaCO_3$ – 11.48%, and $MgCO_3$ – 1.8%, and using emission factors from MRG.

For year 2006-2007 the $CaCO_3$ and $MgCO_3$ content data were estimated from MgO and CaO content data corresponding molar mass of MgO, CaO and CO_2.

For year 2008 the same $CaCO_3$ and $MgCO_3$ content data as for 2007 was used in emission estimation. (Table 4.2.17)

Table 4.2.17 Data and assumptions used for CO_2 emission estimation from fourth bricks production plant

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Use of clay (Gg)	9.000	11.742	24.090	25.234	22.983	25.246	29.826	34.166	27.329
$MgCO_3$ content (%)	1.80%	1.80%	1.80%	1.80%	1.80%	6.47%	6.49%	6.70%	6.70%
$CaCO_3$ content (%)	11.48%	11.48%	11.48%	11.48%	11.48%	14.62%	14.63%	13.71%	13.71%

	2000	2001	2002	2003	2004	2005	2006	2007	2008
$MgCO_3$ amount (Gg)	0.162	0.211	0.434	0.454	0.414	1.634	1.937	2.290	1.832
$CaCO_3$ amount (Gg)	1.033	1.348	2.766	2.897	2.638	3.691	4.363	4.686	3.748
$MgCO_3$ CO_2 EF (tCO2/t oxide)	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.522	0.522
$CaCO_3$ CO_2 EF (tCO2/t oxide)	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440
CO_2 emissions (Gg)	0.54	0.70	1.44	1.51	1.38	2.477	2.93	3.26	2.61
Average CO_2 EF (tCO2/t oxides)	0.451	0.451	0.451	0.451	0.451	0.465	0.465	0.467	0.467

4.2.7.2.5 5th bricks production plant

CO_2 emission for time period 1993-2004 was estimated by using used clay as an activity data and CO_2 emission factor for used clay – 0.047 tCO_2/t used clay.

For year 2005-2008 plant in its annual GHG report within the EU ETS is using calculation method B – alkali earth oxides, from the MRG when calculation is based on the content of the CaO, MgO and other (earth) alkali.

Emission factor is estimated by equation:

$$R\left[tCO_2 / t_{izejv}\right] = MgO_R \times \left(S_1 / 100\right) + CaO_R \times \left(S_2 / 100\right)$$

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 (%)

Still after the review of the GHG report it was stated that plant is using the total used clay data as activity data instead of using particular CaO and MgO data even the MgO and CaO content is determined in Institute of Silicate Materials for the clay used in particular plant.

The plant's used methodology for CO_2 emission estimation in time series is inconsistent as methodology is changed and unknown source CO_2 EF for time series 1993-2004 is used.

So to make emission estimation more consistent CO_2 emissions for whole time series 1993-2008 were recalculate by using average MgO and CaO content data of plant and using emission factors from MRG. (Table 4.2.18)

Table 4.2.18 Data and assumptions used for CO_2 emission estimation from fifth bricks production plant

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Use of clay (Gg)	97.765	80.186	107.382	107.991	111.065	133.373	135.801	112.495	117.412	118.883	95.357	105.546	88.293	94.435	80.895	96.673
MgO content (%)	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%	1.43%
CaO content (%)	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%	10.39%
MgO amount (Gg)	1.398	1.147	1.536	1.544	1.588	1.907	1.942	1.609	1.679	1.700	1.364	1.509	1.263	1.350	1.157	1.382
CaO amount (Gg)	10.153	8.327	11.152	11.215	11.534	13.851	14.103	11.683	12.193	12.346	9.903	10.961	9.169	9.807	8.401	10.039
MgO CO_2 EF (tCO2/t oxide)	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092	1.092
CaO CO_2 EF (tCO2/t oxide)	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785	0.785
CO_2 emissions (Gg)	9.50	7.79	10.43	10.49	10.79	12.96	13.19	10.93	11.41	11.55	9.26	10.25	8.58	9.17	7.86	9.39
Average CO_2 EF (tCO2/t oxides)	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822

4.2.7.3 Uncertainties and time series consistency

The uncertainty of activity data for the bricks production sector is assumed as 10% although the plants' reported data is used. Plants are used several emission estimation methodologies and for some historical years the reported data seems to be less reliable.

CO_2 emission factors used in emission calculation from bricks and tile production are the default from Monitoring and Reporting Guidelines within ETS so the uncertainty of emission factors is assumed as 50%.

For years 1990-1992 and 1993-2008 two different emission estimation methodologies are used still the time series is assumed as consistent as for 1990-1992 default Tier1 methodology is used but for 1993-2008 already plant specific emission estimation methodology assumed as Tier2 level is used.

For time period 1993-2008 two different methodologies are used for 3rd bricks production plant so that could lead to inconsistent time series although it is assumed that these are plant specific data and there is no need to recalculate them with using default emission factors or average carbonates content data.

Only CO_2 emissions from bricks production are estimated. Other emissions are not estimated due to lack of official emission estimation methodology and emission factors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 4.2.19 were double-checked and large fluctuations were explained.

Table 4.2.19 IEF changes higher than 10% for 2.A.7 sector

Source	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
Production of Bricks (plant 3)	CO2	t/t	2004	1.008096	2005	0.477447	-52.64%	CO_2 emission estimation methodology changed for the 2005-2008 comparing to used for previous years estimations. In 1998-2004 CO2 emissions were estimated using MgO and CaO contents in used caly but for 2005-2008 $MgCO_3$ and $CaCO_3$ content was used. One emissions estimation methodology wasn't used as bricks production plant didn't obtained necessary data for historical years.

4.2.7.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

Plant specific CO_2 emission factors and Tier2 CO_2 emission estimation methodology

Tier2 methodology is used to estimate CO_2 emissions from bricks production using plant specific data of used clay characteristics – amount of carbonates, percentage division of carbonates and Tier2 methodology from IPCC GPG.

Activity data is taken from plants reported annual GHG reports within EU ETS. All GHG reports are verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation. Regional Environmental Boards also checks the annual GHG reports and approves the report if everything reported is correct.

CO_2 emission factors are taken from MRG and are the default ones therefore there is no need to re-check correctness of emission factors.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

4.2.7.5 Source-specific recalculations

To correct inconsistencies in methodologies used by the operators in their annual GHG reports within Emission Trading Scheme CO_2 emissions were recalculate for all 5 bricks production plants and the CO_2 emissions from bricks production is reported separately for 5 bricks production plants as the estimation methodology differs (the used EFs differ significantly). CO_2 emissions for 1990-1992 were estimated for the first time for submission 2010 according to Expert Review Team recommendations.

Difference for submission 2009 and submission 2010 in reported CO_2 emissions is quite significant for all years in time series 1990–2008 fluctuating from 64.54% in 2005 to 112.8% in 1998 with average difference 96.35%. (Figure 4.2.5)

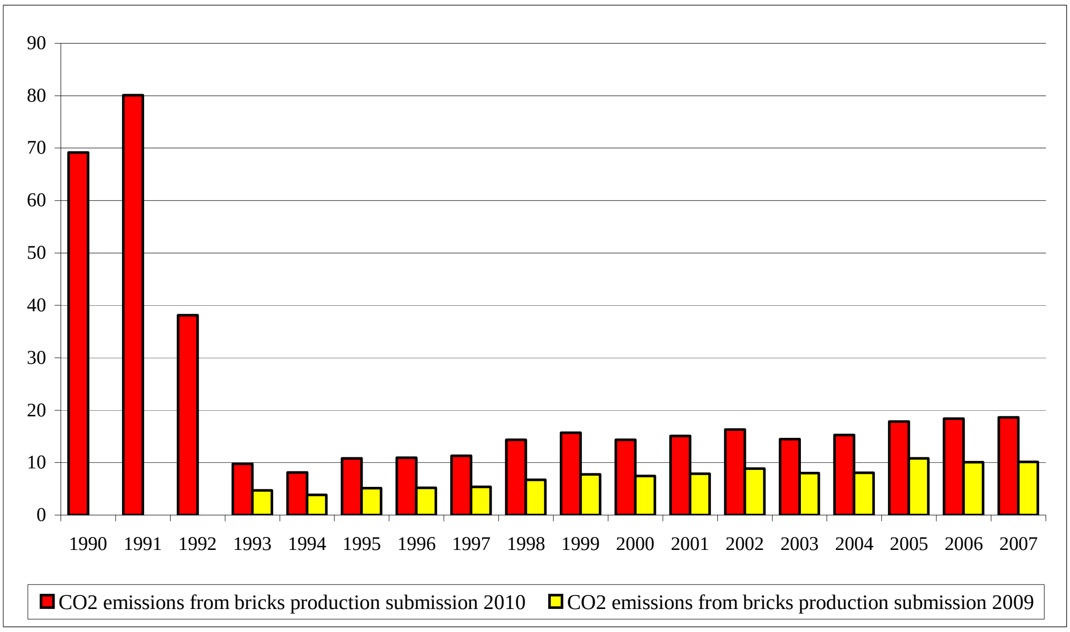


Figure 4.2.5 Comparison for CO_2 emissions from bricks production for submission 2009 and submission 2010 (Gg)

4.2.7.6 Source-specific planned improvements

No improvements are planned for this sector for nearest submissions.

4.2.8 Tiles Production (CRF 2.A.7)

4.2.8.1 Source category description

There is only one tiles production plant in Latvia and CO_2 emissions from use of clay in tile production process in 1995-2008 are reported in this sector. The tiles production plant is participant of ETS so the data from plant's annual GHG reports is available for inventory.

Table 4.2.20 CO_2 emissions from tile production in 1995-2008 (Gg)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
use of clay in tile production	2.034	2.38	2.932	3.065	2.711	2.594	4.065	3.935	4.776	3.2305	1.685	1.74848	2.2417	0.5248

Emissions are decreasing since 2003 with some fluctuation due to decrease of activity of tiles production plant. (Table 4.2.20)

4.2.8.2 Methodological issues

Default methodology was used to estimate emissions when activity data is multiplied with emission factor but the CO_2 emission factor – 0.08794 (t CO_2/t dry clay), used to estimate emissions from clay use in tiles production raw materials use in glass production are taken from Monitoring and Reporting Guidelines within ETS.[23]

Amount of used clay in tiles production is taken from only tiles production plant in Latvia. (Table 4.2.21)

Table 4.2.21 Activity data for tile production in 1995-2008 (Gg)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
use of clay in tiles production	2.034	2.380	2.932	3.065	2.711	2.594	4.065	3.935	4.776	3.231	1.685	1.748	2.242	0.525

4.2.8.3 Uncertainties and time series consistency

The uncertainty of activity data for this sector is assumed as 2%. The activity data reported in production plant's annual GHG reports within ETS is verified by accredited verifiers and Latvia's Regional Environment Boards so the activity data is adequately verified.

CO_2 emission factors used in emission calculation from tiles production are the default from MRG ETS so the uncertainty of emission factors is assumed as 50%.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. Only CO_2 emissions from tiles production are estimated. Other emissions are not estimated due to lack of official emission estimation methodology and emission factors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

4.2.8.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data, CO_2 emission factor and estimated emissions are taken from the annual GHG reports that steel production plant submit within EU ETS. All GHG reports have to be verified by the ISO accredited verifiers that checks that all reported information is correct and corresponds to certain requirements from the legislation. Regional Environmental Boards also checks the annual GHG reports and approves the report if everything reported is correct.

CO_2 emission factors are taken from MRG and are the default ones therefore there is no need to re-check correctness of emission factors.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

[23] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:LV:PDF, page 80

4.2.8.5 Source-specific recalculations

No recalculation has been done for the sector.

4.2.8.6 Source-specific planned improvements

No improvements are planned for this sector for nearest submissions.

4.3 CHEMICAL PRODUCTS (CRF 2.B)

4.3.1 Source category description

Although there are strong traditions of the chemical industry in Latvia there are no production of specific chemical products that generate GHG emissions.

The biggest part of chemical industry is medicine production with small part of paints and varnishes production.

4.4 METAL PRODUCTION (CRF 2.C)

4.4.1 Source category description

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 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.

GHG emissions from metal production contribute 2.54% from total GHG emissions in Industrial Processes sector.

Table 4.4.1 Emissions from 2.C Metal Production in 1990–2008 (Gg)

	CO_2	CH_4	NO_x	CO	NMVOC	SO_2
1990	12.8288	0.0028	2.8050	0.0006	0.2475	0.0880
1991	8.7118	0.0019	1.9048	0.0004	0.1681	0.0598
1992	5.7341	0.0012	1.2538	0.0002	0.1106	0.0393
1993	7.0067	0.0015	1.5320	0.0003	0.1352	0.0481
1994	6.5524	0.0017	1.6930	0.0003	0.1494	0.0531
1995	4.4328	0.0014	1.4246	0.0003	0.1257	0.0447
1996	3.4851	0.0015	1.4952	0.0003	0.1319	0.0469
1997	7.9966	0.0023	2.3691	0.0005	0.2090	0.0743
1998	8.5019	0.0024	2.4013	0.0005	0.2119	0.0753
1999	7.7112	0.0024	2.4671	0.0005	0.2177	0.0774
2000	8.4261	0.0025	2.5515	0.0005	0.2251	0.0800
2001	8.0419	0.0025	2.5616	0.0005	0.2260	0.0804
2002	7.6017	0.0025	2.5867	0.0005	0.2282	0.0812
2003	12.1641	0.0027	2.7915	0.0005	0.2463	0.0876
2004	12.9158	0.0028	2.8406	0.0006	0.2506	0.0891
2005	12.3577	0.0028	2.8272	0.0006	0.2495	0.0887
2006	12.5729	0.0028	2.8479	0.0006	0.2513	0.0893
2007	14.5726	0.0028	2.8466	0.0006	0.2512	0.0893
2008	8.6747	0.0027	2.7054	0.0005	0.2387	0.0849
share of total 2008 emissions	**0.10%**	**0.003%**	**7.138%**	**0.001%**	**0.09%**	**0.16%**

Biggest decrease occurred in time period 1990–1991 due to changes in Latvia's national economy (Table 4.4.1). 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.

CO_2 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

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. There is only one Iron & Steel production plant in Latvia that produces crude steel by melting crude iron not only by melting scrap metals. The plant is participant of ETS and submits their annual GHG reports to LEGMC. It is possible to obtain more accurate and complete activity data and emission factors from enterprise that is involved in the emission trading system. Till Submission 2008 CO_2 emissions from plant's GHG reports were taken to report emissions from crude steel production.

After the In-country review 2007 the CO_2 emissions were completely recalculated according to IPCC GPG 2000 as methodology of CO_2 emission estimation from Monitoring and Reporting Guidelines[24] within ETS didn't correspond to production technology used in plant.

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

<u>CO_2 emission estimations from crude steel production</u>

Following equation from IPCC GPG 2000 is used to calculate CO_2 emissions from steel production:

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

According to information reported by steel producer:

- Average carbon content of crude iron using in steel production is 3 – 4% in 1990-2006, 4% for 2007 and 3% for 2008;
- Average carbon content of produced steel is 0.1 – 0.4% for 1990-2006, 0.3% for 2007-2008.

For year 1990-2006 the used amount of raw materials in different types of production installations – open-heart furnaces and electric arc furnaces was known as CSB reported the data to LEGMC even though the data could be confidential. Total produced amount of crude steel was known without division into particular production installations. So it was necessary to divide amount of crude steel produced in open-heart furnaces and in electric arc furnaces. These amounts are estimated 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 the same percentage is related to amount of produced steel. Accordingly amount of steel produced in open-heart furnaces and in electric arc furnaces is divided from total produced crude steel.

For years 2007-2008 the total produced crude steel amount divided by used production technologies was reported by plant but the plant couldn't report the used raw materials divided by production technologies. The steel producer reported that it's not possible to divide these two amounts, as plant doesn't do it.

[24] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF

So the used raw material amount in 2007-2008 was divided by the same percentage raw material divided in 2006:

- 99.59% of total used scrap metals were used in open heart furnaces;
- 95.52% of total used crude iron were used in open heart furnaces

Since large amount of scrap metals is used in crude steel production it is necessary to exclude this amount from total crude steel amount and to estimate only the amount of crude steel in what production crude iron was involved. It is 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 is 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 to decrease the carbon content in final produced crude steel. The coke is combusted in production process and emissions from coke use is reported in 1.A.2.a Iron & Steel sector of Energy sector.

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 is used because plant reported emission factor – 6 kg carbon per tonne of steel, is considered as unreliable high. For 2008 plant reported 18 kg per tonne of steel as also was assumed as incredibly high.

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

Table 4.4.2 Data for estimation of CO_2 emissions from steel production (Gg)

	crude steel production	mass of steel produced in OHF (%)	mass of steel produced in OHF	used scrap metal in open heart furnaces	crude iron used in open heart furnaces	crude iron/scrap metal ratio	amount of crude steel from crude iron	mass of steel produced in EAF (%)	mass of steel produced in EAF	EF for electric arc furnaces (t/t)	carbon content in crude iron (%)	carbon content in crude steel (%)	conversion factor
1990	**550000**	98.74%	**543074.4**	537227.4	107732.2	20.05%	6925.6	1.26%	**108904.7**	3.50%	0.25%	0.0015	3.664
1991	**373492**	98.74%	**368789**	364818.4	73158.39	20.05%	4703.0	1.26%	**73954.63**	3.50%	0.25%	0.0015	3.664
1992	**245834**	98.74%	**242738.5**	240125	48153.16	20.05%	3095.5	1.26%	**48677.25**	3.50%	0.25%	0.0015	3.664
1993	**300393**	98.74%	**296610.5**	293417	58840	20.05%	3782.5	1.26%	**59480.4**	3.50%	0.25%	0.0015	3.664
1994	**331955**	98.86%	**328163.6**	317658	55116	17.35%	3791.4	1.14%	**56938.79**	3.50%	0.25%	0.0015	3.664
1995	**279326**	98.72%	**275747.1**	285015	37086	13.01%	3578.9	1.28%	**35880.07**	3.50%	0.25%	0.0015	3.664
1996	**293167**	98.90%	**289954.5**	307261	29099	9.47%	3212.5	1.10%	**27460**	3.50%	0.25%	0.0015	3.664
1997	**464529**	99.45%	**461977.5**	469205	67039	14.29%	2551.5	0.55%	**66006.35**	3.50%	0.25%	0.0015	3.664
1998	**470835**	99.48%	**468374.9**	470302	71341	15.17%	2460.1	0.52%	**71048.68**	3.50%	0.25%	0.0015	3.664
1999	**483744**	99.54%	**481521.4**	490912	64631	13.17%	2222.6	0.46%	**63394.67**	3.50%	0.25%	0.0015	3.664
2000	**500292**	99.23%	**496433.9**	503123	70637	14.04%	3858.1	0.77%	**69697.88**	3.50%	0.25%	0.0015	3.664
2001	**502277**	99.21%	**498295.8**	511026	67352	13.18%	3981.2	0.79%	**65674.19**	3.50%	0.25%	0.0015	3.664
2002	**507194**	99.19%	**503079.2**	520425	63620	12.22%	4114.8	0.81%	**61499.55**	3.50%	0.25%	0.0015	3.664
2003	**547346**	99.62%	**545264.6**	524232	102437	19.54%	2081.4	0.38%	**106546.9**	3.50%	0.25%	0.0015	3.664
2004	**556974**	98.92%	**550969.7**	527155	108762	20.63%	6004.3	1.08%	**113675.4**	3.50%	0.25%	0.0015	3.664
2005	**554345**	98.94%	**548472.4**	527950	104010	19.70%	5872.6	1.06%	**108053.1**	3.50%	0.25%	0.0015	3.664
2006	**554546**	98.90%	**548419.1**	531026	105769	19.92%	6126.9	1.10%	**109233.3**	3.50%	0.25%	0.0015	3.664
2007	**558156**	99.76%	**556814**	463939.8	109247.9	23.55%	1342.0	0.24%	**131117.8**	4.00%	0.30%	0.0015	3.664
2008	**530462**	99.34%	**526964**	492449.6	88318.84	17.93%	3498.0	0.66%	**94508.85**	3.00%	0.30%	0.0015	3.664

CH_4 and indirect GHG emission estimations from crude steel production

The CH_4, NMVOC, CO, NO_x and SO_2 emissions from iron and steel production are calculated at the LEGMC based on activity data from the CSB and steel production plant according to EMEP/CORNAIR methodology and emission factors.

Emission factors of methane and indirect GHG emissions were taken from IPCC 1996 (Table 4.4.3).

Table 4.4.3 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.

It has to be noted that for CH_4, NMVOC, CO, NO_x and SO_2 emissions estimations total produced crude steel data is used but for CO_2 emission estimation only crude steel produced from crude iron is taken into account and reported in CRF Reporter. Therefore CH_4 IEF differs in CRF Reporter and in NIR.

4.4.3 Uncertainties and time series consistency

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. Still used raw materials data divided by technological processes aren't available and are estimated by using approximate percentage. So the uncertainty of activity data of iron and steel industry is assumed 25%.

CO_2 emission factor is estimated according to plant specific data reported by steel producer using IPCC GPG 2000 equations so the uncertainty of CO_2 emission factor 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.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. GHG emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 4.4.4 were double-checked and large fluctuations were explained.

Table 4.4.4 IEF changes higher than 10% for 2.A.1 sector

Source	**GHG**	**Unit**	**Year**	**First Year**	**Year**	**Second Year**	**Difference**	**Comments**
2.C.1.1	CH_4	t/t	2007	0.000021	2008	0.000027	26.41%	For CH_4 emission estimation total produced crude steel data is used but for CO_2 emission estimation only crude steel produced from crude iron is taken into account and reported in CRF Reporter. Therefore CH_4 IEF differs in CRF Reporter and in NIR.
2.C.1.1	CH_4	t/t	2006	0.000026	2007	0.000021	-16.69%	
2.C.1.1	CH_4	t/t	2002	0.000041	2003	0.000026	-37.71%	
2.C.1.1	CH_4	t/t	1998	0.000033	1999	0.000038	15.15%	
2.C.1.1	CH_4	t/t	1996	0.000053	1997	0.000035	-34.08%	
2.C.1.1	CH_4	t/t	1995	0.000039	1996	0.000053	37.14%	
2.C.1.1	CH_4	t/t	1994	0.000029	1995	0.000039	33.53%	CH_4 EF is the same for all years
2.C.1.1	CH_4	t/t	1993	0.000025	1994	0.000029	15.44%	

Source	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
2.C.1.1	CO_2	t/t	2007	0.111188	2008	0.088036	-20.82%	In 2007-2008 amount of steel produced in EAF increased by 161%, amount of scrap metal used in steel production (the production process doesn't produce CO_2 emissions) increased by 6% but amount of crude iron used in steel production decreased by 19%. That's why CO_2 emissions decreased and estimated CO_2 IEF decreased.

4.4.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia’s national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

Plant specific CO_2 emission factors and Tier2 CO_2 emission estimation methodology

Tier2 methodology is used to estimate CO_2 emissions from steel production using plant specific data and Tier2 methodology from IPCC GPG.

All the activity data required in CO2 emission estimation (IPCC GPG) is reported by steel production plant to LEGMC within National Inventory System. The plant confirms that the data is reliable and useful. The data then is compared to the CSB data.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

CO_2 emission is estimated according to IPCC GPG and the Tier2 methodology was verified by ERT during two in-country reviews in 2007 and 2009 and accepted as correct.

4.4.6 Source-specific recalculations

Carbon conversion factor was précised for all years in time series. Carbon content in crude steel and in crude iron used in electric arc furnaces was corrected according to steel production plant’s information for 2007. Used raw material data for 2007 was corrected as different percentage to divide raw materials used in open heart furnaces and electric arc furnaces was used.

4.4.7 Source-specific planned improvements

No improvements are planned for this sector for nearest 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 production;
- Food and Drink production.

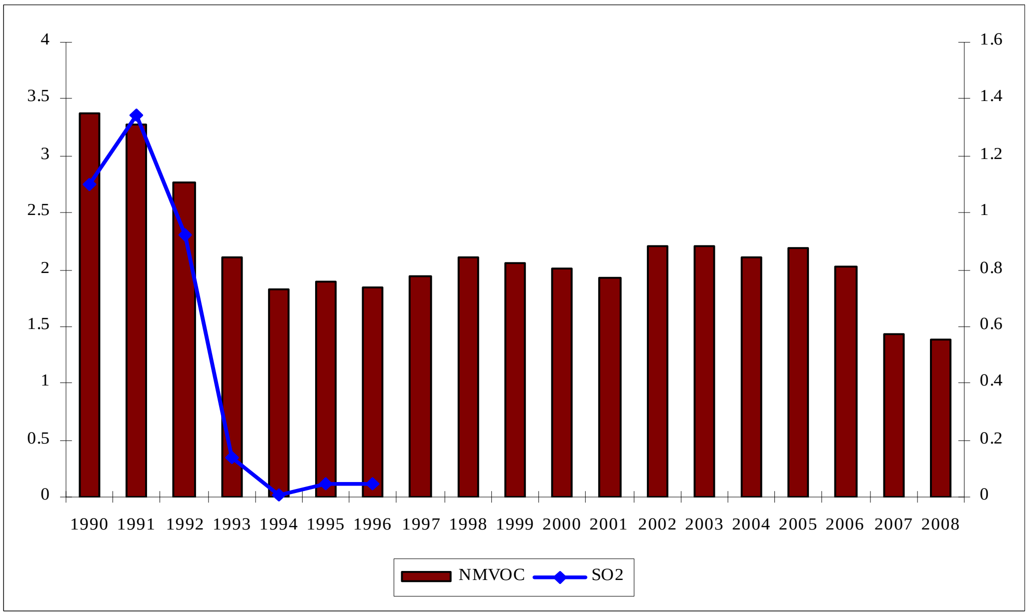


Figure 4.5.1 Total emissions from 2.D Other Production in 1990–2008 (Gg)

Biggest fluctuations occurred in time period 1991–1993 due to changes in economical situation in country (Figure 4.5.1). Decrease of NMVOC emissions in time period 1999 – 2001 is explained with economical crisis in neighbourhood Russia with whom Latvia has stable economical relations. For the years in time period 2002 – 2004 NMVOC emissions were stable. NMVOC emissions decreased by 36.9% in 2005-2008 that is explained with decrease of produced spirits by 28.4% and closure of sugar production plants. Sugar is no longer produced in Latvia since 2007. Total amount of production in 2.D.2 Food and Drink sector has decreased by 3.9% in 2007-2008.

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 LEGMC. 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 LEGMC. IPCC 1996 was used in estimations.

Emission factors

SOx emission factor 0.03 (t/t) is taken from IPCC 1996.

The NMVOC emission factors (Table 4.5.1) are taken from the IPCC 1996 with exception of NMVOC emission factor for spirits production. NMVOC emissions factor from EMEP/CORINAIR that corresponds to other spirits was used. Central Statistical Bureau provided aggregated statistical data where it can be seen that 95.5% of all spirits produced in Latvia is produced from grains (sheer alcohol or spirits) and no brandy and whiskey is produced in Latvia. That's why emission factor for Other Spirits 0.4 kg/hl (alcohol) is used.

Table 4.5.1 NMVOC emission factors for food and drink industries

Production	Emission factors
Wine	0.08 kg/hl
Beer	0.035 kg/hl
Spirits	0.4 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). LEGMC has signed an agreement with CSB to get data of total production of products from sectors where data are confidential.

Still for the 2007-2008 data for the category – wine production, was classified as confidential and not available for the LEGMC. That's why for this category 2006 year's data was used also for last two years in time series.

Table 4.5.2 Activity data of 2.D Other Production sector

	1. Pulp and Paper	2. Food and Drink	Wine	Beer	Spirits	Met, fish, poultry	Sugar	Cakes, biscuits, breakfast cereals	Bread	Animal forage
	Gg		1000 hl	1000 hl	1000 hl	Gg	Gg	Gg	Gg	Gg
1990	36.6	1212.28	19.9	87.4	324.5	569.3	31.0	54.8	314.0	200.0
1991	44.7	1239.88	197.5	1295.3	330.0	490.4	35.0	39.2	293.0	200.0
1992	30.8	912.50	179.8	858.9	259.3	281.6	39.0	22.1	240.0	200.0
1993	4.7	703.70	87.7	545.9	217.4	154.0	26.0	15.8	177.4	245.4
1994	0.2	578.29	134.2	637.9	314.8	95.6	15.8	22.7	161.5	174.0
1995	1.5	611.65	159.2	652.8	341.5	82.8	29.3	24.4	145.4	214.4
1996	1.5	619.02	154.7	644.9	379.6	100.5	31.2	13.1	137.1	206.2
1997	NO	668.39	114.7	714.8	456.4	129.1	41.2	16.9	132.1	205.0
1998	NO	653.00	99.6	721.0	417.4	110.9	64.9	18.1	124.8	203.3
1999	NO	675.64	C	953.2	C	166.9	C	20.8	121.5	144.5
2000	NO	722.04	C	945.1	C	197.3	C	24.3	121.1	173.8
2001	NO	769.63	C	996.6	C	244.6	C	24.4	123.1	184.9
2002	NO	855.57	C	1199.2	C	262.9	C	29.0	122.6	201.3
2003	NO	862.97	C	1336.6	C	264.4	C	37.3	124.0	201.4
2004	NO	871.37	C	1313.1	C	262.5	C	43.6	119.3	211.8
2005	NO	876.09	C	1293.3	C	243.8	C	53.6	116.3	248.6
2006	NO	926.37	C	1383.0	C	288.4	C	45.0	107.3	244.2
2007	NO	942.7	C	1414.3	C	286.0	NO	46.5	102.3	336.8
2008	NO	902.3	C	1333.8	C	297.7	NO	38.5	100.7	307.3

4.5.3 Uncertainties and time series consistency

Uncertainty of activity data was assumed as ±2% for 1990-2006 because statistical data from CSB were used. For 2007-2008 the uncertainty is assumed higher – 10%, as no precise information is available for wine production. SO_2 and NMVOC emission factors were assigned as 50% because default emission factors taken from the IPCC 1996 were used.

Time series of the estimated emissions are consistent and complete because the same methodology, emission factors and data sources are used for sectors for all years in time series. GHG emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

4.5.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data used in NMVOC and SO_x emissions was reported by CSB to LEGMC within National Inventory System. CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. CSB now is working on the development of documentation system that will serve as centralised knowledge base of the calculations and surveys carried out by the CSB because the whole business cycle of data will be described, including quality assessment. The activity data used in estimations is repeatedly verified by CSB energy experts by checking the data input in data estimation database and reported in the NIR.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reported and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

4.5.5 Source-specific recalculations

No recalculations were done for the sector.

4.5.6 Source-specific improvement

No particular improvements are planned for the sector.

4.6 CONSUMPTION OF HALOCARBONS AND SF_6 (CRF 2.F)

4.6.1 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.[25] 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. Within the project questionnaires were sent to 120 enterprises operate with F – gases and response were extremely low about 28%. So experts from LEGMC had to find other ways to collect necessary data.

[25] Project report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003", Riga 2004

Latvia has accepted *Regulation of the European Parliament and of the Council on certain fluorinated greenhouse gases* and within it accepted *Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents* with whom producers, importers, exporters and operators need to report their activities with the F – gases for previous year till next year 1st February. Starting submission 2007 these data are available for LEGMC to estimate actual emissions of F – gases. For the submission 2007 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 2010 more than 530 operators reported data of their operation with f-gases.

The calculation of emissions was carried out for that F – gases, namely: SF_6, HFC–23, HFC–32, HFC–125, HFC–134a, HFC–143a, HFC–152 and HFC–227ea. The most used gas is HFC-134a (used in mobile air conditioners).

The emissions of F-gases are linearly increasing since 1995 – 0.65 (CO_2 eq. Gg) in 1995 to 80.08 (CO_2 eq. Gg) in 2008. (Table 4.6.1, Figure 4.6.1)

Table 4.6.1 Total emissions of HFCs (Gg CO_2 eq)

	2.F	2.F.1:	2.IIA.F.1.1	2.IIA.F.1.2	2.IIA.F.1.3	2.IIA.F.1.6	2.F.3	2.F.4	2.F.9
1995	**0.6462**	0.2822	0.0848	NO	0.1755	0.0219	NO	NO	0.3640
1996	**0.8768**	0.4916	0.1176	NO	0.0421	0.3319	NO	NO	0.3852
1997	**1.2366**	0.8300	0.1330	NO	0.0878	0.6092	NO	NO	0.4066
1998	**2.3804**	1.7681	0.1483	0.0218	0.3159	1.2820	NO	0.1560	0.4564
1999	**2.9800**	2.1383	0.1800	0.0523	0.0060	1.9000	NO	0.6331	0.2086
2000	**4.8346**	3.0030	0.2123	0.0743	0.0354	2.6810	NO	1.1240	0.7076
2001	**7.6049**	4.6169	0.2458	0.1718	0.0741	4.1252	0.0353	1.5751	1.3776
2002	**10.0762**	6.4000	0.2897	0.2456	0.0858	5.7789	0.0353	1.8483	1.7926
2003	**12.9675**	8.9681	0.3573	0.3329	0.2709	8.0071	0.0882	1.7533	2.1578
2004	**18.1877**	13.4106	0.4473	0.8356	0.0949	12.0328	0.1786	1.7357	2.8628
2005	**27.0942**	21.7675	1.0497	0.6314	0.1812	19.9052	0.1150	1.9378	3.2739
2006	**48.6204**	42.5974	1.1964	8.9449	0.1299	32.3262	0.1790	2.1704	3.6736
2007	**67.2558**	60.0963	1.3363	11.2579	NO	47.5021	0.0402	2.5155	4.6038
2008	**80.0848**	72.0122	1.5015	13.2802	NO	57.2306	0.0402	2.7253	5.3070
share of total 2008 GHG emission	**0.67%**	**0.61%**	**0.01%**	**0.11%**	**NO**	**0.48%**	**0.0003%**	**0.02%**	**0.04%**

As it can be seen in Figure 4.6.1 all f-gases emissions have increasing tendency with exception of Transport Refrigeration and Fire Extinguishers sectors where emission decrease could be explained with inaccurate statistical data, closing of enterprises and changes of substances used in equipment. 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. 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. There are no emissions from halocarbons and SF_6 from metal production / Production of halocarbons and SF_6 in Latvia.

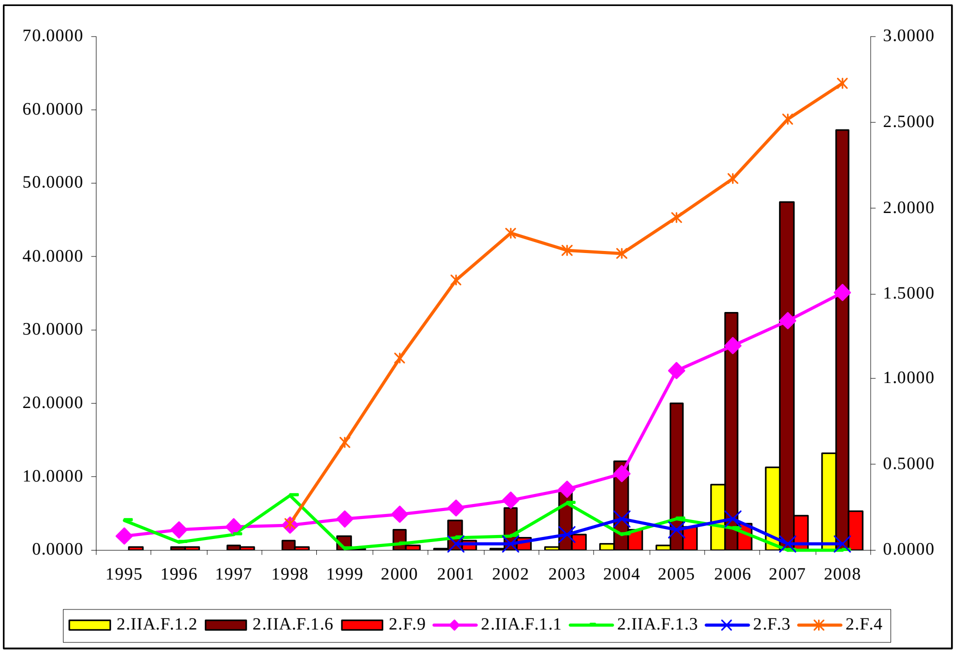


Figure 4.6.1 HFCs emissions from 2.F Consumption of Halocarbons and SF_6 sector in 1990 – 2008 (Gg CO_2 eq)[26]

4.6.2 Methodological issues

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

Data used in estimations of actual f-gases emissions and estimated emissions are reported in Annex III Relevant background information – Industrial Processes Sector.

4.6.2.1 Domestic Refrigeration (CRF 2.F.1.1)

HFC-134a emissions from domestic refrigerators and freezers are estimated by using IPCC 1996 and default emission factors. The basic data for HFC-134a emission estimation from domestic refrigerators and freezers are:

1. amount of inhabitants in Latvia – obtained by CSB[27];
2. amount of households in Latvia – for 1995 and 2001 data was taken from CSB report[28,29], data for 1996-2000 were extrapolated, for 2002-2008 data were taken from CSB database[30];
3. percentage amount of households using refrigerators and freezers – for 1996, 2001 and 2006 data were taken from CSB that obtained data[31] with questionnaires of households made every five years, data for years between these particulars years were extrapolated by CSB;
4. percentage amount of refrigerators and freezers charged with HFC-134a were determined by experts during report “SF_6, HFC and PFC emission inventory in Latvia 1995-2003”.

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[26] sectors 2.IIA.F.1.1, 2.IIA.F.1.3, 2.F.3 and 2.F.9 on the secondary axis

[27] http://data.csb.gov.lv/Dialog/varval.asp?ma=04-02&ti=4%2D2%2E+PAST%C2V%CEGO+IEDZ%CEVOT%C2JU+SKAITS+GADA+S%C2KUM%C2&path=../DATABASE/Iedzsoc/Ikgad%E7jie%20statistikas%20dati/Iedz%EEvot%E2ji/&lang=16

[28] Consumption in Energy resources in households in 1996, Riga 1998

[29] Consumption in Energy resources in households in 2001, Riga 2003

[30] http://data.csb.gov.lv/Dialog/varval.asp?ma=08-19&ti=8%2D19%2E+M%C2JOK%CFU+SKAITS+RE%CCIONOS%2C+REPUBLIKAS+PILS%C7T%C2S+UN+RAJONOS+GADA+BEIG%C2S&path=../DATABASE/Iedzsoc/Ikgad%E7jie%20statistikas%20dati/M%E2jok%EFi/&lang=16

[31] http://data.csb.gov.lv/Dialog/varval.asp?ma=0201&ti=epm2%2E1%2E+M%E2jok%EFu+skaits%2C+kuros+izmanto+elektroier%EEces%2C+un+elektroier%EE%E8u+vid%E7jais+vecums+&path=../DATABASE/vide/Energoresursu%20pat%E7ri%F2%F0%20m%E2jsaimniec%EEb%E2s/&lang=16

4.6.2.1.1 HFC-134a from charging of domestic refrigerators and freezers

There are no manufacturing companies in Latvia and all domestic refrigerators and freezers are imported.

Activity data for emission estimation from recharging of domestic refrigerators and freezers are amount of freezing equipments used in households that contain HFC-134a. This amount was estimated using CSB statistical information and assumptions from the report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003".

According to responses on the questionnaires submitted to report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003" average amount of HFC-134a used in charging of domestic freezing equipments is 176.25 g and charging is made once in lifetime (15 years) – average after 7.5 years. That gives approximate annual amount of HFC-134a charged that is estimated with equation:

$$HFC_{charged,t} = R \times n/f$$

where:
$HFC_{charged}$ – amount of HFC-134a charged in year t (tonnes);
R – amount of refrigerators and freezers charged with HFC-134a (units);
n – average equipment lifetime (years);
f – amount of HFC-134a charged once in lifetime of equipment

After the in country review in 12th – 17th October 2009 it was suggested to use average lifetime 15 years just for early years in time period but for last years use shorter lifetime period. So it was assumed to use 15 years lifetime factor for years 1995-2000 but for time period 2001-2008 lifetime factor used in emission estimation is assumed as 10 years. So for years 2001-2008 charging was assumed as made average after 5 years.

It is assumed that 2% of HFC-134a used in charging is emitted during charging process.[32]

Equation from IPCC 1996 for charging emissions estimation:

$$E_{charged} = HFC_{charged} \times k$$

where:
$E_{charged}$ – amount of emissions from charging of domestic refrigerators and freezers (t)
$HFC_{charged}$ – amount of HFC-134a charged in year t (tonnes);
k – charging losses (%)

4.6.2.1.2 HFC-134a from stocks of domestic refrigerators and freezers

Amount of HFC-134a in stocks is estimated by using the data mainly obtained from CSB. Approximate amount of HFC-134a stored in domestic refrigerators and freezers was estimated based on CSB data.

According to IPCC 1996 average percentage of losses during operation is 1% of the total quantity banked in the stock.[33]

Equation from IPCC 1996 for stocks emissions estimation:

$$E_{operation} = E_{stocks} \times x$$

where:
$E_{operation}$ – amount of emissions during equipment operation (t)
E_{stocks} – amount of HFC-134a held in stocks in year t (tonnes);
x – losses during operation period (%)

[32] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.56
[33] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.55

4.6.2.1.3 HFC-134a from disposal of domestic refrigerators and freezers

Emissions from disposal have to be estimated for time period 1995-2004. Separate expert assumptions were made to estimate the emissions from disposal. For years 1995-2000 percentage amount of HFC-134a were assumed as 80% from HFC-134a charged in previous years but for time period 2000-2004 the percentage losses were assumed lower as 60% as basic regulations of electric equipment that ruled the collection, recovery or export of disposed equipments were adopted.

Equation from IPCC 1996 for disposal emissions estimation:

$$E_{disposal} = E_{charged(t-n)} \times Q$$

where:
$E_{disposal}$ – amount of emissions from system disposal (t)
$E_{charged\,(t-n)}$ – amount of HFCs charged into domestic refrigerators and freezers in year (t-n) (t)
Q – losses after the equipment disposal (%)

Still the activity data for emission estimation is impossible to obtain as the data of HFC-134a charged in new equipment in time period 1980-1992 is needed. It isn't possible to obtain this data as basic statistical information for activity data estimation is necessary. Still according to research made for report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003" the percentage of all freezing domestic equipments in 1995 is quite low as 5%. So for years 1980-1992 the percentage amount is assumed as low as 0-1%. As well as amount of freezing equipments in households is assumed as rather low in this time period. So it was assumed that disposal emissions for time period 1995-2004 is negligible and notation key "NA" for these years for disposal emissions is used.

Regulation of Cabinet of Ministers No 923 "Regulations Regarding the Management of Electrical and Electronic Equipment Waste" was adopted in 9th September 2004 according to what "merchants shall collect waste electric and electronic equipment separately and it shall be transported so that reuse and recycling of the entire electric and electronic equipment or components existing therein was promoted". [34] Also according to the previous mentioned regulations merchants have to remove separately all environment dangerous substances from electric and electronic equipment that includes chlorofluorocarbons (cryofluorane, CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), hydrocarbons (HC) and deliver them to particular treatment facilities. According to these regulations it is assumed that there are no disposal emissions from domestic and commercial refrigerators and freezers since 2005. So the notation key "NO" is used for domestic refrigeration sector emissions for 2005-2008.

3.3.2.7 4.6.2.2 Commercial and Industrial Refrigeration (CRF 2.F.1.2, CRF 2.F.1.4)

According to "Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents" more than 530 operators reported data of their operation with f-gases for submission 2010 for year 2008. For historical years data were obtained with questionnaire done within "SF_6, HFC and PFC emission inventory in Latvia 1995-2003". For 2004-2005 activity data were obtained from enterprises that responded on data request letters sent by LEGMC. For 2006-2007 data were obtained from reporting within previously mentioned new regulation act.

IPCC 1996 was used to estimate emissions from commercial freezing equipment.

[34] http://www.ttc.lv/export/sites/default/docs/LRTA/MK_Noteikumi/Cab._Reg._No._923_-_Regs_re._the_Management_of_Electrical_..._Waste.doc

4.6.2.2.1 F-gases from charging of commercial and industrial refrigeration

There are no manufacturing companies in Latvia and all refrigerators and freezers are imported.

Activity data of amount of f-gases and blends containing f-gases are obtained from operators.

Average 3.5% of HFC-134a used in charging is emitted during charging process according to IPCC 1996.[35] For time period 2006-2008 average 1.5% of HFC-134a charged into refrigerators is assumed as emitted into air. "Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents" was adopted in the second part of 2005 as is regulating the activities with f-gases and set out limitations for these activities. So it is assumed that more accurate operations with f-gases are taken.

Equation from IPCC 1996 for charging emissions estimation:

$$\boxed{E_{charged} = HFC_{charged} \times k}$$

where:
$E_{charged}$ – amount of emissions from charging of commercial and industrial refrigerators (t)
$HFC_{charged}$ – amount of f-gases charged in commercial and industrial refrigerators in year t (tonnes);
k – charging losses (%)

4.6.2.2.2 F-gases from stocks of commercial and industrial refrigeration

Activity data of amount of f-gases and blends containing f-gases are obtained from operators.

According to IPCC 1996 average percentage of losses during operation is 17% (vary for different references)[36] but it was assumed average 15% losses for commercial refrigerators used in Latvia as stand-alone commercial applications are used in commercial refrigerating sector. This percentage is used for time period 1998-2005.

For time period 2006-2008 average 8% of HFC-134a stored in stocks is assumed as emitted into air. "Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents" was adopted in the second part of 2005 as is regulating the activities with f-gases and set out limitations for these activities. So it is assumed that more accurate operations with f-gases are taken.

Equation from IPCC 1996 for stocks emissions estimation:

$$\boxed{E_{operation} = E_{stocks} \times x}$$

where:
$E_{operation}$ – amount of emissions during equipment operation (t)
E_{stocks} – amount of f-gases held in stocks in year t (tonnes);
x – losses during operation period (%)

4.6.2.2.3 F-gases from disposal of commercial and industrial refrigeration

Emissions from disposal have to be estimated for time period 1995-2004. Separate expert assumptions were made to estimate the emissions from disposal. For years 1995-2000 percentage amount of HFC-134a were assumed as 80% from HFC-134a charged in previous years but for time period 2000-2004 the percentage losses were assumed lower as 60% as basic regulations of electric equipment that ruled the collection, recovery or export of disposed equipments were adopted.

Average lifetime of commercial and industrial refrigerating equipment is taken from IPCC 1996 and is 15 years[37] for early years in reporting period 1995-2000 (n in following equation).

[35] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.53
[36] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.56
[37] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.56

For years 2001-2008 it is assumed that average lifetime for commercial and industrial refrigerators is 10 years.

That gives emission factor of disposal emissions – 5.3% for time period 1995-2000 and 6% for time period 2001-2004.

Equation from IPCC 1996 for disposal emissions estimation:

$$E_{disposal} = E_{charged} \times Q$$

where:
$E_{disposal}$ – amount of emissions from system disposal (t)
$E_{charged}$ – amount of f-gases charged in commercial and industrial refrigerators in year (t-n) (t)
Q – losses after the equipment disposal (%)

According to Regulation of Cabinet of Ministers No 923 “Regulations Regarding the Management of Electrical and Electronic Equipment Waste” the f-gases remained in electronic and electric equipment have to be collected and transferred to waste treatment facilities for liquidation or to waste processors for regeneration.

According to these regulations it is assumed that there are no disposal emissions from domestic and commercial refrigerators and freezers since 2005. So the notation key “NO” is used for domestic refrigeration sector emissions for 2005-2008.

3.3.2.8 4.6.2.3 Transport Refrigeration (CRF 2.F.1.3)

During the preparation of the report “SF_6, HFC and PFC emission inventory in Latvia 1995-2003” transport enterprises and auto services were questioned. According to the responses only negligible amount of HFCs is used in railways and water transport. Small amount of HFC-23 is filled into ships refrigerating equipments. Reported HFC-134a and HFC-125 is filled into mobile refrigerators used in road transport.

According to “Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents” f-gases operators that charge and own the mobile refrigerating equipment have to report the amount of used f-gases. These operators use f-gases as freezing agents.

4.6.2.3.1 F-gases from charging of transport refrigeration

For historical years 1995-2006 it is almost impossible to obtain necessary data of f-gases used for charging to mobile refrigerators as enterprises don’t have particular accounting and mainly enterprises serve not only mobile refrigerators but also stationary refrigeration equipment and stationary and mobile air conditioning equipment. So these enterprises have only total charged amount of HFCs. And also enterprises that own mobile refrigerators don’t service their equipment. Till year 2006 there weren’t any rules that enterprises that operate with f-gases have to report used amounts.

For years 2007-2008 it is very difficult or almost impossible to exclude the amount charged in transport refrigeration equipment from amount reported by f-gases operators within national regulation as charged in freezing and conditioning equipment because operators haven't such aggregated accounting

So the amount of f-gases charged in transport refrigeration and emissions from charging are reported under 2.F.1.2 Commercial Refrigeration sector and the notation key “IE” is used for reporting in CRF Reporter.

Equation from IPCC 1996 for charging emissions estimation:

$$E_{charged} = HFC_{charged} \times k$$

where:
$E_{charged}$ – amount of emissions from charging of commercial and industrial refrigerators (t)
$HFC_{charged}$ – amount of f-gases charged in transport refrigerators in year t (tonnes);
k – charging losses (%)

4.6.2.3.2 F-gases from stocks of transport refrigeration

For historical years 1995-2006 the amount of f-gases held in stocks in transport refrigeration equipment is estimated by using the information of road transport and ships refrigeration equipment reported by enterprises within preparation of report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003". Enterprises reported the amount of transport refrigerators they own, type of f-gases filled in it and amount of refrigerators used.

The amount of f-gases in mobile refrigeration equipment (stocks) for 2007-2008 is reported by enterprises within national legislation. Operators don't have to report their NACE code and it's very difficult to exclude the enterprises operating as freight carriers from whole list of enterprises reporting their activities with f-gases. The amount of f-gases transport refrigeration and emissions from stocks are reported under 2.F.1.2 Commercial Refrigeration sector and the notation key "IE" is used for reporting in CRF Reporter.

Equation from IPCC 1996 for stocks emissions estimation:

$$E_{operation} = E_{stocks} \times x$$

where:
$E_{operation}$ – amount of emissions during equipment operation (t)
E_{stocks} – amount of f-gases held in stocks in year t (tonnes);
x – losses during operation period (%)

Average emission factor for stocks emissions is 15% for time period 1995-2005, since 2006 8% leakage factor is used because of adopting "Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents"

4.6.2.3.3 F-gases from disposal of transport refrigeration

Emissions from disposal have to be estimated for time period 1995-2004. Separate expert assumptions were made to estimate the emissions from disposal. For years 1995-2000 percentage amount of HFC-134a were assumed as 80% from HFC-134a charged in previous years but for time period 2000-2004 the percentage losses were assumed lower as 60% as basic regulations of electric equipment that ruled the collection, recovery or export of disposed equipments were adopted.

Equation from IPCC 1996 for disposal emissions estimation:

$$E_{disposal} = E_{charged} \times Q$$

where:
$E_{disposal}$ – amount of emissions from system disposal (t)
$E_{charged}$ – amount of f-gases charged in transport refrigerators in year (t-n) (t)
Q – losses after the equipment disposal (%)

According to Regulation of Cabinet of Ministers No 923 "Regulations Regarding the Management of Electrical and Electronic Equipment Waste" the f-gases remained in electronic and electric equipment have to be collected and transferred to waste treatment facilities for liquidation or to waste processors for regeneration.

According to these regulations it is assumed that there are no disposal emissions from domestic and commercial refrigerators and freezers since 2005. So the notation key “NO” is used for domestic refrigeration sector emissions for 2005-2008.

4.6.2.4 Mobile and Stationary Air Conditioning (CRF 2.F.1.5, CRF 2.F.1.6)

According to “Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents” also f-gases operators that charge the mobile and also own stationary air conditioning equipment have to report the amount of used and stored f-gases. These operators use f-gases as conditioning agents.

IPCC 1996 was used to estimate emissions from stationary and mobile air conditioners.

4.6.2.4.1 HFC-134a from charging of mobile and stationary air conditioning

For historical years 1995-2006 it is almost impossible to obtain precise data of f-gases used for charging of stationary or mobile air conditioners as enterprises don’t have particular accounting as most enterprises serve refrigerating and conditioning equipment altogether. So these enterprises have only total charged amount of HFCs. Until year 2006 there weren’t any rules that enterprises that operate with f-gases have to report used amounts.

For years 2007-2008 it is very difficult or almost impossible to exclude the amount charged in stationary and mobile air conditioning equipment from amount reported by f-gases operators within national regulation as charged in freezing and conditioning equipment because operators haven't such aggregated accounting.

So the amount of f-gases charged in stationary and mobile air conditioners and emissions from charging are reported under 2.F.1.2 Commercial Refrigeration sector and the notation key “IE” is used for reporting in CRF Reporter.

Equation from IPCC 1996 for charging emissions estimation:

$$E_{charged} = HFC_{charged} \times k$$

where:
$E_{charged}$ – amount of emissions from charging of mobile and stationary air conditioners (t)
$HFC_{charged}$ – amount of f-gases charged in year t (tonnes);
k – charging losses (%)

4.6.2.4.2 HFC-134a from stocks of stationary and mobile air conditioning

The amount of f-gases in stationary air conditioning equipment (stocks) is reported by enterprises within national legislation. Operators don't have to report the equipment type where f-gases are stored and it's very difficult to exclude the enterprises reporting f-gases filled in their stationary air conditioning equipment from total f-gases reported as stocks of enterprise

HFC-134a emissions from mobile air conditioning are estimated by using IPCC 1996 and default percentage amounts. The basic data for HFC-134a emission estimation from mobile air conditioners:

1. amount of passenger cars and trucks manufactured after 1995 – obtained by Road Traffic Safety Directorate and reported by CSB[38];
2. percentage of cars filled with HFCs – taken from report “SF_6, HFC and PFC emission inventory in Latvia 1995-2003”;

Percentage of cars filled with HFCs according to project report is 20% for passenger cars and 50% for trucks. This percentage is used for time period 1995-2000.

[38] http://data.csb.gov.lv/DATABASE/transp/Ikgadējie%20statistikas%20dati/Transports/Transports.asp

The fleet age is constantly improving when in 2002 almost 30% of total passenger cars manufacturing year were higher than year 2000, in 2005 the percentage was 42.8%. In year 2008 more than 50% of total registered passenger cars is younger than year 2000 (manufacturing year) and for 23.9% manufacturing year is higher than year 2005.

According to this factor it can be assumed that in year 2000 the percentage of passenger cars equipped with MACs filled with f-gases is higher than 20% and it percentage has to increase year by year. The expert judgement is – starting year 2000 the percentage of passenger cars equipped with f-gases filled MACs are constantly increasing and reaches 60% in year 2008. The same percentage increase has to be applied for trucks when percentage of trucks equipped with MACs increase from 50% in 2000 to 70% in 2008.

According to IPCC 1996 average percentage of losses during operation lifetime is 15% of the total quantity banked in the stock.[39]

Equation from IPCC 1996 for stocks emissions:

$$E_{operation} = E_{stocks} \times x$$

where:
$E_{operation}$ – amount of emissions during equipment operation (t)
E_{stocks} – amount of f-gases held in stocks in year t (tonnes);
x – losses during operation period (%)

4.6.2.4.3 HFC-134a from disposal of stationary and mobile air conditioning

For emissions estimation according IPCC 1996 amount of f-gases charged in particular historical years is needed. It means that data for amount of f-gases charged in the eighties and nineties is needed. It is impossible to obtain data of these years.

During the project for the "SF_6, HFC and PFC emission inventory in Latvia 1995-2003" it was assumed that approximate 8% of total MACs is disposed every year. Average lifetime factor for MACs is 12 years.[40] According to assumption it is possible to estimate amount of f-gases remained in MACs after the disposal) every year by multiplying amount of MACs disposed with the approximate amount of f-gases remained in one amount. It is assumed that approximate 75% of f-gases filled in MACs is remained after the lifetime of MACs.

$$HFC_{remained} = MAC_{total} \times m \times HFC_{fill} \times r$$

where:
$HFC_{remained}$ – amount of f-gases remained in MACs after their lifetime in year (t)
MAC_{total} – total amount of MACs in passenger cars and trucks (pieces)
M – amount of MACs disposed (%)
HFC_{fill} – amount of f-gases filled in one MAC of passenger car or truck
R – amount of f-gases remained in one MAC (%)

It is assumed that 90% of f-gases remained in MACs after their lifetime is emitted as there is no national regulation that set out rules that f-gases from mobile air conditioning equipments from cars have to be treated in particular manner.

Equation from IPCC 1996 for disposal emissions:

$$E_{disposal} = HFC_{remained} \times Q$$

where:
$E_{disposal}$ – amount of emissions from system disposal (t)
$HFC_{remained}$ – amount of f-gases remained in MACs after their lifetime in year
Q – losses after the equipment disposal (%)

[39] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.57
[40] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.57

4.6.2.5 Potential Emissions from Refrigeration and Air Conditioning equipment

Data for potential HFCs emission from refrigerants and air conditioning equipment estimation was taken from LEGMC Chemical Substances Registry where all enterprises operating with any chemical substances have to report the amount of imported, produced and exported chemical substances according to "Chemical Substances and Chemical Preparations Law".[41]

Potential annual consumption of particular f-gas was estimated by following equation:

$$HFC_{potential} = \sum HFC_{produced} + \sum HFC_{imported} - \sum HFC_{exported}$$

where:
$HFC_{potential}$ – amount of consumption of particular f-gas in year (t)
$HFC_{produced}$ – amount of produced particular f-gas in year (t)
$HFC_{imported}$ – amount of imported particular f-gas in year (t)
$HFC_{exporteded}$ – amount of exported particular f-gas in year (t)

According to information from Chemical Substances Registry no f-gases are produced in Latvia or exported from Latvia that's why only imported data is used in emission estimation. Due to this potential annual consumption of particular f-gas was estimated by following equation:

$$HFC_{potential} = \sum HFC_{imported}$$

where:
$HFC_{potential}$ – amount of consumption of particular f-gas in year (t)
$HFC_{imported}$ – amount of imported particular f-gas in year (t)

According to information from the enterprises the f-gases are imported in bulk and in products. Only HFC-134a is reported as imported in bulk. Other f-gases are reported as imported in products.

The potential f-gases emissions from freezing and conditioning equipment is estimated by taking into account only the HFCs imported in products as it is not know where HFC-134a imported in bulk is used and when.

It is assumed that up to 100% of total imported in products HFC-134a potentially could be emitted in air in particular year.

The following equation is used to estimate potential emissions from refrigerating and conditioning equipment:

$$E_{PHFC} = HFC_{products}$$

where:
E_{PHFC} – potential f-gases emissions from refrigerating and conditioning equipment in year (t)
$HFC_{products}$ – amount of total HFCs imported in products in year (t)

4.6.2.6 Foam Blowing (CRF 2.F.2)

Although the activity of building sector in last years radically increased emissions are not estimated due to lack of activity data of imported and in-country used building foams or foams used in windows manufacturing and lack of data of containing f-gases.

[41] http://www.ttc.lv/export/sites/default/docs/LRTA/Likumi/Chemical_Substances_and_Chemical_Products_Law.doc

To prepare f-gases emission calculation for the particular sector precise or at least approximate data of imported / in-country used building foams for the time period is needed. CSB and Central Custom Service are collecting data according to TARIC nomenclature (Commission Regulation No 1031/2008 of 19 September 2008 amending Annex I to Council Regulation (EEC) No 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff[42]) that doesn't provide particular data collection. According to TARIC classification the data under sector "Mixtures containing halogenated derivatives of methane, ethane or propane" can be obtained. There is no data of imported units of building foams and the chemical substances within them.

To obtain particular data for the sector it is necessary to collect the data from main importers or building wholesalers but it is not possible to collect these data for this inventory. It is possible to do this for the Submission 2011. So for submission for the 2.F.2 Foam Blowing sector the notation key "NE" is reported.

4.6.2.6.1 Potential emissions from foam blowing

In Chemical Substances Registry of LEGMC also the import of construction sealants is reported. The data is available since year 2004 when Chemical Substances Registry was created. Still these data are very inaccurate as only few importers reported their data, for example in 2004-2006 only on importer reported the imported amount of "Tecfoam" construction sealant.

It is possible to estimate imported amount of f-gases within foams if the approximate percentage amount of f-gases in product is known.

It is assumed that 100% of foams imported in particular year to country are used in the same year so 100% leakage factor is used for potential f-gases emissions estimation.

The following equation is used to estimate potential f-gases emissions from foam blowing:

$$E_{PHFC} = HFC_{products}$$

where:
E_{PHFC} – potential f-gases emissions from foam blowing in year (t)
$HFC_{products}$ – amount of total HFCs imported in products in year (t)

4.6.2.7 Fire extinguishers (CRF 2.F.3)

It is very difficult to estimate f-gases emissions from fire extinguishing because there is only statistical information of the registered fire extinguishing equipment (pieces) in Latvia done by State Fire and Rescue Service. Type of substance used in equipment isn't registered.

It is necessary to know at least percentage of total registered fire extinguishing equipment that is filled with f-gases.

4.6.2.7.1 HFC-227ea from charging of fire extinguishing equipment

During the project preparation for the report SF_6, HFC and PFC emission inventory in Latvia 1995-2003" it was found that there is no manufacturing of fire extinguishers containing f-gases. 19 enterprises were questioned including only manufacturer of fire extinguishers. According to responses fir extinguishers filled with f-gases are used in quite small amount. Only 2 enterprises reported the amount of HFC-227ea in installed equipment in particular year and amount of HFC-227ea held in stocks (containers) of fire extinguishing equipments. It was reported that no charging was done for the installed equipment. Fire extinguishers were installed already filled with f-gases and there weren't any necessity to recharge them. So only emissions from stocks were calculated.

[42] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:291:0001:0894:EN:PDF

4.6.2.7.2 HFC-227ea from stocks of fire extinguishing equipment

Amount of f-gases in annually installed equipment and amount held in containers is used as activity data for emission estimation from stocks. It is assumed that 5% from total stocks is emitted during equipment operations annually according to IPCC GPG 2000.[43]

For 2007-2008 emission estimation data of year 2006 was used as no response was received on sent questionnaires

The equation for portable fire extinguishing equipment from IPCC 1996:

$$E_{stocks} = HFC_{charged} \times x$$

where:
E_{stocks} – Emissions of f-gases from fire extinguishing equipment (t)
$HFC_{charged}$ – amount of f-gases filled in equipment (t)
x – losses during operation period (%)

4.6.2.7.3 HFC-227ea from disposal of fire extinguishing equipment

In year 2006 one enterprise reported the amount of HFC-227ea disposed. It is assumed that only 5% is emitted from the disposal as in 2006 new national regulation for the operation with f-gases and for the dangerous waste treatment was adopted.

Equation from IPCC 1996 for disposal emissions:

$$E_{disposal} = HFC_{disposed} \times Q$$

where:
$E_{disposal}$ – amount of emissions from system disposal (t)
$HFC_{disposed}$ – amount of f-gases collected and disposed (t)
Q – losses during the collection of f-gases (%)

4.6.2.7.4 Potential HFC-227ea emissions from fire extinguishing equipment

Potential HFC-227ea emissions from fire extinguishing equipment was estimated taking into account actual emissions from fire extinguishing equipment and assuming 5% leakage factor for containers filled with HFC-227ea (x in following equation).

Equation for potential HFC-227ea emission from fire extinguishing equipment estimation:

$$P_{EHFC} = E_{stocks} + HFC_{containers} \times x$$

where:
P_{EHFCs} – total potential emissions of HFC-227ea from fire extinguishing equipment (t)
E_{stocks} – Emissions of f-gases from fire extinguishing equipment (t)
$HFC_{containers}$ – amount of f-gases held in containers (t)
x – losses during operation period (%)

3.3.2.9 4.6.2.8 Emissions from Metered Dose Inhalers (CRF 2.F.4)

During the project within preparation of the report “SF_6, HFC and PFC emission inventory in Latvia 1995-2003” 4 Latvia’s enterprise producing household and professional cleaning agents and disinfectants were questioned. The enterprises stated that in the aerosols production f-gases are not used in Latvia. It means that all aerosols used in Latvia are imported. As it is stated in IPCC GPG 2000 it is very difficult to collect the data of imported aerosols as it is necessary to divide HFCs containing aerosols from others.[44] It is almost impossible to question all household and industrial aerosols importers in Latvia. Central Custom Service only register all imported aerosols with one custom code not dividing them by type or by substances containing. Also since Latvia is in Schengen zone only imported amount from Third Countries is registered.

[43] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.117
[44] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.87

So only the emissions used in medicine for asthmatics are estimated and reported under this sector. During the project for the preparation of the report “SF_6, HFC and PFC emission inventory in Latvia 1995-2003” amount of inhalers contained HFC–134a were clarified as well as average amount of HFC-134a filled in one inhaler divided by the type of medicine. All the inhalers are imported as no inhalers for asthmatics are produced in Latvia.

For year 1998-2006 data of imported inhalers reported by importers of medical preparations was used as activity data. For years 2007-2008 data of imported inhalers obtained by State Agency of Medicine of Latvia was used. All importers of the medical preparations have to report the imported and sold amount of medicines so these data are very precise.

It is possible to estimate total amount of HFC-134a used in Latvia in particular year as metered dose inhaler if imported amount of inhalers containing HFC-134a is known as well as average amount of HFC-134a filled in each type of inhalers is known.

Equation for total amount HFC-134a used as medical preparation:

$$HFC_{sold} = \sum MDI_{sold} \times HFC_{filled}$$

where:
HFC_{sold} – total amount of HFC sold/imported in country (t)
MDI_{sold} – amount of sold/imported particular type of metered dose inhalers containing f-gases (pieces)
HFC_{filled} – amount of HFCs filled in particular type of inhaler (t)

According to IPCC 1996 50% leakage from metered dose inhalers sold in particular year and 50% from inhalers sold in year before particular year is assumed.[45]

Equation from IPCC 1996 for metered dose inhalers emissions:

$$E_{HFCs} = HFC_{sold} \times x_t + HFC_{sold} \times x_{t-1}$$

where:
E_{HFCs} – total emissions of HFC-134a from metered dose inhalers (t)
HFC_{sold} – total amount of HFC sold/imported in country (t)
x_t – leakage from inhaler in year t (%)
x_{t-1} – leakage from inhaler in year t-1 (%)

4.6.2.8.1 Potential HFC-134a emissions from metered dose inhalers

Potential emissions of metered dose inhalers use was estimated from the amount of HFCs imported to Latvia in particular year within inhalers.

It is assumed that 100% HFC-134a filled in inhalers imported in country in particular year is emitted to air.

Equation from IPCC 1996 for metered dose inhalers emissions:

$$P_{EHFCs} = HFC_{sold}$$

where:
P_{EHFCs} – total potential emissions of HFC-134a from metered dose inhalers (t)
HFC_{sold} – total amount of HFC sold/imported in country (t)

4.6.2.9 SF_6 emission from electrical equipment (CRF 2.F.8)

There is only one enterprise where huge amount of SF_6 is used in commutation and control installations. Installations are not produced in Latvia and the old equipment without any fill of the SF_6 was dismantled at the beginning of nineties. Only starting 1992 new equipment was gradually installed. Since 1992, it consumes small amount of SF_6 in electrical equipment, but since 1995 used amount is increasing.

[45] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.61

4.6.2.9.1 SF_6 emissions from charging of electrical equipment

Enterprise only imports equipment already filled with SF_6. There is no manufacturing of the electric equipment containing SF_6 within country.

The amount of SF6 in newly installed equipment is used as activity data for emission estimation and 2% leakage factor from IPCC GPG 2000 for operations was used.[46]

Equation from IPCC 1996 for charging emissions estimation:

$$E_{charged} = HFC_{charged} \times k$$

where:
$E_{charged}$ – amount of emissions from installation of electrical equipment (t)
$HFC_{charged}$ – amount of f-gases charged in particular year (t);
k – charging losses (%).

4.6.2.9.2 SF_6 emissions from stocks of electrical equipment

According to IPCC GPG 2000 2% leakage factor for operations was used.[47]

Equation from IPCC GPG 2000 for stocks emissions:

$$E_{stocks} = HFC_{stocks} \times x$$

where:
E_{stocks} – emissions of SF_6 from electrical equipment (t)
HFC_{stocks} – amount of SF_6 held in stocks in equipment (t)
x – losses during operation period (%)

4.6.2.9.3 SF_6 from disposal of electrical equipment

Lifetime of used equipment is 30 years and there is no equipment that lifetime would be approached. So no equipment was dismantled.

Still for years 2003-2008 enterprise report the emergency leakage from electrical equipment. As amount of SF_6 emergency leaked is known it is reported as 100% emissions and is reported as disposal emissions.

4.6.2.9.4 Potential SF_6 emissions from electrical equipment

The potential SF_6 emissions from electrical equipment is estimated by taking into account actual emissions from charging and stocks and assuming 5% leakage factor for containers filled with SF_6 and held as reserve (x in following equation).

Equation for potential SF_6 emissions from electrical equipment estimation:

$$P_{EHFC} = E_{charged} + E_{stocks} + HFC_{containers} \times x$$

where:
P_{EHFCs} – total potential emissions of HFC-227ea from fire extinguishing equipment (t)
$E_{charged}$ – amount of emissions from installation of electrical equipment (t)
E_{stocks} – emissions of SF_6 from electrical equipment (t)
$HFC_{containers}$ – amount of SF_6 held in containers (t)
x – losses from containers during operation period (%)

4.6.2.10 Emissions from shoes production (CRF 2.F.9)

Other source of HFC-134a emissions is production and use of shoes whose soles are filled with HFC-134a. Manufacturing of shoes (shoe soles) containing HFC-134a occurred in 1995-2002. After 2002 only HFC-134a emissions from stocks and disposal is emitted.

[46] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.57
[47] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.57

Activity data for emission estimation is taken from CSB databases about produced, imported and exported amount of shoes.

Assumptions and default leakage factors from Danish project "The Greenhouse gases: HFCs, PFCs and SF6" since no researches of f-gases use in Latvia is done. [48]

4.6.2.10.1 HFC-134a emissions from manufacturing of shoes containing f-gases

The manufacturing of shoe soles containing HFC-134a occurred in Latvia in 1995-2002. The amount of produced shoes (shoe sole) is obtained by CSB. According to Danish project it is assumed that 5% of all shoes with plastic, rubber and leather soles contain polyether containing 8 g of HFC-134a per shoe.

Total amount of HFC-134a used for manufacturing of shoe soles can be estimated by using equation:

$$HFC_{filled} = Sh_{produced} \times d_{HFC} \times HFC_{sh}$$

where:
HFC_{filled} – total amount of HFC-134a used in manufacturing of shoes (t)
$Sh_{produced}$ – amount of produced shoes (pieces)
d_{HFC} – amount of shoes containing HFC-134a (%)
HFC_{sh} – amount of HFC-134a filled in one shoe sole (t)

Danish default leakage factor for HFC-134a emitted during manufacturing is 15%.

The HFC-134a emissions from manufacturing of shoe soles can be estimated by using equation:

$$E_{production} = HFC_{filled} \times k$$

where:
$E_{production}$ – HFC-134a emissions from shoe manufacturing (t)
HFC_{filled} – total amount of HFC used in manufacturing of shoes (t)
k – leakage from shoes production (%)

4.6.2.10.2 HFC-134a emissions from stocks in shoes containing f-gases

In whole period 1995-2008 amount of imported shoes in Latvia is increasing.

The amount of imported and exported as well as produced shoes (shoe sole) is obtained by CSB. According to Danish project it is assumed that 5% of all shoes with plastic, rubber and leather soles contain polyether containing 8 g of HFC-134a per shoe.

Total amount of HFC-134a held in stocks in shoe soles can be estimated by using equation:

$$HFC_{stocks} = HFC_{filled} + HFC_{imported} - HFC_{exported}$$

where:
HFC_{stocks} – total amount of HFC-134 held in stocks in shoe soles and used in country in particular year (t)
HFC_{filled} – total amount of HFC-134a filled in shoes during manufacture of shoes (t)
$HFC_{imported}$ – total amount of HFC-134a imported in shoes (t)
$HFC_{exported}$ – total amount of HFC-134a exported in shoes (t)

Danish default leakage factor for HFC-134a emitted during lifetime is 4.5% or 1.5% annually.

The HFC-134a emissions from stocks held in shoe soles can be estimated by using equation:

$$E_{stocks} = HFC_{stocks} \times x$$

where:
E_{stocks} – HFC-134a emissions from shoe lifetime (t)
HFC_{stocks} – total amount of HFC-134 held in stocks in shoe soles and used in country in particular year (t)
x – leakage from using of shoes during its lifetime (%)

[48] http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publications/2009/978-87-7052-962-4/html/bred01_eng.htm

4.6.2.10.3 HFC-134a emissions from disposal of shoes containing f-gases

According to Danish project average lifetime of shoes is 3 years. It means that form HFC-134a emission estimation the amount of HFC-134a remained in shoe soles after their lifetime in $year^{-3}$ has to ne known. As CSB doesn't have so old data the approximate amount back to year 1992 is extrapolated taken into account the amount curve in 1995-2000.

Total amount of HFC-134a left in shoe soles after their lifetime ends can be estimated by using equation:

$$HFC_{remained} = HFC_{stocks} \times (1 - x)$$

where:
$HFC_{remained}$ – total amount of HFC-134a remained in shoes after their lifetime in $year^{-3}$ (t)
(1-x) – percentage amount of HFC left in shoes (%)

For the emission estimation from disposal default Danish emission factor 71.5% is used as some part of shoes are destroyed in incineration and thereby not released as emissions.

The HFC-134a emissions from disposal of shoe soles can be estimated by using equation:

$$E_{disposal} = HFC_{remained} \times Q$$

where:
$E_{disposal}$ – total amount of HFC-134a emissions from disposal
$HFC_{remained}$ – total amount of HFC-134a remained in shoes after their lifetime in $year^{-3}$ (t)
Q – leakage from disposal (%)

4.6.2.10.4 Potential HFC-134a emissions from shoes containing f-gases

Potential emission from HFC-134a held in stocks – amount produced in country and imported within shoe soles, was estimated by taking into account assumption that 100% from amount of HFC-134a remained in shoe soles after the lifetime of shoes (Q in following equation).

As well as it was assumed annual 5% leakage from HFC-134a held as stocks in shoes soles during operation of the shoes (x in following equation)

$$E_{PHFC} = E_{production} + HFC_{stocks} \times x + HFC_{remained} \times Q$$

where:
E_{PHFC} – potential HFC-134a emissions from shoes (shoes soles) (t)
$E_{production}$ – HFC-134a emissions from shoe manufacturing (t)
HFC_{stocks} – total amount of HFC-134 held in stocks in shoe soles and used in country in particular year (t)
x – leakage from using of shoes during its lifetime (%)
$HFC_{remained}$ – total amount of HFC-134a remained in shoes after their lifetime in $year^{-3}$ (t)
Q – leakage from disposal (%)

4.6.3 Uncertainties and time series consistency

Activity data for HFCs is obtained from reports of enterprises operated with f-gases therefore it is assumed that uncertainty could arise to 75%. Also uncertainty of emission factors for HFCs is assumed as 75%.

More precise is SF_6 use data in electrical equipment category – one facility used this gas and reported it to LEGMC. Estimation of emissions also is quite precise. Uncertainty of activity data for SF_6 from electrical equipment is assumed as ±2%, but EF uncertainty is 10%.

Time series of the estimated emissions are consistent because the same methodology, emission factors and data sources are used for sectors for all years in time series.

HFCs and SF_6 emissions in 1990-1994 are reported as "not estimated" due to lack of official statistical data. Particular HFCs emissions are not estimated for other years also due to lack of activity data.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 4.6.2 were double-checked and large fluctuations were explained.

Table 4.6.2 IEF changes higher than 10% for 2.F sector

Source	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
2.F.1.2	HFC-125	%	2005	15.000000	2006	8.000000	-46.67%	Till 2005 default higher EFs were used taken from IPCC GPG and IPCC 1996. "Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents" was adopted in the second part of 2005 as is regulating the activities with f-gases and set out limitations for these activities. Therefore used EFs were decreased. Detailed information is given in particular chapters of NIR.
2.F.1.2	HFC-134a	%	2005	15.000000	2006	8.000000	-46.67%	
2.F.1.2	HFC-143a	%	2005	15.000000	2006	8.000000	-46.67%	
2.F.1.2	HFC-32	%	2005	15.000000	2006	8.000000	-46.67%	
2.F.1.2	HFC-125	%	2005	3.500000	2006	1.500000	-57.14%	
2.F.1.2	HFC-134a	%	2005	3.500000	2006	1.500000	-57.14%	
2.F.1.2	HFC-143a	%	2005	3.500000	2006	1.500000	-57.14%	
2.F.1.2	HFC-32	%	2005	3.500000	2006	1.500000	-57.14%	
2.F.1.3	HFC-125	%	2005	15.000000	2006	8.000000	-46.67%	
2.F.1.3	HFC-134a	%	2005	15.000000	2006	8.000000	-46.67%	
2.F.1.3	HFC-125	%	2005	3.500000	2006	1.500000	-57.14%	
2.F.1.3	HFC-134a	%	2005	3.500000	2006	1.500000	-57.14%	

4.6.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

4.6.5 Source-specific recalculations

Data of whole sector was recalculated after the in-country review 2009. The emission estimation methodology was completely changed and now IPCC 1996 and IPCC GHG 2000 are fully used for emission estimation.

Statistical data of SF_6 from electrical equipment was changed because in last year enterprise made mistake in their reported data. Statistical data of domestic refrigeration equipment was changed due to available information of freezing equipment in households and available information of refrigerators and freezers percentage in households. Statistical data of trucks with manufactured year >1995 was changed according to information published by responsible information. Statistical information of produced, exported and imported shoes was changed as previously amount of pairs were reported by mistake.

Estimated emissions for Refrigeration and Air Conditioning Equipment changed due to change of leakage factors for different years in 2.F.1 Domestic and Commercial refrigeration sector. Disposal emission estimation of HFC-134a from shoes was done for the first time

Potential emissions for all sub-sectors were estimated where possible – for first time potential emissions were estimated for the 2.F.2 Foam Blowing sector.

4.6.6 Source-specific planned improvements

No improvements will be possible to do this sector for nearest submissions.

4.7 POTENTIAL EMISSIONS OF HALOCARBONS AND SF_6 (CRF 2.F)

4.7.1 Source category description

Potential emissions are calculated only for 2004 – 2008 due to lack of historical statistical information regarding import and export of F – gases (Figure 4.7.1). Data for estimations are obtained from Division of Chemicals Registry of LEGMC where enterprises have to report data of F – gases with whom enterprises operated in current year.

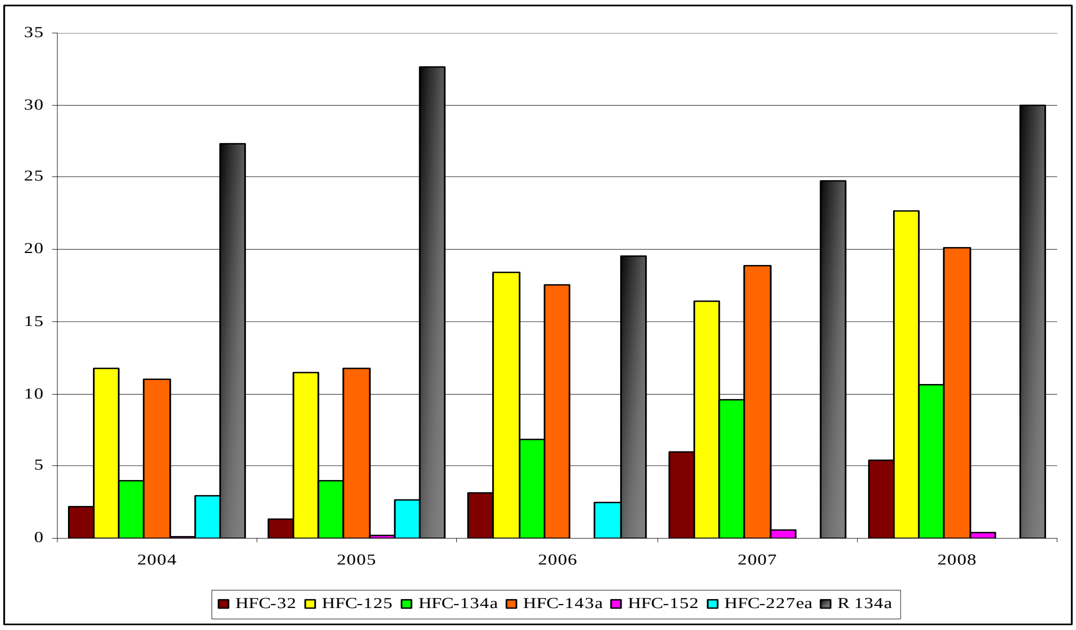

Figure 4.7.1 Total potential emissions of F-gases in 2004 – 2008 (tonnes)

4.7.2 Methodological issues

Methods

It was assumed that 100% of f-gases imported in products and in bulk 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 substances amount of chemicals were estimated and reported as potential emissions.

Table 4.7.1 Imported amounts of chemicals or chemical products 2004–2008 (tonnes)

Chemicals, products	2004	2005	2006	2007	2008
R 407c	6.1	5.9	10.5		11
R 410a	1.5	0	1.36		5.69
R 507	1.5	0.7			0.76
R 404a	19.8	21.9	33.8		38
R 134a	27.3	32.6	19.5	24.75	30
DBS 9802 PUR B1				0.139	
FIXER MEGAPRO				1.425	
FIXER				1.076	
DBS 9802 PUR B1				0.239	
FIXER MEGAPRO				8.548	
FIXER				1.972	
FIXER				1.076	
FIXER				1.972	
Tecfoam SP-27-B5/365/245	2.9	2.7	2.5		
SUVA MP 39	0.5	1.2			
SUVA HP 80	0	0.1	0.27		
SUVA HP 81	0	0.4			

Table 4.7.2 Percentage amounts of chemicals in imported products 2004 – 2008 (%)

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%
DBS 9802 PUR B1			6.25%			
FIXER MEGAPRO			13%			
FIXER			13%			
DBS 9802 PUR B1			6.25%			
FIXER MEGAPRO			13%			
FIXER			13%			
FIXER			10.5%			
FIXER			10.5%			

4.7.3 Uncertainties and time series consistency

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

Potential HFCs emissions are not estimated for time period 1990-2004 due to lack of official statistical data. Also potential SF_6 emissions are not estimated for all years also due to lack of imported SF_6 data.

4.7.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia’s national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

4.7.5 Source-specific recalculations

Data for 2005-2007 was recalculated due to update statistical information and activity data clarification.

4.7.6 Source-specific planned improvements

No improvements will be possible to do this sector for nearest submissions.

CHAPTER 5: SOLVENT AND OTHER PRODUCT USE (CRF 3)

5.1 Overview of sector

5.1.1 Quantitative overview

This sector contains CO_2 and N_2O and NMVOC emissions from sectors:

- Paint Application (CRF 3.A);
- Degreasing and dry cleaning (CRF 3.B);
- Chemical Products, Manufacture and Processing (CRF 3.C);
- Other (CRF 3.D):
    - Use of N_2O for Anaesthesia (CRF 3.D.1);
    - Printing Industry (CRF 3.D.5);
    - Glue Manufacturing (CRF 3.D.5);
    - Domestic solvent use (CRF 3.D.5).

Emissions from Fire Extinguishers, N_2O emissions from Aerosol Cans and Other Use of N_2O sector are not estimated due to unavailability of statistical data.

The NMVOC emissions from productions of pharmaceuticals are included under Chemical Products, Manufacture and Processing for 1997-2008. The NMVOC emissions are based on emission data from the enterprises and collected by REB and LEGMC.

Table 5.1.1 Reported emissions from Industrial Processes in Latvia in 2008

Source	Emissions		
	CO_2	N_2O	NMVOC
Paint Application (CRF 3.A)	√		√
Degreasing and dry cleaning (CRF 3.B)	√	NO	√
Chemical Products, Manufacture and Processing (CRF 3.C)	√		√
Other (CRF 3.D)			
Use of N_2O for Anaesthesia (CRF 3.D.1)		√	
Fire Extinguishers (CRF 3.D.2)		NE	
N2O emissions from Aerosol Cans (CRF 3.D.3)		NE	
Other Use of N2O (CRF 3.D.4)		NE	
Printing Industry (CRF 3.D.5)	√	NO	√
Glue Manufacturing (CRF 3.D.5)	√	NO	√
Domestic solvent use (CRF 3.D.5)	√	NO	√

5.1.2 Description

Solvent and Other Product Use sector GHG emissions contribute only about 0.45% of the total GHG emissions in Latvia. (Table 5.1.2)

Table 5.1.2 Emissions from Solvent and Other Product use in 1990–2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CO_2	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	51.10	52.26	51.03	49.06
N2O						0.01	0.02	0.02	0.01	0.01	0.01	0.03	0.02	0.02	0.02	0.01	0.04	0.01	0.01
NMVOC	17.85	16.50	15.75	14.80	14.51	13.35	13.83	14.01	14.27	14.50	14.77	15.03	15.28	15.49	15.83	16.44	16.83	16.43	15.77

Emissions in the Solvent and Other Product Use sector are linked with the economic situation of the country. Decrease in emissions occurred between 1990 and 1995, when industry was going through a crisis. (Figure 5.1.1)

It has to be noted that in the beginning of 90ties during the countrywide change in government system and national economy statistics was not well kept. Therefore there is lack of statistical data.

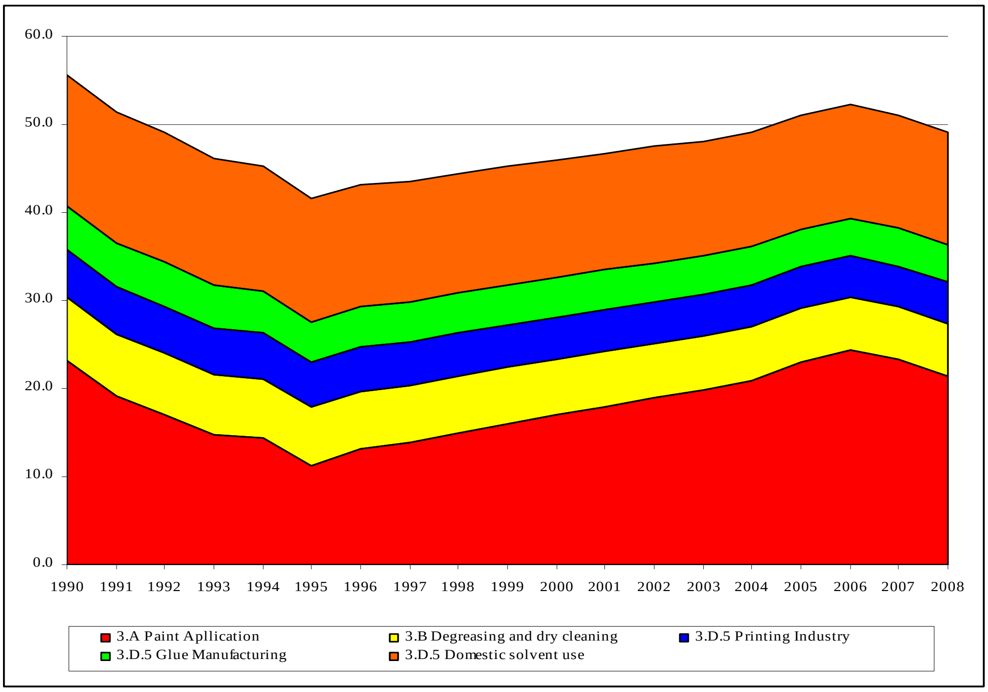

Figure 5.1.1 CO_2 emission from Solvent and Other Product Use in 1990-2008 (Gg)

Since year 1995 CO_2 emissions from sector have increased by 17.83% in 1995-2008, NMVOC emissions have increased by 18.17% in 1995-2008. It is explained with improving of population's living standards and increasing demand for higher comfort that influenced increasing of construction and repairing activities.

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.

Solvent and Other Product Use generates 29.22% from all NMVOC emissions (Figure 5.1.2).

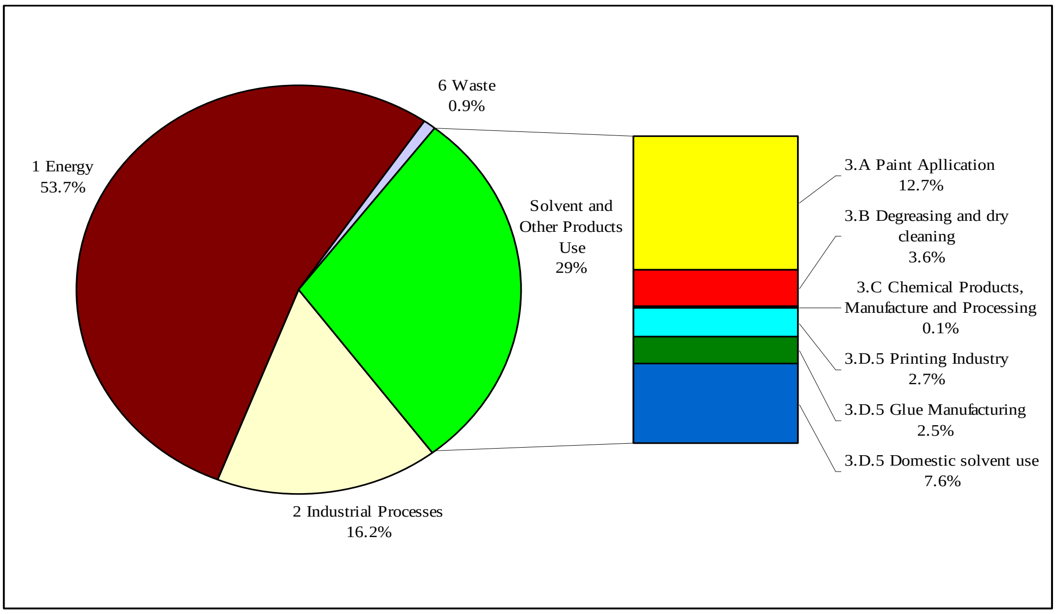

Figure 5.1.2 NMVOC emissions distribution in main sectors for 2008

Economy has been growing and total paint use has grown from 10.32 to 21.55 thousand liters from 1996–2006 therefore GHG emissions in the solvent and other product use sector increased (32.7%). Then in 2006-2008 emissions from paint application has decreased. (Figure 5.1.3) The reason is that is coming in force first period of determinate solvent concentrations into paint products, what is written, in Latvian legislation. Therefore national emission factor is lower and emissions decrease.

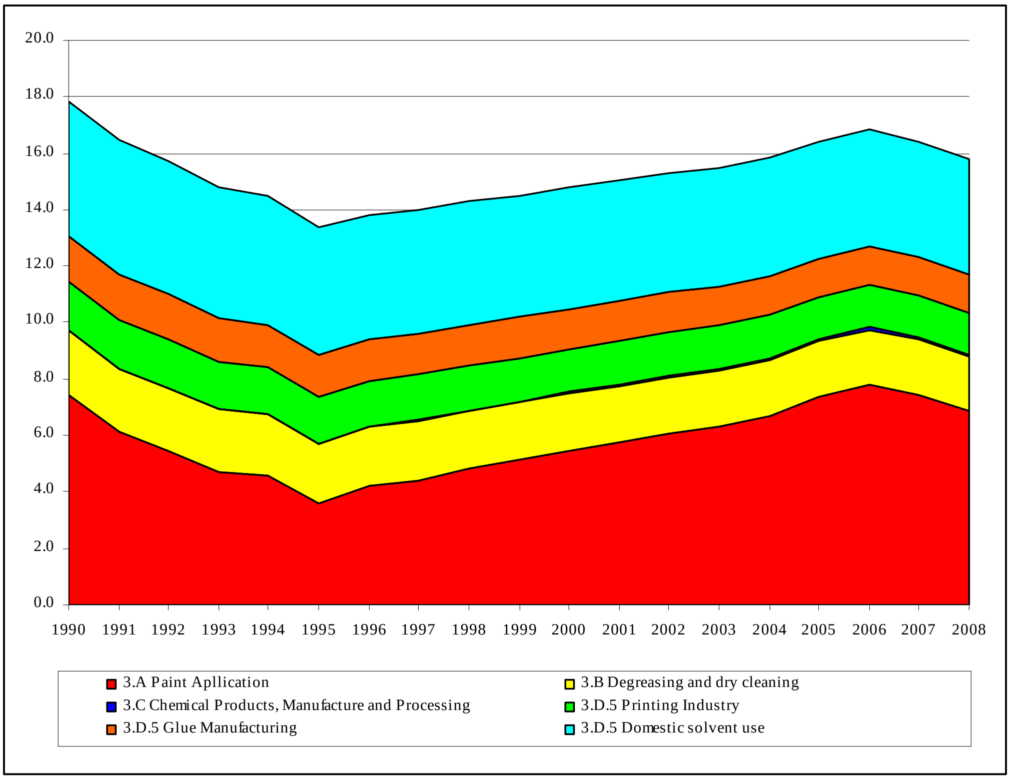

Figure 5.1.3 NMVOC emission from Solvent and Other Product Use in 1990-2008 (Gg)

Key categories

There are no key categories in the sector.

5.2 Paint Application (CRF 3.A)

5.2.1 Source category description

CO_2 and NMVOC emissions are estimated for the sector.

Paint application is the most important category of Solvent and Other Products Use sector with 43.55% of total this sector's NMVOC emissions and 12.73% of total Latvia's NMVOC emissions and 43.7% of total sector's CO_2 emissions and 0.18% from Latvia's total CO_2 emissions. The importance of the category has tendency to increase due to increased paint demand. (Table 5.2.1)

Table 5.2.1 Emissions from Paint Application use in 1990–2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Share of total 2008 emissions
NMVOC	7.45	6.13	5.45	4.72	4.60	3.60	4.21	4.43	4.80	5.13	5.45	5.76	6.06	6.33	6.70	7.38	7.80	7.46	6.87	12.73%
CO_2	23.23	19.13	16.99	14.73	14.36	11.23	13.12	13.81	14.98	16.01	17.01	17.96	18.92	19.76	20.90	23.03	24.33	23.27	21.43	0.18%

NMVOC emissions from paint use have increased by 116.72% in 1995-2006 due to development of construction and repairing activities as well as improving of population's living standards.

5.2.2 Methodological issues

Methods

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:

$$E_{CO_2} = 0.85 \times (44/12) \times NMVOC$$

where:
E_{CO2} – CO_2 emissions (Gg)
0.85 – carbon content conversion factor
NMVOC – NMVOC emissions (Gg)

NMVOC emissions are estimated using simpler default methodology:

$$E_{NMVOC} = AD_{pa\,\mathrm{int}} \times EF_{NMVOC}$$

where:
E_{NMVOC} – NMVOC emissions (Gg)
AD_{paint} – paint application consumption divided in water-based and solvent-based consumption (Gg)
EF_{NMVOC} – water-based or solvent-based paint’s NMVOC emission factor (Gg/Gg)

Emission factors

Emission factors used for paint application calculations are shown in Table 5.2.2. Starting from 2007 is coming in force a first period of determinate solvent concentrations into paint products. Therefore in 2007 is changing national emission factors.

Table 5.2.2 Emission factors for paint application

Paint type	Emission factor, t/t
Paint on water base*	0.2
Paint on water base**	0.15
Paint on solvent base*	0.5
Paint on solvent base**	0.4

* Emission factor from 1990 – 2007 first six months
** Emission factor starting from middle of 2007

Activity data

In Latvia NMVOC emissions for the Paint Application sub-sector was calculated, making use of activity data available from expert made judgement on realized paint amount and national emission factor. Expert divided realized paint amount in two parts – paint on water base and paint on solvent base. (Table 5.2.3)

Table 5.2.3 Activity data for paint application estimation in 1990-2008 (1000litres)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*	2007**	2008
Population (thsnd.)	2.67	2.66	2.64	2.59	2.54	2.5	2.47	2.44	2.42	2.4	2.38	2.36	2.35	2.33	2.32	2.31	2.305	2.29		2.28
paint consumption per capita (l)	6	5	4.5	4	4	3.2	3.8	4.1	4.5	4.9	5.3	5.7	6.1	6.5	7	8	8.5	9		10
total consumption (1000litres)	17.6	14.63	13.07	11.4	11.18	8.8	10.32	11	12	12.94	13.88	14.8	15.77	16.66	17.86	20.33	21.55	11.33	11.34	25.08

Activity data estimation for year 2007 was divided in two parts as in the middle of 2007 Cabinet of Ministers regulation No. 231 “Regulations Regarding the Limitation of Emissions of Volatile Organic Compounds from Certain Products” came into force. These Regulations prescribe the procedures by which the emission of volatile organic compounds from paints, varnishes and vehicle refinishing products is limited.

5.2.3 Uncertainties and time series consistency

Activity data and emission factor for paint application were taken from expert research and uncertainty for these activity data and emission factors is assumed rather high at 50%.

Time series of the estimated emissions are consistent because the same methodology, emission factors and data sources are used for sectors for all years in time series. No emissions are reported as “not estimated”.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. All issues given below in Table 5.2.4 were double-checked and large fluctuations were explained.

Table 5.2.4 IEF changes higher than 10% for 3.A sector

Source	GHG	Unit	Year	First Year	Year	Second Year	Difference	Comments
3.A Paint Application	CO2	t/t	2007	1.035133	2008	0.857994	-0.17113	In NMVOC estimation national emission factor is used - emission factor in latest years decreased due to decrease of solvent based paint and increase of water based paint consumption

5.2.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia’s national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

5.2.5 Source-specific recalculations

No recalculations were done for current submission.

5.2.6 Source-specific planned improvements

It is necessary to review activity data for the sector as current only paint application data determined in national expert research is used.

All the enterprises that operate with chemical substances need to report their activities to Chemical Substances Register. So it is possible to obtain the data of used paint, degreasing and other chemical data consumption.

It needs to be studied if data from national statistics about imported, exported and sold in-country amounts could be used in NMVOC and CO2 emissions estimations. Also it has to be reviewed could the data from State Custom Service could be used. This data still possible will be available only till the end of 2007 as Latvia became the part of Schengen zone in 21st December 2007.

5.3 Degreasing and Dry Cleaning, Printing Industry, Glues Manufacturing and Domestic solvents Use (CRF 3.B, 3.D.5)

5.3.1 Source category description

CO_2 and NMVOC emissions from these four sectors are estimated using one methodology taking into account number of population amount.

NMVOC emissions from this sector are only 3.58% from total national NMVOC emissions and 5.1% of Solvent and Other Product Use sector NMVOC emissions. CO_2 emissions are 0.05% from total country's CO_2 emissions and 12.3% of Solvent and Other Product Use sector's CO2 emissions. (Table 5.3.1)

Table 5.3.1 Emissions from Degreasing and Dry Cleaning in 1990–2008 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Share of total 2008 emissions
NMVOC																				
3.B Degreasing and dry cleaning	2.27	2.26	2.25	2.20	2.16	2.12	2.10	2.08	2.06	2.04	2.02	2.01	1.99	1.98	1.97	1.96	1.95	1.94	1.93	3.58%
3.D.5 Printing Industry	1.73	1.73	1.72	1.68	1.65	1.62	1.60	1.59	1.57	1.56	1.54	1.54	1.52	1.52	1.51	1.50	1.49	1.48	1.48	2.73%
3.D.5 Glue Manufacturing	1.60	1.59	1.59	1.55	1.52	1.50	1.48	1.47	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.38	1.37	1.36	2.52%
3.D.5 Domestic solvent use	4.80	4.78	4.76	4.65	4.57	4.50	4.44	4.40	4.35	4.32	4.28	4.26	4.22	4.20	4.17	4.15	4.13	4.11	4.09	7.57%
CO_2																				
3.B Degreasing and dry cleaning	7.08	7.05	7.01	6.85	6.74	6.63	6.55	6.48	6.42	6.36	6.30	6.27	6.22	6.18	6.15	6.12	6.09	6.05	6.02	0.05%
3.D.5 Printing Industry	5.41	5.39	5.36	5.24	5.15	5.07	5.01	4.96	4.91	4.86	4.82	4.79	4.76	4.73	4.70	4.68	4.65	4.63	4.61	0.04%
3.D.5 Glue Manufacturing	4.99	4.98	4.95	4.84	4.76	4.68	4.62	4.57	4.53	4.49	4.45	4.43	4.39	4.36	4.34	4.32	4.30	4.27	4.25	0.04%
3.D.5 Domestic solvent use	14.98	14.93	14.84	14.52	14.26	14.04	13.86	13.72	13.59	13.46	13.34	13.28	13.17	13.09	13.02	12.95	12.89	12.81	12.75	0.11%

Emissions are decreasing steadily since 1990. NMVOC emissions are estimated taking into account number of population so the NMVOC emissions reflect total decreasing of Latvia's population

5.3.2 Methodological issues

Methods

The IPCC 1996 allows using two basic approaches for CO_2 emission estimation depending on the available activity data and emission factors: Production-based approach and Consumption-based approach. According EMEP/CORINAIR CO_2 emissions can occur during production, during actual use and during disposal.

CO_2 emissions were estimated based on EMEP/CORINAIR methodology using following equation:

$$E_{CO_2} = 0.85 \times (44/12) \times NMVOC$$

where:
E_{CO2} – CO_2 emissions
0.85 is carbon content conversion factor
NMVOC – NMVOC emissions

Simpler Tier1 methodology using number of population as activity data and using per capita emission factor is used in NMVOC emission estimation.

$$E = I \times EF_{NMVOC}$$

where
E – NMVOC emissions (Gg)
I – number of inhabitants
EF_{NMVOC} – per capita factor (Gg/cap/year)

Emission factors

EMEP/CORINAIR Guidelines provide per capita emission factors if there are no locally available data and emission factors to apply detailed methodology. Emission factor used for other sub-sectors calculations are shown in Table 5.3.2.

Table 5.3.2 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

Activity data

The activity data is taken from Statistical yearbook 2001 prepared by CSB for years 1990-2000; from Statistical yearbook 2007 prepared by CSB for 2000-2007 and online database of CSB for 2008. CSB updates number of population almost every year so historical statistical yearbooks were used to divert necessity to recalculate the emissions every year. (Table 5.3.2)

Table 5.3.3 Activity data for degreasing emissions estimation in 1990-2008

	Population
1990	2667887
1991	2657709
1992	2642355
1993	2584792
1994	2539812
1995	2499327
1996	2468148
1997	2443414
1998	2419195
1999	2397557
2000	2375339
2001	2364254
2002	2345768
2003	2331480
2004	2319203
2005	2306434
2006	2294590
2007	2281305
2008	2270894

5.3.3 Uncertainties and time series consistency

The uncertainty of the statistical data (the number of inhabitants) was assumed to be negligible (2%) compared to the other uncertainties because CSB data is used.

Time series of the estimated emissions are consistent because the same methodology, emission factors and data sources are used for sectors for all years in time series. No emissions are reported as “not estimated”.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues

5.3.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia’s national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

5.3.5 Source-specific recalculations

No recalculations were done for current submission.

5.3.6 Source-specific planned improvements

It is necessary to review activity data for the sector as current default simpler emission estimation methodology is used basing on the number of inhabitants.

All the enterprises that operate with chemical substances need to report their activities to Chemical Substances Register. So it is possible to obtain the data of used paint, degreasing and other chemical data consumption.

It needs to be studied if data from national statistics about imported, exported and sold in-country amounts could be used in NMVOC and CO_2 emissions estimations. Also it has to be reviewed could the data from State Custom Service could be used. This data still possible will be available only till the end of 2007 as Latvia became the part of Schengen zone in 21st December 2007.

5.4 Chemical Products, Manufacture and Processing (CRF 3.C)

5.4.1 Source category description

Only NMVOC emissions are reported from Chemical Products, Manufacture and Processing sector.
NMVOC emissions from the sector contribute only 0.0085% from total country’s NMVOC emissions and 0.29% from total sector’s NMVOC emission.

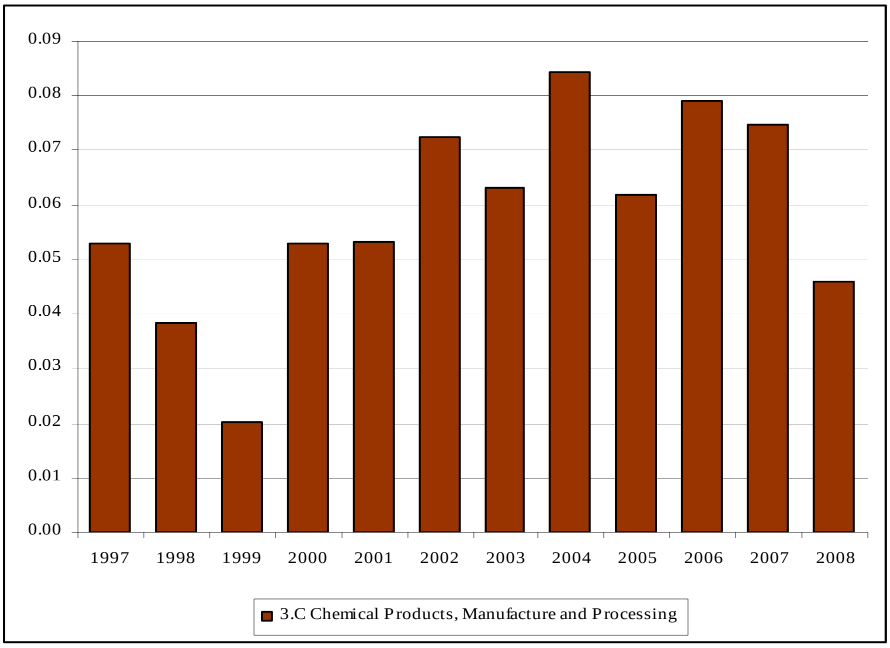

Figure 5.4.1 NMVOC emissions Chemical Products, Manufacture and Processing sector in 1997–2008 (Gg)

Clearly visible fluctuations of NMVOC emissions can be observed in the sector. Still as emissions are reported by pharmaceutical and perfumery production plants it is quite difficult to explain these fluctuations.

5.4.2 Methodological issues

The emissions from Chemical products, Manufacture and Processing come from database "2-Air" on production of pharmaceutical formulations and perfumery products. "2-Air"is the database where enterprises that do any pollution activity and have A, B or C category pollution permits report their emission data; it is approximately 3000 enterprises in total every year. From these approximately 3000 enterprises data from only the enterprises that product pharmaceutical formulations and perfumery products is used. For example in 2007 data from eight enterprises were collected.

5.5.3 Uncertainties and time series consistency

Time series of the estimated emissions are consistent because the same methodology, emission factors and data sources are used for sectors for all years in time series. As database "2-Air" was created only in 1997 therefore data from these enterprises are available only since 1997. Data for previous years are not available do the emissions also are not estimated. CO_2 emissions for whole time series are not estimated due to unavailability of activity data and emission factors.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

5.5.4 Source-specific QA/QC and verification

Enterprises that need to report their data to national database "2-Air" estimate their emissions by themselves using mass balance, measurements or emission factors methodology.

After the data is input in database environment inspectors from Regional Environmental Boards verify and approve input data.

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

5.5.5 Source-specific recalculations

Under category 3C for 1998 -2001 NMVOC emissions was corrected because of previously mistaken activity data input.

5.5.6 Source-specific planned improvements

Currently no future improvements are foreseen for this category.

5.5 Use of N_2O in Anaesthesia (CRF 3.D.1)

5.5.1 Source category description

N_2O emissions from N_2O used in anaesthesia activities are estimated taking into account amount of N_2O actually used in medicine sector.

N_2O emissions from anaesthesia are negligible and contribute only about 0.27% from total N_2O emissions (Figure 5.5.1).

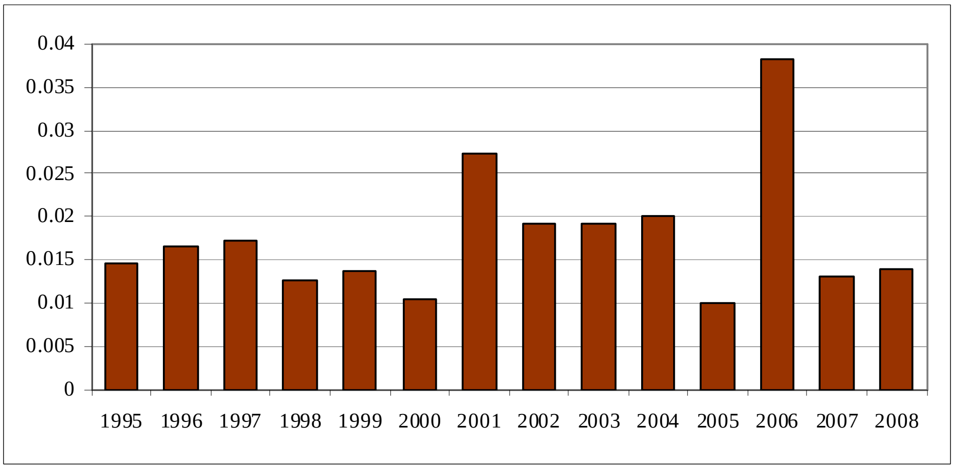

Figure 5.5.1 N_2O emissions from N_2O for anaesthesia 1995 – 2008 (Gg)

5.5.2 Methodological issues

It is assumed that 100% of N_2O used for anaesthesia needs is emitted to the air therefore activity data is equal to estimated emissions.

The data for the use of N_2O in anaesthesia are available since 1995. The activity data are taken from enterprises. Since 2007 activity data is taken from State Agency of Medicines of Latvia. The agency is obtaining information of used N_2O from all enterprises. Other sources of N_2O emissions are not estimated due to lack of activity data.

5.5.3 Uncertainties and time series consistency

Uncertainty of this sector can be assumed as rather low to 2% as bottom-up data reported from N_2O consumers and enterprises that import and/or realise this gas is used.

Time series of the estimated emissions are consistent because the same methodology, emission factors and data sources are used for sectors for all 1995-2008. N2O emissions for 1990-1994 are not estimated due to lack of activity data.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. There are no such issues.

5.5.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

Activity data reported to State Agency of Medicine by N_2O consumers of medicine sector is verified and checked by the agency.

All estimations of the emissions done in the LEGMC also are checked on the logical mistakes by checking the time series of the activity data, emission factors and emissions consistency to display all significant and illogic changes in the activity data and emissions.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes that are higher than 10% in time series are double-checked and reasonable explanation for IEF changes has to be found.

Each expert reviewer has to check and fill in QC form for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is sent to National Inventory Compiler and archived.

5.5.5 Source-specific recalculations

No recalculations were done for the sector.

5.5.6 Source-specific planned improvements

Currently no future improvements are foreseen for this category.

CHAPTER 6: AGRICULTURE (CRF 4)

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.

The emissions are reported in CRF tables 4.A, 4.B (a), 4.B (b) and 4D. CO_2 emissions from agricultural soils are included in the Land use, Land-use change and Forestry (LULUCF) sector (Chapter 7) under Cropland and Grassland categories.

Rise isn't cultivated in Latvia and savannas don't exist therefore CRF Tables 4.C and 4E have not been completed. Field Burning of Agricultural Residues is taking place in Latvia on small scale, therefore it is assumed that emission is insignificant and wasn't calculated, and notation key "NA" is used. Emissions from previous grass burning are included under LULUCF sub sector Grassland.

6.1 OVERVIEW OF SECTOR

In 2008, the Agriculture sector contributes 17% from total national emissions and is the second largest source of GHG emissions in Latvia. The major part of the emission is related to livestock production, especially by the production of cattle. Given in CO_2 equivalents, the N_2O emission contributed with 64% of total GHG emission from the agricultural sector, but CH_4 contributed with the remaining 36% in 2008.

Total GHG emissions from agriculture have declined approximately 65% over the period of 1990 – 2008 (Table 6.1). The total N_2O emission from 1990-2008 has decreased by 62.4%, but CH_4 emissions by 69 %.

Table 6.1 Greenhouse gas emission in the agricultural sector in 1990 – 2008

	CH_4, Gg CO_2 eq.	N_2O, Gg CO_2 eq	Total, Gg CO_2 eq
1990	2427	3545	5973
1991	2315	3284	5599
1992	1890	2495	4385
1993	1173	1740	2914
1994	1002	1509	2511
1995	983	1135	2118
1996	930	1138	2068
1997	911	1144	2056
1998	842	1090	1932
1999	733	994	1727
2000	727	1018	1744
2001	766	1123	1889
2002	764	1099	1862
2003	745	1168	1913
2004	736	1155	1891
2005	757	1225	1982
2006	749	1263	2012
2007	781	1350	2132
2008	752	1333	2085

Some inter-annual variation between the years can be noticed from the time series (Figure 6.1). This is mainly caused by fluctuation in activity data between the years because of changes in animal numbers, for example, which is largely affected by economical situation in country as well as agricultural policy.

CH_4 and N_2O emissions from manure management are affected by the fluctuation in animal numbers and the proportion of manure managed in different manure management systems which vary depending on animal species.

N_2O emissions from agricultural soils generally are affected by the cultivation of organic soils; amount of synthetic fertilizers sold annually, animal numbers and crop yields of cultivated crops, which may have large variation between the years.

Figure 6.1 show the distribution of GHG emission across the main agricultural sources.

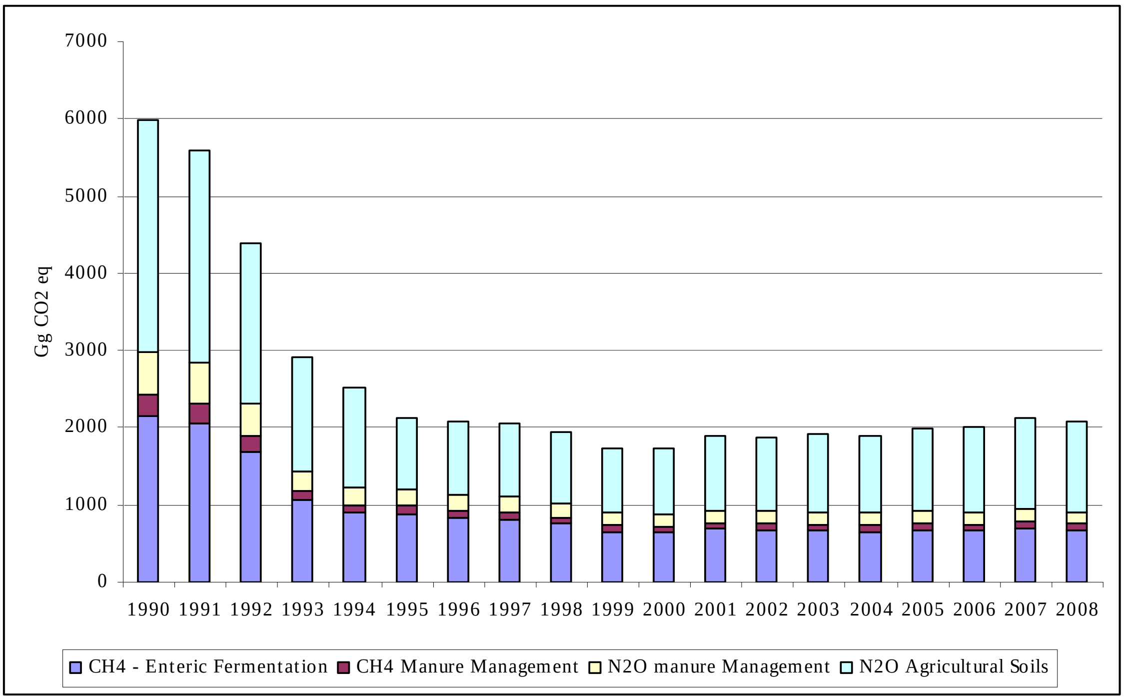

Figure 6.1 Trend in agricultural emissions in 1990 – 2008 (Gg CO_2 eq)

Since the previous reporting, there have been some changes for all time series.

The calculations of the emissions are based on methods described in Revised 1996 IPCC and the IPCC 2000.

Mainly activity data are used from Central Statistical Bureau (CSB). For submission 2010, additionally activity data for specific CH_4 emission factor calculation from Enteric Fermentation activities were discussed with specialists from Ministry of Agriculture and CSB.

Key categories

The key categories in agriculture in 2008 are summarized in Table 6.2. The Tier 1 quantitative method was used.

Table 6.2 Key categories in Agriculture in 2008 (excluding LULUCF)

IPCC source category	Gas	Identification criteria
4.A. Enteric fermentation	CH_4	L, T
4.B. Manure management	N_2O	L,T
4.D. Agricultural soils: direct emissions	N_2O	L
4.D. Agricultural soils: indirect emissions	N_2O	L, T
4D. Pasture range and paddock	N_2O	L, T

6.2 ENTERIC FERMENTATION (CRF 4.A)

6.2.1 Source category description

Livestock are produced throughout the world and are a significant source of global methane (CH_4) emissions. The amount of enteric methane emitted is driven primarily by the number of animals, the type of digestive system, and the type and amount of feed consumed. Cattle and sheep are the largest sources of enteric methane emissions[49].

The emission source covers domestic livestock (Table 6.3). Latvia reports emissions from cattle (including dairy cows), swine, horses, goats and sheep. Emissions from poultry have not been estimated.

Table 6.3 Reported emissions under the subcategory Enteric Fermentation

CRF	Source	Emissions reported
4.A 1	Cattle Dairy Cattle Non-Dairy Cattle	CH_4
4.A 2	Buffalo	NO
4.A 3	Sheep	CH_4
4.A 4	Goats	CH_4
4.A 5	Camels and Llamas	NO
4.A 6	Horses	CH_4
4.A 7	Mules and Asses	NO
4.A 8	Swine	CH_4
4.A 9	Poultry	NE

In 2008, methane emissions from Enteric Fermentation of domestic livestock comprised 32.3% of total agricultural emission, expressed in CO_2 equivalents. CH_4 emissions were 32.03 Gg and decreased 67% since 1990 generally due to decreasing number of cattle (Figure 6.3).

For submission for dairy cattle and non dairy cattle methane emissions were recalculated as these categories contribute biggest part of emissions (Table 6.4).

Table 6.4 Methane emissions from Enteric Fermentation by animal type in 1990–2008 (Gg)

	DC	**NDC**	**Sh**	**G**	**H**	**Sw**	**P**	**Total, CH_4 Gg**	**Total, Gg CO_2 eq**
1990	51.07	47.19	1.32	0.03	0.56	2.10	NE	102.26	2147.55
1991	49.40	44.47	1.47	0.03	0.54	1.87	NE	97.78	2053.44
1992	42.77	34.56	1.32	0.03	0.50	1.30	NE	80.48	1690.00
1993	30.96	17.07	0.91	0.03	0.47	0.72	NE	50.16	1053.31
1994	28.10	12.48	0.69	0.04	0.48	0.75	NE	42.54	893.39
1995	26.75	12.79	0.58	0.04	0.49	0.83	NE	41.49	871.25
1996	25.68	12.21	0.44	0.04	0.46	0.69	NE	39.53	830.14
1997	26.31	11.17	0.33	0.04	0.41	0.65	NE	38.92	817.25
1998	24.58	10.02	0.23	0.05	0.40	0.63	NE	35.92	754.25
1999	20.90	8.98	0.22	0.04	0.34	0.61	NE	31.08	652.78
2000	21.17	8.47	0.23	0.05	0.36	0.59	NE	30.87	648.27
2001	22.01	9.19	0.23	0.06	0.36	0.64	NE	32.49	682.28
2002	21.36	9.55	0.26	0.07	0.34	0.68	NE	32.26	677.37
2003	20.05	10.07	0.31	0.08	0.27	0.67	NE	31.45	660.42
2004	20.13	9.65	0.31	0.07	0.28	0.65	NE	31.09	652.93
2005	20.35	10.44	0.33	0.07	0.25	0.64	NE	32.09	673.88
2006	20.28	10.18	0.33	0.07	0.25	0.63	NE	31.73	666.39
2007	20.41	11.43	0.43	0.07	0.23	0.62	NE	33.20	697.10
2008	19.67	10.95	0.54	0.06	0.24	0.58	NE	32.03	672.65
Share of total % of 2008	**61.41**	**34.19**	**1.69**	**0.19**	**0.75**	**1.81**			

[49] IPCC 2000, page 4.23.

DC=Dairy cows, NDC- Non-Dairy cattle, Sh=Sheep, G=Goats, H=Horses, Sw=Swine, P=Poultry, F=Fur animals, R=Reindeer, NE=Not estimated.

6.2.2 Methodological issues

Methods

Emissions from Enteric Fermentation of domestic livestock have been calculated by using the IPCC Tier 1 and Tier 2 methodologies presented in the Revised 1996 IPCC and the IPCC 2000.

CH_4 emissions from Enteric Fermentation for horses, swine and goats have been calculated with the IPCC Tier 1 method by multiplying the number of the animals in each category with the IPCC default emission factor of the respective animal category, IPCC 2000, equation 4.12:

$$CH_4(Gg / year) = EF(kg / animal / year) \bullet population /(10^6 kg / Gg)$$

The total emission is the sum of emissions from each category, IPCC 2000, equation 4.13:

$$CH_4 = \sum_i E_i$$

The contribution of emissions from horses, swine, sheep and goats to the total emissions from Enteric Fermentation is not significant (Table 6.4).

The Tier 2 method has been used for cattle as emissions from cattle make the biggest part of total agricultural sector CH_4 emissions. In the Tier 2 method the emissions have been calculated as in the Tier 1 method above, but the emission factors for dairy cattle and non-dairy cattle has been calculated according to Equation 4.14 in the IPCC 2000:

$$EF=(GE*Y_m* 365\ days/year)/(55.65\ MJ/kg\ CH_4),$$

where:
GE = Gross energy intake (MJ/animal/day)
Ym= Methane conversion rate, fraction of gross energy in feed converted to methane (IPCC default value 0.06 used)

The national values for gross energy intake (GE) of cattle have been used. The value of GE for Dairy cattle and Non-Dairy cattle has been calculated by using a slightly modified version of Equation 4.11 in the IPCC 2000:

$$GE = \{[NEm + NEa + NE_1 + NEp) /(NEma/DE)] + [(NEg) / (NEga / DE)]\} / (DE / 100)$$

where,
NE_m = Net energy required by the animal for maintenance, MJ/day
NE_a = Net energy for animal activity, MJ/day
NE_l = Net energy for lactation, MJ/day (dairy cattle)
NE_p = Net energy required for pregnancy, MJ/day (dairy cattle)
NE_g = Net energy needed for growth, MJ/day (non dairy cattle)

The equations for calculating NEm, NEa, NEl, NEp and NEg are:

$$NEm = Cfi * (Weight)^{0.75}$$

$$NEa = [Cap * tp/365 + Cao * (1-(tp/365)) * NEm$$

$$NEl = My/365 * (1.47 + 0.40 * Fat)$$

$$NEp = Cp * NEm \quad NEg = 4.18*\{0.0635*[0.891*(BW*0.96)*(478/(C*MW))]^{0.75} * (WG * 0.92)^{1.097}\}$$

$$NEma/DE = 1.123 - (4.092 * 10^{-3} * DE) + [1.126 * 10^{-5} * (DE)^2] - (25.4/DE)$$

$$NEga/DE = 1.164 - (5.160 * 10^{-3} * DE) + (1.308 * 10^{-5} * (DE)^2) - (37.4/DE)$$

where,
Cfi = Coefficient, the IPCC default value 0.335 for dairy cattle and the IPCC default value 0.322 for non-dairy cattle used;
Weight – dairy cattle (assumed according to available national information - average 550 kg); non- dairy cattle (assumed according to available national information - average 500 kg);
tp = Length of pasture season, 185 days non- dairy cattle, 145 days for dairy cattle,;
Cap = Coefficient for pasture, the IPCC default value 0.17 used;
Cao = Coefficient for stall, the IPCC default value 0.00 used;
My = The amount of milk produced per year, kg a^{-1}/cow, Table 6.5;
Fat = Fat content of milk (%), Table 6.5;
Cp = Pregnancy coefficient, the IPCC default value 0.10 was used;
C = Coefficient related to growth for non- dairy cattle - 1.2 and for dairy cattle- 0.8 was used;
MW = Mature weight, (see IPCC 2000, p. 4.12);
WG = Average weight gain, (IPCC 2000, page 4.12) (kg/day), 0.25 kg for dairy cattle and for non- dairy cattle – 0.5 kg were used;
DE = Digestible energy (IPCC 2000, page 4.13), the proportion of feed energy (%) - 60% for dairy cattle and non- dairy cattle were used.

Table 6.5 Average milk yield per cow (kg/head/year) and Fat content, %

	Average milk yield (kg/head/year) according to information from CSB	Fat content, %
1990	9.42	3.5*
1991	8.78	3.5*
1992	7.65	3.5*
1993	7.51	3.5*
1994	8.01	3.5*
1995	8.42	3.5*
1996	8.87	3.5*
1997	9.82	4.09
1998	10.23	4.06
1999	10.28	4.00
2000	10.68	4.08
2001	11.11	4.08
2002	10.84	4.08
2003	11.67	4.11
2004	11.65	4.17
2005	11.96	4.25
2006	12.31	4.26
2007	12.70	4.31

*Fat content for 1990 - 1997 - expert judgment. Since 1997 - Central Statistical Bureau data

Emission factors and other parameters

To calculate CH_4 emissions from Enteric Fermentation the default emission factors for sheep, goats, horses and swine were used (Table 6.6).

Table 6.6 Default CH_4 emission factors from Enteric Fermentation

Types of animals	EF (kg/head/year)
Sheep	8
Goats	5
Horses	18
Swine	1.5

For submission 2010, only for dairy cattle and non dairy cattle separate emission factors (Table 6.7) have been calculated. For cattle, the gross energy intake (GE) has been calculated by using the IPCC method. The calculation is based on the development of animal weight milk production, fat content and etc.

Table 6.7 Calculated CH_4 emission factors for dairy cattle and non-dairy cattle from Enteric Fermentation, (kg/head/year)

	Dairy cattle	Non-Dairy cattle
1990	95.46	52.2
1991	93.02	
1992	88.72	
1993	88.19	
1994	90.09	
1995	91.65	
1996	93.37	
1997	100.05	
1998	101.58	
1999	101.46	
2000	103.54	
2001	105.31	
2002	104.20	
2003	107.80	
2004	108.09	
2005	109.88	
2006	111.42	
2007	113.40	
2008	115.42	

Activity data

The number of cattle, sheep, horses, swine and goats were obtained from the Statistical yearbooks of Latvia (Table 6.8)[2].

Table 6.8 Number of livestock for 1990 -2008 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	311.9	239.1	86.3	7.4	26.8	500.7	3700
1995	291.9	245.1	72.1	8.9	27.2	552.8	4198
1996	275	234	55.5	8.4	25.8	459.6	3790.7
1997	263	214	41	9	23	430	3551
1998	242	192	29	10.5	22	421	3209
1999	206	172	27	8.1	19	405	3237
2000	204.5	162.2	28.6	10.4	19.9	393.5	3104.6
2001	209	176	29	11.5	20	429	3621
2002	205	183	32	13	19	453	3882
2003	186	193	39	15	15	444.4	4003
2004	186.2	184.9	38.6	14.7	15.5	435.7	4049.5
2005	185.2	200	41.6	14.9	13.9	427.9	4092.3

	Dairy cattle	Non - Dairy cattle	Sheep	Goats	Horses	Swine	Poultry
2006	182	195	41	14	14	417	4488
2007	180	219	54	13	13	414	4757
2008	170.4	209.8	67.1	12.9	13.1	383.7	4620.5

The source of data on the number of livestock (till the end of 2007) is sample survey of agricultural farms. The sample for 2008 covers a total of 5 thsd farms selected by economic size and specialisation.[50]

Latvian livestock industry has been influenced by historical events and the changing world economic situation. Particularly significant changes in the livestock industry began in 1992 after the collapse of the Soviet Union and the restoration of Latvian independence. Since the Soviet Union had a planned economy, when Latvia was composed, most of the output of livestock products was carried out in other Soviet republics. Most farms which were a big dairy cows, fattening cattle, pig and poultry farms, went into liquidation. Many industrial companies stopped their activities, the purchasing power of people fell, fell for dairy products, meat and meat products, eggs exports to Russia and other CIS countries, but Russia's vast economic crisis, it would stop altogether. Livestock products export to Western reorientation caused difficulties in the European markets were saturated and the Latvian products did not meet the national requirements.

All the above conditions affect the Latvian farmers were forced to reduce the milk, meat and egg production levels, and reduce and eliminate the herds. Consequently, livestock numbers declined most rapidly in 1990. - 1994 in all sectors, except for goat farming, goat rearing, in Latvian was not particularly widespread. Starting with 1995 dairy cow numbers continued to decline, but not as fast as the farm begins to develop herds of cows and is disposed with low productivity. Beef cattle numbers continue to decline until 2001, which is due to the fact that the Latvian mostly subsistence farmers developed in the beef cattle breeding don’t occupied, but they held from 1 to 2 dairy cows. Even with the sheep at the farm liquidation of the Soviet system was engaged at the level of subsistence farms. Pig industry declined rapidly until 1996, but starting in 1997 the reduction is no longer as sharp as it had developed the farm, which the tumor and a small number of pigs had survived some big (pig complexes) holdings, which were eliminated after 1990. In the case of stud-farms - after 1990 because of all the above-mentioned social and economic changes stud-farms eliminating, the horses were sold, but continued to work only the strongest stud-farms. Poultry industry is related to the reduction of large poultry farms dissolution in 1990. - 1993.

Starting with 2002 the number of animals has stabilized, but with 2004, according to Latvian accession to the European Union, the increase in the number of animals is seen for beef cattle, sheep and goat industries. The livestock sector has contributed to the development of European Union agricultural subsidies and public sectors.

In 2008, there has been a reduction in dairy cows, compared with 2007, by 5.5%, which was due to the low procurement prices of milk, and pig production has seen a reduction in the number of animals compared to the year 2007 with the year 2008 by 7%, which is associated with very high feed prices.

6.2.3 Uncertainties and time series consistency

For estimating uncertainty for this category was used following assumptions:

- CSB assessed that for number of livestock uncertainty could be 2-3%. In the calculations is used 2%.

[50] CSB. Agricultural farms of Latvia 2008 (2009).

- Emission factors estimated using the Tier 1 method may be uncertain to ±30% or ±50%[51]. Emission factor estimates using the Tier 2 method are likely to be in the order of ± 20% [52]. The overall uncertainty of 20% was assumed as biggest part of emissions consists from cattle.

6.2.4 Source-specific QA/QC and verification

General (Tier 1) Quality Control (QC) procedures applied to the category Enteric Fermentation based on the IPCC GPG (IPCC 2000, Table 8.1, p. 8.8-8.9). These procedures are implemented every year during the agricultural inventory. If errors or inconsistencies are found they are documented and corrected. The QC checklist is used during the inventory.

Tier 2 QC for emission factors:

The agricultural inventory has been reviewed several times by the UNFCCC Expert Review Teams, and improvements to the inventory have been made according to the suggestions for submission 2010. Country – specific factors were calculated for dairy cattle and non dairy cattle. A difference between country specific emission factors and default factors is occurred. The changes are documented and explained in above chapters.

No specific verification process has been implemented for the agricultural inventory yet, but it is planed for future.

6.2.5. Source-specific recalculations

CH_4 emissions were recalculated for dairy cattle and non dairy cattle using Tier 2 method to assessing specific emission factor (Table 6.9, Figure 6.2).

Table 6.9 CH_4 emissions from Enteric Fermentation in 1990-2007 (Gg)

	CH_4 Enteric Fermentation - Dairy cattle (the 2009 submission)	CH_4 Enteric Fermentation - Dairy cattle (the 2010 submission)	Increase of CH_4 emissions, %	CH_4 Enteric Fermentation - Non-Dairy cattle (the 2009 submission)	CH_4 Enteric Fermentation - Non-Dairy cattle (the 2010 submission)	Decrease of CH_4 emissions, %
1990	43.34	51.07	15.14	50.62	47.19	-7.27
1991	43.01	49.40	12.93	47.71	44.47	-7.28
1992	39.04	42.77	8.71	37.07	34.56	-7.27
1993	28.43	30.96	8.16	18.31	17.07	-7.27
1994	25.26	28.10	10.11	13.39	12.48	-7.28
1995	23.64	26.75	11.64	13.73	12.79	-7.31
1996	22.28	25.68	13.23	13.10	12.21	-7.25
1997	21.30	26.31	19.06	11.98	11.17	-7.24
1998	19.60	24.58	20.27	10.75	10.02	-7.26
1999	16.69	20.90	20.15	9.63	8.98	-7.26
2000	16.56	21.17	21.79	9.08	8.47	-7.24
2001	16.93	22.01	23.08	9.86	9.19	-7.32
2002	16.61	21.36	22.24	10.25	9.55	-7.30
2003	15.07	20.05	24.84	10.81	10.07	-7.30
2004	15.08	20.13	25.07	10.35	9.65	-7.23
2005	15.00	20.35	26.29	11.20	10.44	-7.28
2006	14.74	20.28	27.31	10.92	10.18	-7.28
2007	14.58	20.41	28.57	12.26	11.43	-7.24

[51] IPCC GPG 2000, p. 4.27
[52] IPCC GPG 2000, p. 4.28

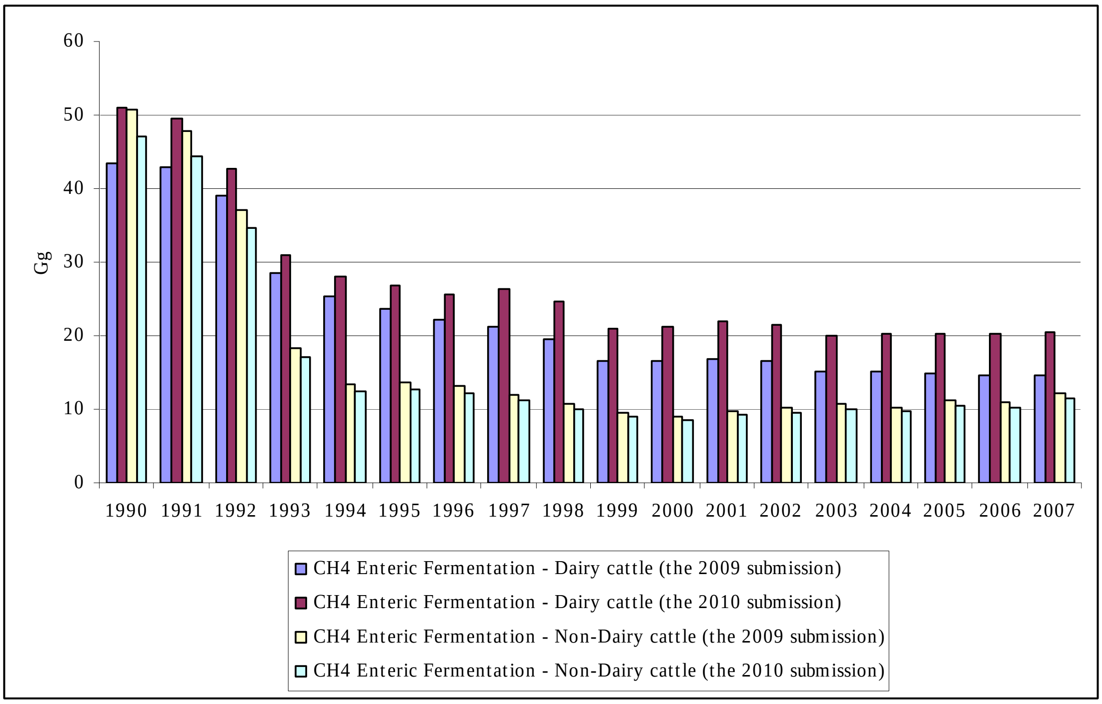

Figure 6.2 CH_4 emissions from Enteric Fermentation in 1990-2007, Gg

6.2.6. Source-specific planned improvements

In the next inventory specific methane emission factor for subcategory non-dairy cattle (bovine animals – ages between 1 and 2 years, calves – less than 1 year old, mature females, matures males) are planned to elaborate.

6.3 MANURE MANAGEMENT (CRF 4.B)

6.3.1 Source category description

Total emissions from Manure Management of domestic livestock consisted approximately 11.2% of total agricultural emissions (expressed in CO_2 equivalents) in 2008. Methane emissions from Manure Management were 3.79 Gg and nitrous oxide emissions 0.50 Gg. Nitrous oxide emissions from manure management were about 7.4% and methane emissions about 3.8% of total agricultural emissions in 2008. 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 (Table 6.10).

Table 6.10 Reported emissions under the subcategory Manure Management

CRF	Source	Emissions reported
4.B 1	Cattle Dairy Cattle Non-Dairy Cattle	CH_4, N_2O
4.B 2	Buffalo	NO
4.B 3	Sheep	CH_4, N_2O
4.B 4	Goats	CH_4, N_2O
4.B 5	Camels and Llamas	NO
4.B 6	Horses	CH_4, N_2O
4.B 7	Mules and Asses	NO
4.B 8	Swine	CH_4, N_2O
4.B 9	Poultry	CH_4, N_2O
4.B 11	Anaerobic Lagoons	NO
4.B 12	Liquid Systems	N_2O
4.B 13	Solid Storage and Dry Lot	N_2O
4.B 14	Other AWMS	N_2O

Production of nitrous oxide during storage and treatment of animal wastes can occur via combined nitrification-denitrification of nitrogen contained in the wastes.[53] Nitrous oxide emissions from manure management have decreased by 71.9%, but Methane emissions by 71.5% over the time period 1990-2008 (Figure 6.3 and Tables 6.11; 6.12). The fluctuation in the emissions is related the changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of animal waste management systems (AWMS).

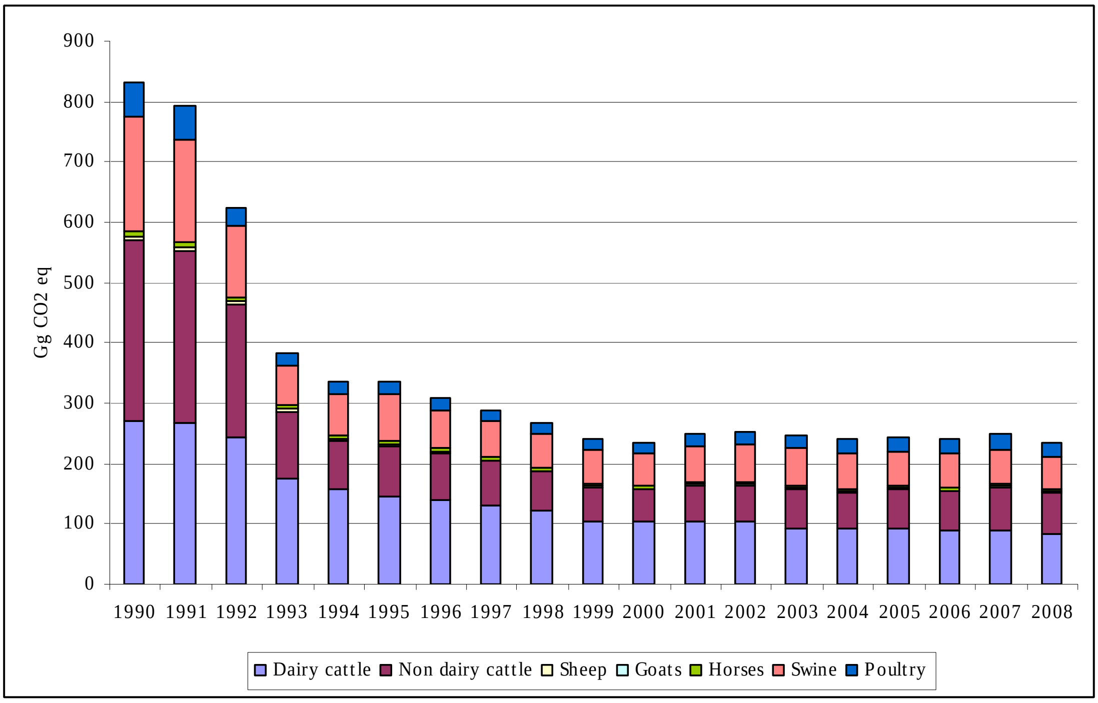

Figure 6.3 Total emissions of Manure Management by animal type in 1990–2008 Gg CO_2 eq.

Table 6.11 N_2O emissions from Manure Management in 1990-2008 by animal type*

	Dairy cattle	Non-Dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total, Gg	Total Gg CO_2 eq
1990	0.650	0.729	0.018	0.001	0.022	0.238	0.123	1.78	551.63
1991	0.645	0.687	0.020	0.001	0.021	0.212	0.123	1.71	529.74
1992	0.585	0.534	0.018	0.001	0.020	0.147	0.065	1.37	424.49
1993	0.426	0.264	0.012	0.001	0.019	0.082	0.049	0.85	264.19
1994	0.379	0.193	0.009	0.001	0.019	0.085	0.044	0.73	226.22
1995	0.354	0.198	0.008	0.001	0.019	0.094	0.050	0.72	224.43
1996	0.334	0.189	0.006	0.001	0.018	0.078	0.045	0.67	208.00
1997	0.319	0.172	0.004	0.001	0.016	0.073	0.042	0.63	194.96
1998	0.294	0.155	0.003	0.001	0.016	0.072	0.038	0.58	179.25
1999	0.250	0.139	0.003	0.001	0.014	0.069	0.038	0.51	159.15
2000	0.248	0.131	0.003	0.001	0.014	0.067	0.037	0.50	155.37
2001	0.254	0.142	0.003	0.001	0.014	0.073	0.043	0.53	164.36
2002	0.249	0.148	0.003	0.001	0.014	0.077	0.046	0.54	166.76
2003	0.226	0.156	0.004	0.002	0.011	0.075	0.048	0.52	161.51
2004	0.222	0.145	0.004	0.002	0.011	0.074	0.048	0.51	156.69
2005	0.221	0.157	0.004	0.002	0.010	0.073	0.049	0.51	159.41
2006	0.217	0.153	0.004	0.001	0.010	0.070	0.055	0.51	157.86
2007	0.214	0.171	0.006	0.001	0.009	0.069	0.058	0.53	163.99
2008	0.198	0.164	0.007	0.001	0.009	0.064	0.057	0.50	154.92
Share of total % of 2008	39.57	32.80	1.42	0.27	1.82	12.81	11.31		

***emissions from pasture not included, they are reported under 4.D Agricultural soils**

53 Jun et al., 2002

Table 6.12 CH_4 emissions from Manure Management in 1990-2008 by animal type

	Dairy cattle	Non dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total	Total Gg CO_2 eq
1990	3.210	3.616	0.031	0.001	0.043	5.604	0.805	13.310	279.518
1991	3.186	3.408	0.035	0.001	0.042	4.988	0.811	12.470	261.880
1992	2.892	2.648	0.031	0.001	0.039	3.468	0.424	9.503	199.572
1993	2.106	1.308	0.022	0.001	0.036	1.928	0.322	5.722	120.171
1994	1.871	0.956	0.016	0.001	0.038	2.003	0.289	5.174	108.654
1995	1.751	0.980	0.014	0.001	0.038	2.211	0.327	5.323	111.789
1996	1.650	0.936	0.011	0.001	0.036	1.838	0.296	4.768	100.123
1997	1.578	0.856	0.008	0.001	0.032	1.720	0.277	4.472	93.913
1998	1.452	0.768	0.006	0.001	0.031	1.684	0.250	4.192	88.029
1999	1.236	0.688	0.005	0.001	0.027	1.620	0.252	3.829	80.413
2000	1.227	0.649	0.005	0.001	0.028	1.574	0.242	3.727	78.257
2001	1.254	0.704	0.006	0.001	0.028	1.716	0.282	3.991	83.818
2002	1.230	0.732	0.006	0.002	0.027	1.812	0.303	4.111	86.332
2003	1.116	0.772	0.007	0.002	0.021	1.778	0.312	4.008	84.169
2004	1.117	0.740	0.007	0.002	0.022	1.743	0.316	3.946	82.871
2005	1.111	0.800	0.008	0.002	0.019	1.712	0.319	3.971	83.394
2006	1.092	0.780	0.008	0.002	0.020	1.668	0.350	3.919	82.302
2007	1.080	0.876	0.010	0.002	0.018	1.656	0.371	4.013	84.274
2008	1.022	0.839	0.013	0.002	0.018	1.535	0.360	3.789	79.578
Share of total % of 2008	**26.98**	**22.15**	**0.34**	**0.04**	**0.48**	**40.50**	**9.51**		

6.3.2 Methodological issues

Methods

Methane emissions from Manure Management are calculated multiplying the number of the animals in each category with the emission factor for each category.[54]

Nitrous oxide emissions from Manure Management have been calculated by using IPCC 2000 methodology equation 4.18. The amount of nitrogen excreted annually per animal has been divided between different manure management systems and multiplied with the IPCC default emission factor for each manure management system.

The manure management systems reported in the inventory are liquid system, solid storage and dry lot, pasture range and paddock and other[55]. N excretion during the year per each animal type and the distribution of manure management systems are national calculated values.

For emission calculation was used IPCC Tool and then data was put in the CRF Reporter.

Emissions from pasture are calculated under manure management, but are reported under *pasture, range and paddock manure* in CRF 4.D.

Emission factors and other parameters

To calculate CH_4 emissions from Manure Management were used IPCC default emission factors (Table 6.13). Emission factors as for *cool* climate region were chosen because annual temperature in Latvia is 6.0 ºC (reference period 1971-2000).

Table 6.13 CH_4 emission factors from manure Management

Types of animals	EF (kg/head/year)
Dairy cattle	6
Other cattle	4

[54] IPCC GPG 2000, Equation. 4.15
[55] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006, Other systems - farms with smaller number of cows and cattle, manure is bedding manure and it is stored as solid manure. 3% and 2% respectively would be related to manure storage type “Other”.

Types of animals	EF (kg/head/year)
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 6.14).

Table 6.14 IPCC default emission factors for N_2O from Manure Management

Manure management system	Emission factor (kg N_2O – 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 6.8) and directly, statistical bulletins for each year. The distribution of different manure management systems used according to Research made by LSIAE (2005)[56] is shown in the Table 6.15 - 6.19.[57,58,59]

Forecast is that in the future not only pasture period of livestock could become longer, but possibly also percentage of liquid manure in manure management systems could increase.

Table 6.15 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 6.16 Distribution of different manure management systems for 2004 (%)

	Liquid system	Solid storage and dry lot	Pasture range and paddock	other
Dairy cattle	3.5	52.5	41	3
Non - Dairy cattle	2.1	49.3	46.6	2
Sheep		56.2	43.8	
Goats		56.2	43.8	
Horses		48	52.0	
Swine	46	51		3
Poultry	39	61		

Table 6.17 Distribution of different manure management systems for 2005 (%)

	Liquid system	Solid storage and dry lot	Pasture range and paddock	other
Dairy cattle	3.5	52.5	41	3
Non - Dairy cattle	2.2	49.2	46.6	2
Sheep		56.2	43.8	
Goats		56.2	43.8	
Horses		48	52.0	

[56] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006
[57] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006
[58] Melece L. Evaluation of Manure Management Systems for 1990 – 2003. 2005
[59] Research during the Project „CORINAIR – Institutional strengthening of National Air Emissions Inventories in Latvia”, R. Sudārs. Nitrogen Separation

	Liquid system	Solid storage and dry lot	Pasture range and paddock	other
Swine	47	50		3
Poultry	39	61		

Table 6.18 Distribution of different manure management systems for 2006 -2007 (%)

	Liquid system	Solid storage and dry lot	Pasture range and paddock	other
Dairy cattle	3.6	52.4	41	3
Non - Dairy cattle	2.2	49.2	46.6	2
Sheep		56.2	43.8	
Goats		56.2	43.8	
Horses		48	52.0	
Swine	47	50		3
Poultry	37	63		

Table 6.19 Distribution of different manure management systems for 2008 (%)

	Liquid system	Solid storage and dry lot	Pasture range and paddock	other
Dairy cattle	5	51	41	3
Non - Dairy cattle	2.3	49.1	46.6	2
Sheep		56.2	43.8	
Goats		56.2	43.8	
Horses		48	52.0	
Swine	47	50		3
Poultry	37	63		

Data about annual N excretion per animal (Table 6.20) obtained from Research made by LSIAE (2005).[60,61] 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 3).

As regards average N excretion for sheep and goats (Table 6.20) in Latvia there is very low level of produced nitrogen in difference from IPCC Default (16 kg/animal/yr)[62] nitrogen amounts because:

- dairy sheep are not bred in the country;
- basis of sheep nutrition is not that rich as sheep usually are not fed additionally;
- mainly local breed is used which is not very productive;
- in general sheep farming as a branch in Latvia is relatively weakly developed.

Table 6.20 Average N excretions per head of animal[63]

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

* Value of Nex for Goats is assumed as for sheep.

6.3.3 Uncertainties and time series consistency

For estimating uncertainty for this category was used following assumptions:

- CSB assessed that for number of livestock uncertainty could be 2-3%;

[60] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006
[61] Research during the Project „CORINAIR – Institutional strengthening of National Air Emissions Inventories in Latvia", R. Sudārs. Nitrogen Separation
[62] Revised 1996 IPCC, Table 4-20, page 4.99.
[63] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006

- 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.

6.3.4 Source-specific QA/QC and verification

General (Tier 1) Quality Control (QC) procedures applied to the category Manure management.

The QA/QC plan for the agricultural sector includes the QC measures based on the guidelines of the IPCC (IPCC 2000, Table 8.1). These activities are implemented every year in preparation process of agriculture inventory. If errors or inconsistencies are found they are documented and corrected. The QC checklist is used during the inventory.

Tier 2 QC for activity data: A checklist is used for ensuring consistency of the activity data in different sections of the agricultural inventory.

Tier 2 QC for emission factors: It will be checked annually if new data for updating emission factors has been published.

6.3.5 Source-specific recalculations

A small correction of AWMS for 2004-2007 for sheep, goats and horses were done due to previously incorrect value was used.

6.3.6 Source-specific planned improvements

Currently the Ministry of Agriculture (MoA) is working on a manure regulatory approval and the new rule making. The new rules will be based on "an overview of the development, regulation of manure and animal unit calculation, which was prepared for the State Ltd." Agrochemical Research Center. In the overview, Commission's recommended methodology, one of the agricultural producers of the animal manure, nitrogen, phosphorus and potassium intake calculation model is based on the following general principles:

Manure mass and excretion of N, P, K = quantity of feed consumed and the N, P, K the quantity of feed - forage dry matter and N, P, K consumption of animal weight gain, loss of output produced and shed, manure storage and grazing.

The calculations are made based on data for:

- Feed forage, its chemical composition;

- Animal productivity (weight gain, piglets);

- Used in bedding, and their chemical composition;

- Animal housing and manure storage types;

- Dry matter, nitrogen, phosphorus and potassium loss and storage shed.

Taking into account above mentioned information as well as recommendation of MoA in the GHG inventory N excretion and Animal Waste Management Systems will be revised according to the newest available information.

The general changes could be regarding N excretion for dairy cattle, pigs, sheep and goats.

No specific verification process has been implemented for the agricultural inventory yet, but it is planed for future.

6.4 AGRICULTURAL SOILS (CRF 4.D)

6.4.1 Source category description

This source category includes direct and indirect nitrous oxide emissions from Agricultural Soils (Table 6.21). 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.

Table 6.21 Reported emissions under the subcategory Agricultural Soils

CRF	Source	Emissions reported
4.D 1	Direct Soil Emissions	N_2O
4.D 2	Pasture, Range and Paddock Manure	N_2O
4.D 3	Indirect Emissions	N_2O
4.D 4	Other	NO

N_2O emissions from Agricultural Soils contribute 56.5 % of total agricultural emissions (expressed in CO_2 equivalents) in 2008. Nitrous oxide emissions from Agricultural Soils were 3.80 Gg in 2008. Emissions have decreased and fluctuated over the period 1990 – 2008 (Table 6.22 and Figure 6.3). 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 and cultivation of organic soils.

Table 6.22 Direct and indirect nitrous oxide emissions from agricultural soils by source category (Gg)

	SF	MS	N	C	MP	H	A	L	Total, Gg
1990	2.323	0.940	0.015	0.257	1.156	1.631	0.539	2.796	9.658
1991	1.987	0.897	0.014	0.220	1.116	1.633	0.496	2.521	8.885
1992	1.167	0.697	0.006	0.147	0.935	1.629	0.360	1.739	6.679
1993	0.702	0.434	0.003	0.134	0.574	1.630	0.221	1.063	4.762
1994	0.513	0.380	0.003	0.092	0.475	1.644	0.181	0.850	4.139
1995	0.203	0.384	0.003	0.071	0.461	1.022	0.152	0.640	2.937
1996	0.256	0.351	0.005	0.088	0.436	1.078	0.147	0.638	3.000
1997	0.343	0.329	0.006	0.090	0.408	1.073	0.147	0.667	3.063
1998	0.347	0.305	0.008	0.082	0.372	1.053	0.138	0.634	2.937
1999	0.336	0.274	0.002	0.071	0.323	0.980	0.125	0.581	2.693
2000	0.407	0.268	0.003	0.077	0.315	0.963	0.129	0.620	2.781
2001	0.559	0.286	0.003	0.073	0.329	0.954	0.148	0.741	3.092
2002	0.488	0.291	0.003	0.084	0.331	0.967	0.143	0.699	3.006
2003	0.661	0.284	0.003	0.085	0.318	0.937	0.155	0.803	3.247
2004	0.622	0.275	0.003	0.106	0.322	0.970	0.150	0.772	3.219
2005	0.723	0.278	0.002	0.123	0.331	0.974	0.161	0.846	3.439
2006	0.755	0.277	0.001	0.108	0.324	1.074	0.163	0.863	3.565
2007	0.815	0.286	0.002	0.151	0.340	1.143	0.172	0.917	3.826
2008	0.840	0.272	0.002	0.147	0.326	1.126	0.170	0.917	3.799
Share of total % in 2008	**22.106**	**7.163**	**0.052**	**3.859**	**8.582**	**29.636**	**4.470**	**24.132**	

SF=synthetic fertilisers, MS= manure applied to soils, MP=manure deposited on pastures, C=crop residues, N=N-fixation, H=cultivation of organic soils, A=atmospheric deposition, L=leaching and run-off

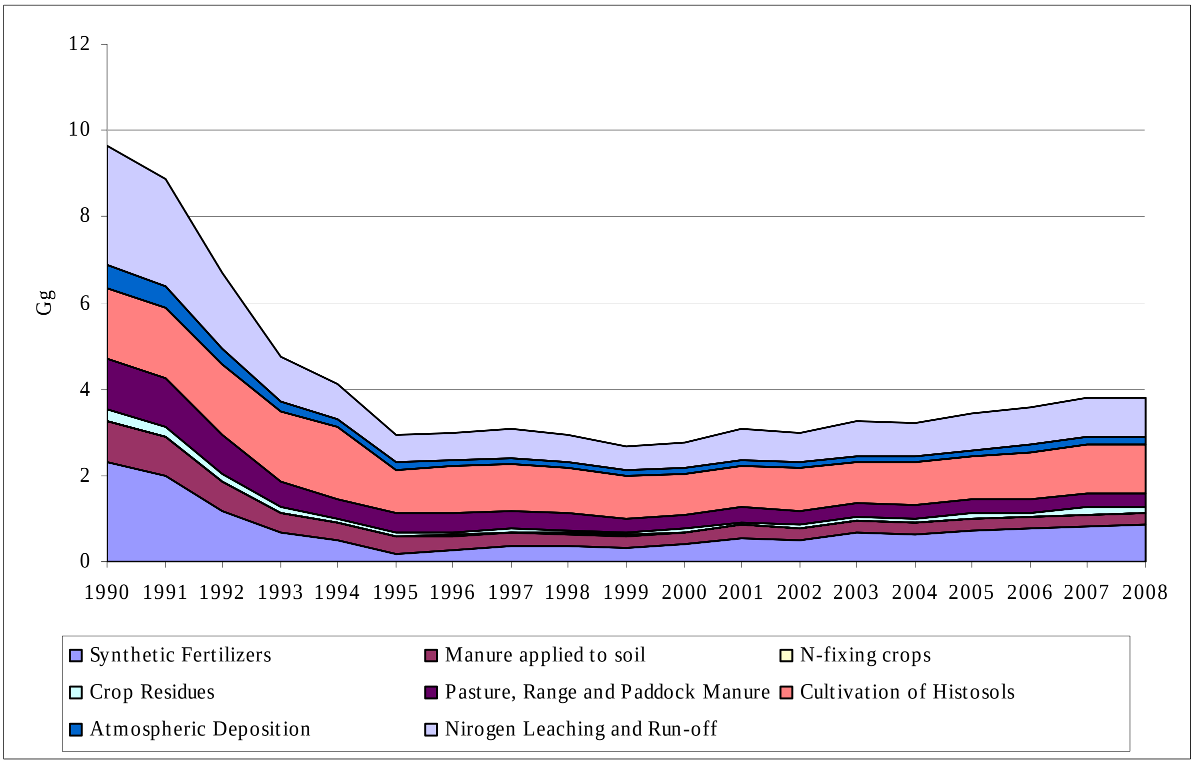

Figure 6.3 Direct and indirect N_2O emissions from Agricultural Soils by source category

6.4.2 Methodological issues

Methods

Nitrogen inputs to soils from all sources were calculated using IPCC Guidelines.

Direct N_2O emissions from agricultural soils are estimated as follows (IPCC 20000, 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-N * 44/28

Nitrogen input through application of mineral fertilizers

The method applied for calculation of emissions is IPCC 2000 Tier 1a, equation 4.22:

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

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 (Table 6.27)
$Frac_{GASF}$ Fraction of nitrogen lost through gaseous emissions of NH_3 and NOx (**0.1** kg NH_3-N +NOx-N/kg of synthetic fertiliser N applied, Revised 1996 IPCC, Table 4-19)

Nitrogen input through application of animal manure

For emission calculation is used equation from Revised 1996 IPCC:

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

Nex Amount of nitrogen excreted by the livestock (Table 6.20);
$Frac_{Fuel}$ Such activities not occurred ;
$Frac_{GRAZ}$ Fraction of livestock nitrogen excreted and deposited onto soil during grazing (national values – manure on pasture range and paddock divaided by total amount of manure);
$Frac_{GASM}$ Fraction of livestock nitrogen excretion that volatilises as NH_3 and NOx (**0.2** kg NH_3-N+NOx-N/kg, Revised 1996 IPCC, Table 4-19).

N fixed by Crops (F_{BN})

The method applied for calculation of emissions is IPCC 2000 Tier 1b, equation 4.26:

$$F_{BN} = \sum_i (Crop_{BF_i} \bullet (1 + Res_{BFi} / Crop_{BFi}) \bullet Frac_{DM} \bullet Frac_{NCRBFi}) \bullet EF \bullet 44/28$$

$Crop_{BFi}$ – seed yield of pulses (peas and beans) (Table 6.28);
$Res_{BFi}/Crop_{BFi}$ – Residue to crop product ratio (used average values 1.5 and 2.1 =**1.8** from Table 4.16, p.4.58, IPCC 2000);
$Frac_{DM}$ – Dry Matter Fraction (**0.87**, Table 4.16, p.4.58, IPCC 2000);
$Frac_{NCRBFi}$ – Nitrogen Fraction (**0.0142,** Table 4.16, p.4.58, IPCC 2000);
EF – emission factor (**0.0125** kg N_2O –N/kg N load).

Nitrogen input from crop residues

The method applied for calculation of emissions is IPCC 2000 Tier 1b, equation 4.29, modified:

$$F_{CR} = \sum_i [(Crop_{Oi} \bullet Res_{Oi} / Crop_{Oi} \bullet Frac_{DM} \bullet Frac_{NCROi}) \bullet (1 - Frac_r) + \sum_i [Crop_{BFj} \bullet Res_{BFj\bullet} / Crop_{BFj} \bullet Frac_{DM} \bullet Frac_{NCRBFj}) \bullet (1 - Frac_R)] \bullet EF \bullet 44/28$$

$Cropo_i$ – Crop production (crop type i) (Table 6.28);
$Crop_{BFj}$ - Crop production (each nitrogen-fixing crop type) (Table 6.28);
$Res_i/Crop_i$; $Res_{BFj}/ Crop_{BFj}$ - Residue to crop product ratio) (Table 6.26);
$Frac_{DM}$ – Dry Matter Fraction) (Table 6.26);
$Frac_{NCRBFj}$; $Frac_{NCRROi}$ – Nitrogen Fraction) (Table 6.26);
$Frac_R$ – crop biomass removed from field as product = **0.45** kg N/kg crop-N, Revised 1996 IPCC, Table 4-19);
EF – emission factor (**0.0125** kg N_2O –N/kg N load).

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

The IPCC 2000 defines F_{OS} as the area of organic soils cultivated annually. 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.

For assessing area of Histosols it was assumed that Histosols is 7% from cultivated utilized agricultural land (arable land, permanent crops and cultivated meadows and pastures) area according to national research[64]. Latvia is still using the former Soviet soil classification system to describe both soil texture and soil groups. To estimate cultivated meadows and pastures data from Central Statistical Bureau surveys was analysed and used. In the Table 6.23, % distribution for assessing cultivated meadows and pastures are shown.

Table.6.23 Proportion of cultivated meadows and pastures in the histosols for period 1990-2008

Years	%
1990-2002	18.6
2003	15.8
2004	13
2005	17.2
2006	17.2
2007-2008	15.8

For submission 2010, areas of cultivated Histosols were reassessed according to recommendations by ERT (2009) and are shown in the Table 6.24.

[64] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006

Table 6.24 Revised areas of Histosols

	Arable Land, thsd, ha	Permanent crops, thsd.ha	Cultivated meadows and pastures, thsd.ha	Total Cultivated area of Utilised agricultural land, thsd. ha	**Histosols, 7% from Cultivated Utilised Agricultural Land area, thsd.ha**
	1	*2*	*3*	*1+2+3 =4*	***7% of 4***
1990	1685.1	11.4	157.02	1853.53	129.75
1991	1687.4	11.6	156.87	1855.88	129.91
1992	1689.1	8.4	153.47	1850.95	129.57
1993	1694.9	8.4	149.43	1852.72	129.69
1994	1710.5	8.6	149.43	1868.54	130.80
1995	1002.3	10.6	148.89	1161.77	81.32
1996	1059.9	16.2	148.45	1224.55	85.72
1997	1078.6	15.1	126.09	1219.79	85.39
1998	1058.6	12.1	126.09	1196.79	83.78
1999	987.4	11.7	114.89	1113.99	77.98
2000	969.9	11.5	112.66	1094.06	76.58
2001	958.2	12.1	113.70	1084.00	75.88
2002	972.8	12.2	113.52	1098.52	76.90
2003	956.4	12.0	96.87	1065.27	74.57
2004	1008.6	12.4	80.72	1101.72	77.12
2005	1091.8	12.8	108.17	1212.77	84.89
2006	1205.1	13.2	109.53	1327.83	92.95
2007	1188.1	10	101.28	1299.38	90.96
2008	1169.9	7	102.40	1279.30	89.55

Additional information related assessing area of Histosols is presented in the Annex 3.3

Atmospheric Deposition (NH_3 and NOx)

Atmospheric deposition of nitrogen compounds such as nitrogen oxides (NO_x) and ammonium (NH_4) fertilises soils and surface waters that results in enhanced biogenic N_2O formation[65].

The default IPCC Tier1 method (eq. 4.31) is used to estimate emissions from the atmospheric deposition:

$$N_2O_{(G)} - N = [(N_{FERT} \bullet Frac_{GASF}) + (\sum_T (N_{(T)} \bullet Nex_{(T)}) \bullet Frac_{GASM})] \bullet EF_4$$

$N_2O_{(G)}$ – N_2O produced from atmospheric deposition of N, kg N/yr;
N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soil, kg N/yr (Table 6.27);
$\sum_T (N_{(T)} * Nex_{(T)})$ – total amount of animal manure nitrogen excreted in a country, kg/Nyr;
$Frac_{GASF}$ – fraction of synthetic N fertiliser volatilises as NH_3 and NOx, kg NH_3-N and NOx-N/kg of N input;
$Frac_{GASM}$ – fraction of animal manure N volatilises as NH_3 and NOx, kg NH_3-N and NOx-N/kg of N excreted;
EF_4 – emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, kg N_2O-N/kg NH_3-N and NOx-N emitted (Table 6.25).

Leaching/runoff of applied or deposited nitrogen

A large proportion of nitrogen is lost from agricultural soils through leaching and runoff. This nitrogen enters the groundwater, riparian areas and wetlands, rivers, and eventually the ocean, where it enhances biogenic production of N_2O[66].

The default IPCC Tier1 method (eq. 4.34) is used to estimate emissions from the leaching/runoff:

$$N_2O_{(L)} - N = [N_{FERT} + \sum_T (N_{(T)} \bullet Nex_{(T)})] \bullet Frac_{LEACH} \bullet EF_5$$

N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soil, kg N/yr;
$Frac_{LEACH}$ – fraction of N input that is lost through leaching and runoff;
EF_5 – emission factor for leaching and runoff, kg N_2O-N/kg N leached and runoff (Table 6.25).

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[65] IPCC GPG 2000, page 4.68.
[66] IPCC 2000, page 4.70.

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 6.25 and 6.26.

Table 6.25 N_2O emission factors for emissions calculation from agricultural soils

Categories	Emission factors	Reference
Synthetic fertilizers	0.0125 kg N_2O-N/kg N	IPCC 2000, Table 4.17
AWAS	0.0125 kg N_2O-N/kg N	IPCC 2000, Table 4.17
N-fixing Crops	0.0125 kg N_2O-N/kg dry biomass	IPCC 2000, Table 4.17
Crop residue	0.0125 kg N_2O-N/kg dry biomass	IPCC 2000, Table 4.17
Organic soils	8 kg N_2O – N/ha	IPCC 2000, Table 4.17
Atmospheric deposition (EF_4)	0.1 kg N_2O-N/kg NH_3-N&NOx-N deposited	IPCC 2000, Table 4.18
N-leaching and run-off (EF_5)	0.025 kg N_2O-N/kg N yr	IPCC 2000, Table 4.18
N excretion on pasture range and paddock	0.020 kg N_2O-N/kg N yr	Revised 1996 IPCC, Table 4-22

The nitrogen excreted per animal is the same used for calculating nitrous oxide emissions from Manure Management (Table 6.20).

For submission 2010, values of dry matter fraction (for wheat, barley and for other crops), nitrogen fraction and residue/crop production ratio are corrected and presented in the Table 6.26.

Table 6.26 Corrected values of Residue/Crop product ratio, Dry Matter Fraction and Nitrogen content of crops

	Dry Matter Fraction	Nitrogen Fraction (Frac NCRBF)	Residue/Crop product ratio
Wheat	0.82[1)]	0.0028[1)]	1.3[1)]
Barley	0.82[1)]	0.0043[1)]	1.2[1)]
Maize for green feed and silage	0.78[1)]	0.0081[1)]	1[1)]
Crops for green feed and silage	0.78[2)]	0.0081[2)]	1[2)]
Oats	0.92[1)]	0.007[1)]	1.3[1)]
Rye	0.90[1)]	0.0048[1)]	1.6[1)]
Rape	0.82[3)]	0.015[5)]	1.8[3)]
Potatoes	0.45[4)]	0.011[1)]	0.4[1)]
Sugar beet	0.15[4)]	0.015[5)]	0.2[4)]
Fodder roots	0.15[4)]	0.015[5)]	0.3[1)]
Vegetable	0.15[6)]	0.015[5)]	0.2[6)]
Peas and beans	0.87[1)]	0.0142[1)]	1.8[1)]

[1)] IPCC 2000, Table 4.16.
[2)] No values presented in IPCC Guidelines therefore assumed as for maize.
[3)] National assessment for Residue /Crop product ratio; DM of Rape assumed as for wheat and barley as no values presented in IPCC.
[4)] Revised 1996 IPCC, Table - 4.17.
[5)] For Non- N-fixing crop types for which a Nitrogen Fraction values is not provided in Table 4.16 IPCC 2000 and in Table 4.17 Revised 1996 IPCC, default values for Non- N-fixing crops that are listed in table 4-19 of Reference manual of the Revised 1996 IPCC is used (0.015 kg N/kg of dry biomass).
[6)] No values presented in IPCC Guidelines therefore value assumed as for sugar beet.

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 6.8)), use of N synthetic fertilizers (Table 6.20) and productions of crops (Table 6.22).

Other data sources are LSIAE[67] (distribution of different manure management systems are shown in the Tables 6.15- 6.19 and researches made by local experts (area of cultivated organic soils).[68,69]

Table 6.27 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	40.9
2006	42.7
2007	46.1
2008	47.5

Table 6.28 Crops production (thsd.t) used for calculation of N_2O emissions

	Wheat*	Barley	Maize, for silage and forage	Oats	Rye	Crops for green feed and silage	Rape	Potatoes	Sugar beet	Fodder roots	Vegetable	Peas and beans
1990	402.50	697.00	967.30	176.10	323.60	952.80	3.80	1016.10	439.10	1389.40	169.40	22.70
1991	190.20	761.90	785.00	177.20	145.80	894.10	0.90	944.00	377.90	1211.80	209.20	20.70
1992	332.40	426.30	317.50	60.00	295.00	442.00	1.40	1167.40	462.60	901.50	250.80	8.60
1993	338.30	445.80	137.60	73.70	340.70	341.60	2.50	1271.70	298.00	859.00	284.80	4.30
1994	199.40	476.80	26.50	88.90	113.40	206.60	1.80	1044.90	228.20	687.20	233.20	4.50
1995	260.50	284.00	13.00	73.20	71.30	164.80	0.90	863.70	250.00	432.70	223.70	4.70
1996	374.90	371.50	11.90	101.40	112.90	151.30	1.30	1081.90	257.80	399.10	179.50	7.80
1997	424.60	359.80	10.40	116.50	133.50	154.30	0.50	946.20	387.50	404.00	162.50	8.30
1998	428.80	321.70	13.30	103.60	104.80	164.30	1.60	694.10	597.00	347.00	119.60	11.30
1999	396.00	232.60	15.70	66.10	88.70	128.00	11.70	795.50	451.50	235.10	130.10	3.60
2000	472.20	261.10	24.10	79.60	110.70	137.60	10.00	747.10	407.70	222.30	105.80	3.90
2001	507.30	231.10	25.10	82.40	107.20	98.00	13.00	615.30	491.20	203.00	159.30	4.00
2002	584.90	262.40	25.70	79.70	101.50	98.40	32.70	768.40	622.30	153.70	148.20	4.20
2003	519.90	246.60	44.30	78.30	87.60	140.30	37.40	739.00	532.40	158.50	217.50	5.00
2004	571.80	283.50	52.80	107.40	96.80	148.50	103.60	628.40	505.60	130.10	180.80	4.50
2005	739.30	365.80	58.00	122.00	87.20	112.10	145.70	658.20	519.90	88.30	172.20	3.50
2006	643.30	307.00	63.80	91.60	116.80	110.70	120.60	550.90	473.90	61.40	174.40	1.40
2007	873.4	351.00	122.60	130.00	181.00	148.60	197.00	642.00	11.00	53.20	156.00	2.60
2008	1046	307.10	125.30	141.50	194.90	109.90	198.50	673.40	-	22.40	143.20	2.90

*including triticale and mixed cereals.

[67] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006
[68] Melece L. Pētījums par organisko augšņu (histosols) daudzumu Latvijā 1990-2004. (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
[69] Raubēna. A. Reassessed emissions regarding FCR. "Zemes dati" in Excel (Received Extrapolated data for permanent crop (1990-1995) from Central Statistical Bureau of Latvia. Riga 24.05. 2007)

Activity data is taken from Central Statistical Bureau[70]. Statistical surveys are the source of data on crop in commercial companies, private farms and individual merchants. Crop grouping tables involve farms with more than 1 ha of agricultural land area. Fluctuations in activity data is observed due to economical situation in the country. Since 2007, two sugar companies stopped their activity therefore no data presented further.

6.4.3 Uncertainties and time series consistency

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.

6.4.4 Source-specific QA/QC and verification

General (Tier 1) Quality Control (QC) procedures were applied. The QA/QC plan for the agricultural sector includes the QC measures based on the guidelines of the IPCC (IPCC 2000, Table 8.1). These activities are implemented every year in preparation process of agriculture inventory. If errors or inconsistencies are found they are documented and corrected. The QC checklist is used during the inventory.

Tier 2 QC for activity data: Activity data were checked for ensuring consistency of the different sections of the agricultural inventory.

Tier 2 QC for emission factors:

The agricultural inventory has been reviewed several times by the UNFCCC Expert Review Teams, and improvements to the inventory have been made according to the suggestions for submission 2010. The changes are documented and explained in above chapters.

No specific verification process has been implemented for the agricultural inventory yet, but it is planed for future.

6.4.5 Source-specific recalculations

For submission 2010, following recalculations were done:

1. Values of dry matter fraction for wheat, barley and other crops were corrected;
2. in the assessment of nitrogen input from crop residues the maize for silage and forage and crops for green feed and silage as well as fodder roots were included;
3. For N fixed by crops and nitrogen input from crop residues method for N_2O emissions estimation was changed. Instead of Tier 1a, Tier 1b was used;
4. As was highlighted during the in country review (2009) Latvia did not include arable lands in the estimations of emissions from Histosols or organic soils areas, but during the in country review (2007), ERT recommended that for calculation of Histosols consistent data source is necessary, therefore sown area, which was collected by CSB and has consistent time series was used instead of previously used area of arable land.

The ERT recommends (2009) that Latvia change the method of estimating total organic soil areas and the organic soil areas used in agriculture and revise the estimates accordingly, and submit it. The time is very short for change the method of estimating total organic soil areas for submission 2010, but work on getting the better information for further submissions is started.

[70] http://www.csb.gov.lv/csp/content/?lng=en&cat=355

For submission 2010, Latvia recalculated area of Histosols using arable land according to ERT recommendation during in-country review 2009 (for 1990 – 1994 is State Land Service data published by CSB and from 1995 CSB data based on surveys) instead of sown area (Table 6.29).

Table 6.29 Comparison of submitted Area of Histosols (thsd.ha)

	Histosols, 7% from cultivated Utilized agricultural land area (including Sown area), thsd.ha Submitted on 15.04.2009	Histosols, 7% from cultivated Utilized agricultural land area (including Arable land), thsd.ha Revised	Difference %
1990	125.68	129.75	3.13
1991	125.26	129.91	3.58
1992	121.37	129.57	6.33
1993	110.87	129.69	14.51
1994	94.71	130.80	27.59
1995	76.26	81.32	6.23
1996	80.55	85.72	6.03
1997	80.09	85.39	6.20
1998	78.48	83.78	6.32
1999	72.70	77.98	6.77
2000	70.36	76.58	8.13
2001	69.71	75.88	8.13
2002	70.26	76.90	8.63
2003	67.19	74.57	9.90
2004	69.45	77.12	9.95
2005	71.05	84.89	16.31
2006	79.69	92.95	14.26
2007	86.61	90.96	4.78
2008	85.50	89.55	4.52

6.4.6 Source-specific planned improvements

In the future submissions it is planned to evaluate new methodology for assesing area of cultivated organic soils (Histosols) for N_2O emission calculation.

6.5 FIELD BURNING OF AGRICULTURAL RESIDUES (CRF 4.F)

Field Burning of Agricultural Residues is taking place in Latvia on small scale and according to latest information from Ministry of Agriculture is negligible for the whole time series and it is decided to use notation key – NA.

CHAPTER 7: LULUCF (CRF 5)

7.1 OVERVIEW OF LULUCF

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 due to the fact, that the country is rich with forests. According to data provided by National statistical forest inventory (NFI) total area of Forest land remaining forest land in 2008 was 3 220.87±23.51 th.ha (more than 50 % of total land area in Latvia). Besides, 55.16±2.44 th.ha is Land converted to forest land, generally, because of afforestation of farmlands during last decades. In the 1990-2008 reporting period all Forest land areas were calculated according to NFI data using historical recalculation method approved in 2007 (reporting period 1990-2006, 3rd annex of annual report). It should be also mentioned that significant share of Forest land (forest infrastructure, mares and wetlands), which didn't fit to the forest definition in this report are moved to other categories, where no removals are reported to avoid overestimation. Category Other land was introduced in this report to separate lands, which doesn't fit into other land use categories. Actually, Other lands are mostly abandoned farmlands, which doesn't fit jet to the Forest land category or are randomly managed therefore it's complicated to identify particular land use type.

In submission 2010, Latvia reports carbon stock changes and GHG emissions from Forest Land, Wetland, Cropland and Grassland using the CRF tables. In the Forest Land category removals and emissions associated with living biomass and soil are calculated. Calculations were done by Latvian State Forest Research Institute “Silava” (LSFRI Silava) with support of Ministry of Agriculture of Republic of Latvia (MoA). Emissions from organic soils (Cropland, Grassland, Forest land), liming of agricultural soils (Cropland), controlled burning (Forest land, Grassland) and wildfires (Forest land) are reported as well. Additionally, emissions associated with industrial peat extraction are reported this year under Wetland's category, however methodology of estimation will be improved and data will be revised in future reports.

Removals and emissions of GHG from forest fires in LULUCF sector in this report are calculated using data provided by the NFI. The last values are calculated combining information about area of wildfires estimated by State forest service (SFS) and measured volumes of damaged wood in the NFI database.

This submission excludes removals from the Grassland's, Cropland's Wetland's, Settlement's and Other land's, where currently available data about carbon stock changes contains considerably high level of uncertainty.

In data submission 2010 National division of land categories corresponds to the IPCC GPG LULUCF. Initial source of information about area of Forest land and Land converted to forest come from the NFI. Initial source of information about Grassland, Cropland, Wetland and Other land is State land service and Central statistical bureau, but the information about Other land is updated according to measurements of NFI sample plots – woodlands, which corresponds to definition of forests are moved to Forest land or Land converted to forest. The areas of IPCC land-use categories and Latvia's official land area are given in Table 7.1.1.

Table 7.1.1 The areas of IPCC land-use classes in 1990-2008

Year	Total area	Forests[71]	Land converted to forest[72]	Cropland	Grassland	Wetland	Settlement	Other lands
1990	6 458 900	3 142 370	10 437	1 696 510	844 200	570 000	143 000	52 383
1991	6 458 900	3 147 460	12 514	1 699 005	843 400	570 000	143 000	43 522
1992	6 458 900	3 154 420	13 582	1 697 483	825 100	497 000	165 670	105 646
1993	6 458 900	3 158 150	16 228	1 703 284	803 400	482 400	188 330	107 108
1994	6 458 900	3 165 980	17 391	1 719 111	803 400	467 800	211 000	74 219
1995	6 458 900	3 171 630	20 187	1 012 878	800 500	453 200	233 670	766 835
1996	6 458 900	3 181 360	23 024	1 076 100	798 100	438 600	256 330	685 386
1997	6 458 900	3 189 450	29 478	1 093 700	677 900	424 000	279 000	765 372
1998	6 458 900	3 197 610	31 155	1 070 700	677 900	456 000	310 000	715 535
1999	6 458 900	3 206 050	33 365	999 100	617 700	466 000	316 000	820 685
2000	6 458 900	3 213 830	38 103	981 400	605 700	484 241	285 470	850 157
2001	6 458 900	3 217 925	42 118	970 300	611 300	483 009	294 480	839 769
2002	6 458 900	3 221 590	44 369	985 000	610 300	485 822	282 420	829 399
2003	6 458 900	3 227 580	44 369	968 400	613 100	485 311	277 030	843 111
2004	6 458 900	3 233 150	44 369	1 021 000	620 900	480 840	267 970	790 671
2005	6 458 900	3 243 890	44 498	1 104 600	628 900	486 691	228 350	721 971
2006	6 458 900	3 246 170	44 498	1 218 300	636 800	486 066	227 550	599 516
2007	6 458 900	3 257 150	52 644	1 198 100	641 000	487 588	245 310	577 108
2008	6 458 900	3 220 870	55 155	1 176 900	648 100	489 110	228 670	640 095

Net emissions of aggregated GHGs (CO_2, CH_4 and N_2O) in LULUCF sector in 2008 were -28 878 Gg of CO_2 equivalents (Figure 7.1.1). Other GHGs aren't reported yet. The most of the emissions and removals are associated with the carbon stock changes (Figure 7.1.2), mainly in forest biomass. Net emissions of GHGs have decreased by 54 % in 2008 in comparing to 1990. The reason for such a considerable decrease is proper forest management in 70[ths] and 80[ths] as well as favourable forest age structure.

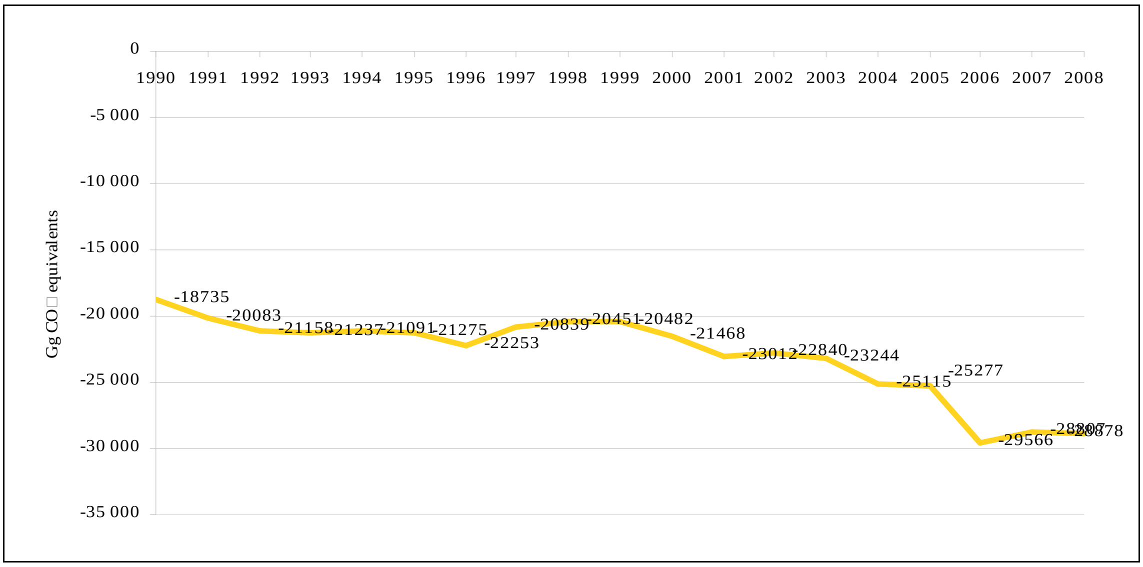

Figure 7.1.1 Aggregated GHGs CO_2, CH_4 and N_2O in LULUCF sector

71 Areas reported under the Article 3.4 of the Kyoto protocol
72 Areas reported under the Article 3.3 of the Kyoto protocol

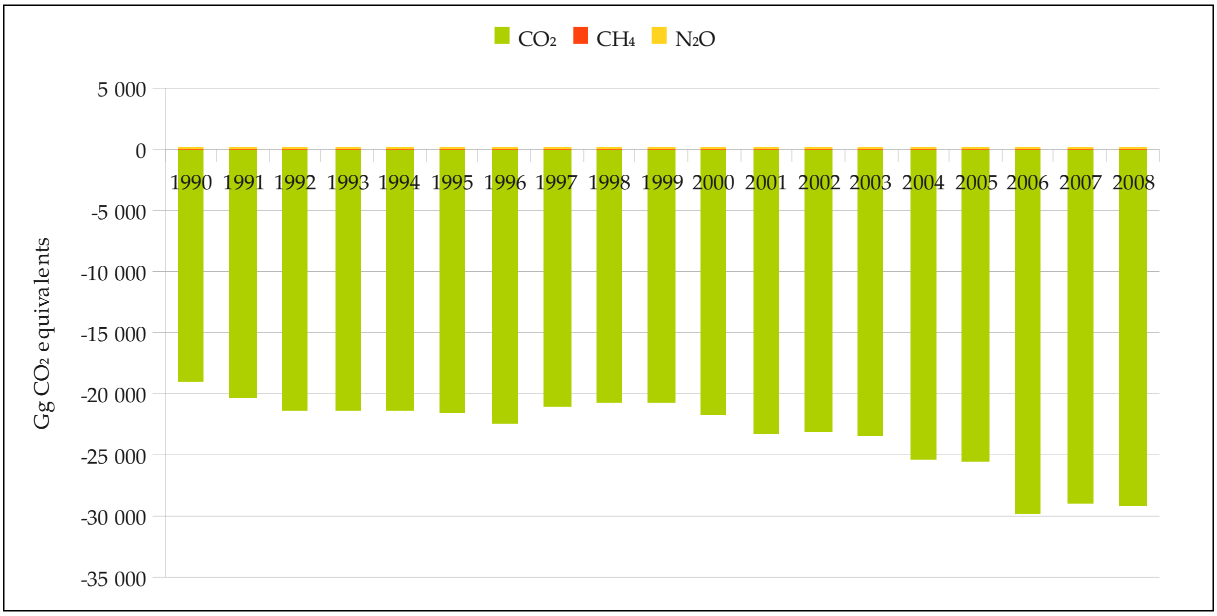

Figure 7.1.2 Net emissions of CO_2, CH_4 and N_2O in the LULUCF sector

In 2008, the LULUCF sector in Latvia is a sink because total sector emissions are significantly smaller than removals due to accumulation of carbon in living biomass in Forest land (Table 7.1.2).

Table 7.1.2 Aggregated net emissions of GHGs (CO_2, CH_4 and N_2O) in LULUCF

Year	Forest land	Cropland	Grassland	Wetland	Settlement	Other land
1990	-19206.6	440.07	10.07	21.12	-	-
1991	-20554.53	440.7	10.07	21.12	-	-
1992	-21629.74	440.29	9.85	21.12	-	-
1993	-21709.58	441.8	9.63	21.12	-	-
1994	-21567.41	445.87	9.77	21.12	-	-
1995	-21571.33	264.59	10.54	21.12	-	-
1996	-22565.77	279.65	11.83	21.12	-	-
1997	-21151.45	282.04	9.18	21.12	-	-
1998	-20759.44	276.88	10.46	21.12	-	-
1999	-20774.51	258.6	12.43	21.12	-	-
2000	-21757.14	256.39	11.5	21.12	-	-
2001	-23298.8	249.35	16.35	21.12	-	-
2002	-23157.17	267.29	29.06	21.12	-	-
2003	-23570.65	272.24	33.24	21.12	-	-
2004	-25417.21	263.02	17.84	21.12	-	-
2005	-25593.64	284.96	10.88	21.12	-	-
2006	-29956.93	314.01	55.68	21.12	-	-
2007	-29154.75	312.23	14.13	21.12	-	-
2008	-29212.96	304.7	8.77	21.12	-	-
Changes from 1990	-52.10%	30.76%	12.99%	0.00%	-	-

7.2 FOREST LAND (CRF 5.A)

7.2.1 Description

The estimation of the area of Forest land is based on the National Forest Inventory (NFI). Parks and yards, for example, are excluded regardless of whether they would meet the Forest land definition. 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 th.ha. Removals in unmanaged forests (corresponding to removals in sample plots located in strict protected nature reserves and strict protected zones in national parks) aren't accounted in the inventory. Removals and emissions are reported in the category Forest land remaining forest and Other land converted to forest.

The NFI data are used to estimate time series for areas, increment of growing stock and tree biomass. The FAO TBFRA 2000 definition of forests was introduced in 2007 and all time series were recalculated according to this definition. In the same year the inventory was switched from the State forest service input data to the NFI data raising significant difference in data between 2006 and 2007, therefore all the increment of growing stock data from 1990 to 2006 was recalculated according to the field measurements of radial increment of trees in the NFI sample plots. Methodology of recalculation is reported within the scope of the Latvia's National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2006[73] in 2008.

Distinction between forest land remaining forest land and areas converted to forest land is made according to age of dominant species in forests on abandoned farmlands – if age of dominant specie was less than zero in 1990, it is considered as Land converted to forest, in other cases it is considered as Forest land remaining forest land. Taking into account, that transition between other land use categories and forests usually is not one step action, but gradual succession of species during natural afforestation of abandoned lands, it is assumed, that Land converted to forest land arises from the Other land category.

Only the carbon stock changes in above and below ground biomass of the growing stock is reported in the 2008 submission as removals. Increment of dead wood reported by the NFI is exuded from the GHG inventory as not a source to avoid overlapping with increment of living biomass in recalculation of data from 1990. Changes of organic carbon in litter and soil organic matter in naturally dry and wet soils are assumed to be zero according to Tier 1 approach of the IPCC GPG LULUCF due to lack of reliable information. Carbon stock changes are reported separately on naturally dry and wet mineral and organic soils and drained mineral and organic soils. Organic soils are considered peat-lands as defined in the NFI: a site is classified as peat-land if the organic layer is peat with at least 30 cm deep peat layer (H horizon) below the litter layer. In Croplands and Grasslands criteria for organic soil is 40 cm deep peat layer. Additionally to emissions of CO_2 also emissions of N_2O from drained organic and mineral soil are reported. Time series are recalculated from 1990 according to information provided by the NFI about the area of forest site types on drained mineral and organic soils (Figure 7.2.1).

[73] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/x-zip-compressed/lva_2007_nir_12apr.zip

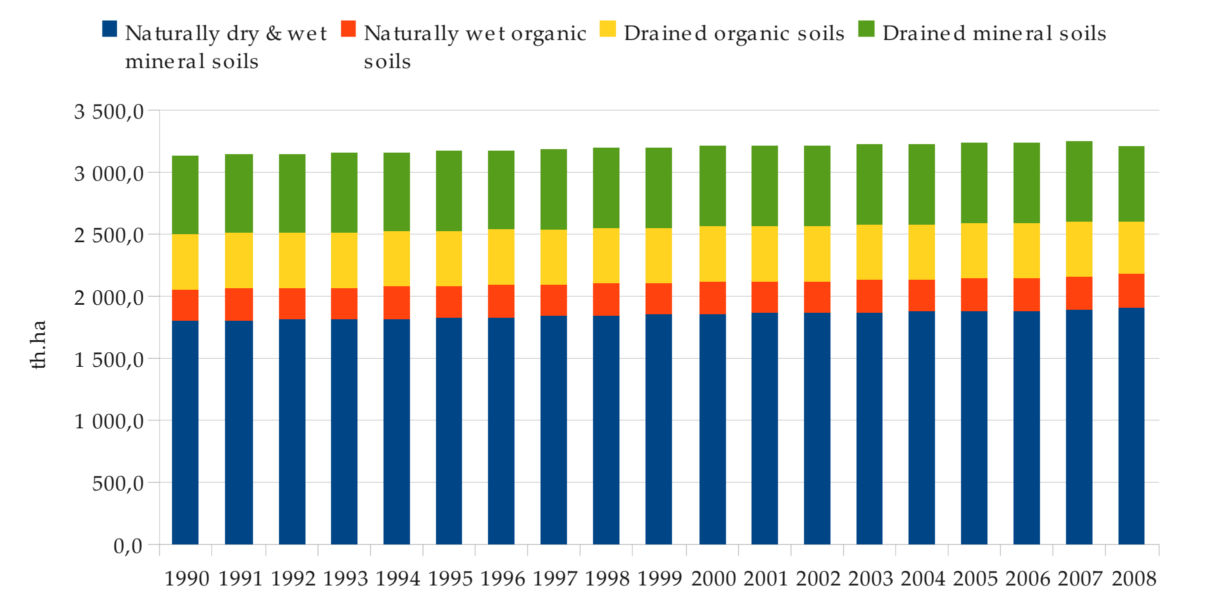

Figure 7.2.1 Distribution of drained, naturally dry and wet mineral and organic soils in Latvia's forests

The carbon stock change in living biomass is estimated with the default method of the IPCC GPG LULUCF – carbon uptake and release of the growing stock correspond to the mean annual increment and annual harvesting of trees. Considerable part of emissions is associated with incineration of slash in clear-cuts. This value is based on expert judgement and is well known for overestimation, because this method of management of the slash is not used any more. However, due to lack of reliable data about utilization of the slash, it is considered that about 30 % of the slash is left for incineration on-site. As soon as more detailed data will be available from the NFI, actual emissions associated with incineration of slash will be calculated. The method of evaluation of management of the slash is under development.

The time series for yearly increment in timber on the Forest land remaining forest are given in Figure 7.2.2 and in the Land converted to forest – in Figure 7.2.3. The yearly increment of timber volume in the forest lands per area increased by 51 % in 2008 in a compare to 1990, total yearly increment increased by 54 % in 2008 in a compare to 1990. That comes from the increased growth of trees due to proper management of forests in 70^{ths} and 80^{ths} as well as due to significant increase of area of premature forests with the highest increment figures. Annual increment of trees has increased almost steadily therefore the CO_2 uptake has also has grown. The total drain of trees is very much affected by commercial felling and the global market situation. The demand for timber products was low at the beginning of the 1990s for which reason felling was also at a low level and the CO_2 sink of trees was high. The felling stock increased during nineteens and reached top average in early 2000s (Figure 7.2.4). However increment of growing stock in forests, especially premature forest stands were considerably higher, securing constantly growing removals of CO_2 in living biomass of trees.

The Land converted to forest provides considerably small removals – less than 0.1 mill. m^3 in 2008. Taking in account that these forests are generally young stands, no emissions from commercial felling are considered. However methodology of estimation of area of afforested lands will be improved in future to separate farmlands afforested after 1990. Current approach is based on the field observation during visits to the NFI sample plots, therefore there is always possibility that an observer will mark a sample plot as the Forest land, while it belongs to the Land converted to forest. Possibility of this mistake is higher in deciduous stands, where stumps persist a shorter time than in coniferous stands.

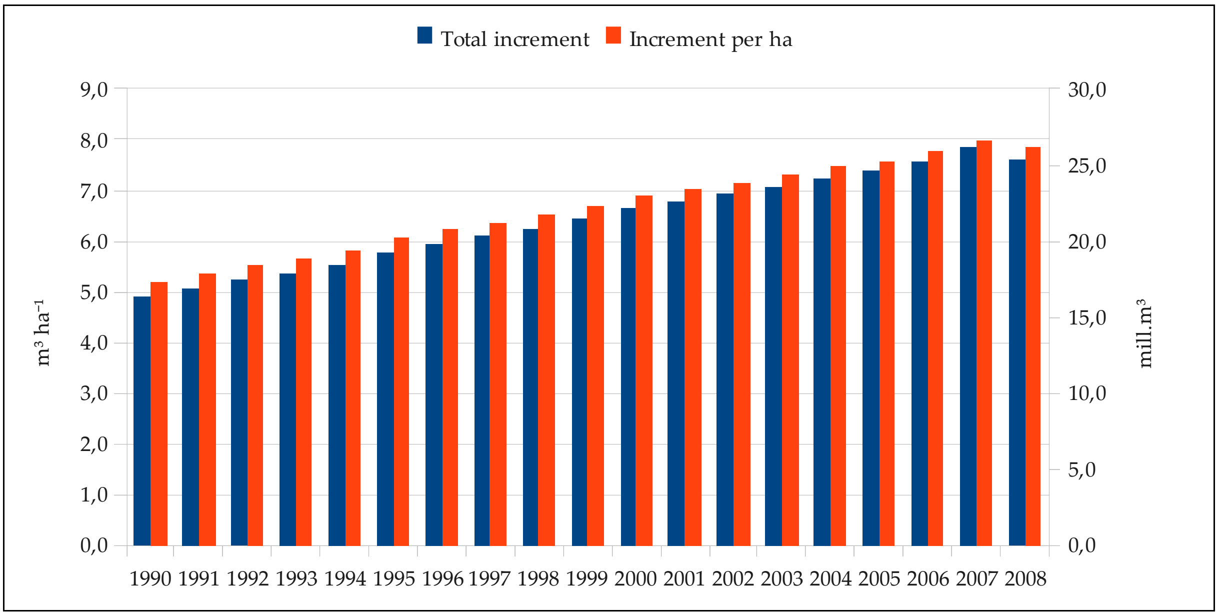

Figure 7.2.2 Increment of growing stock of timber on the Forest land remaining forest

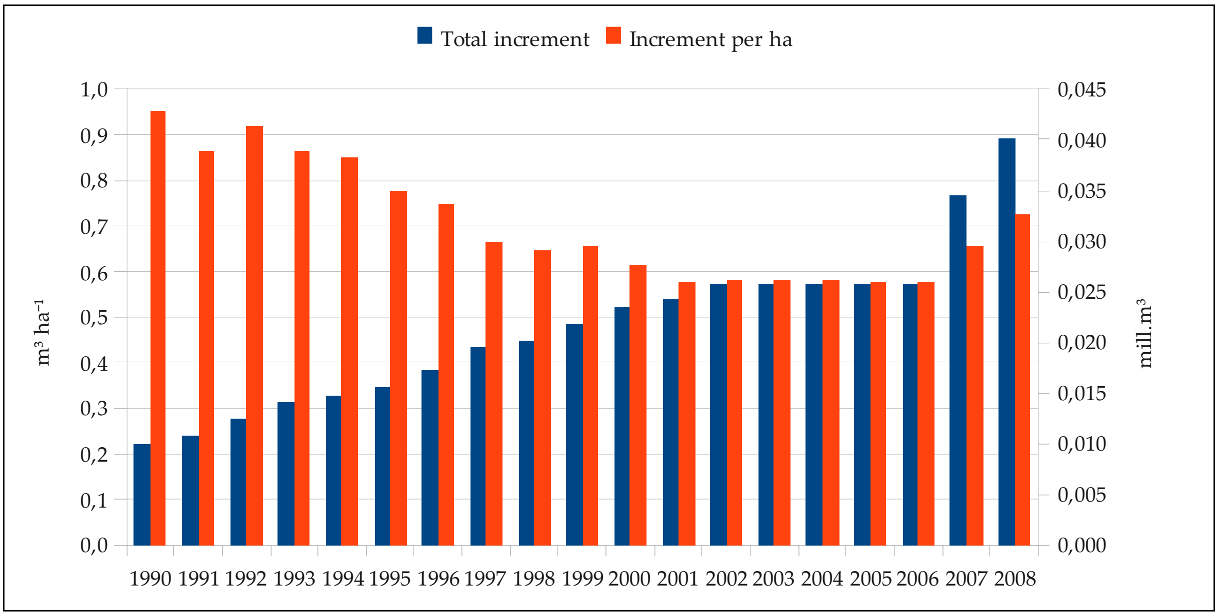

Figure 7.2.3 Increment of growing stock of timber on the Land converted to forest

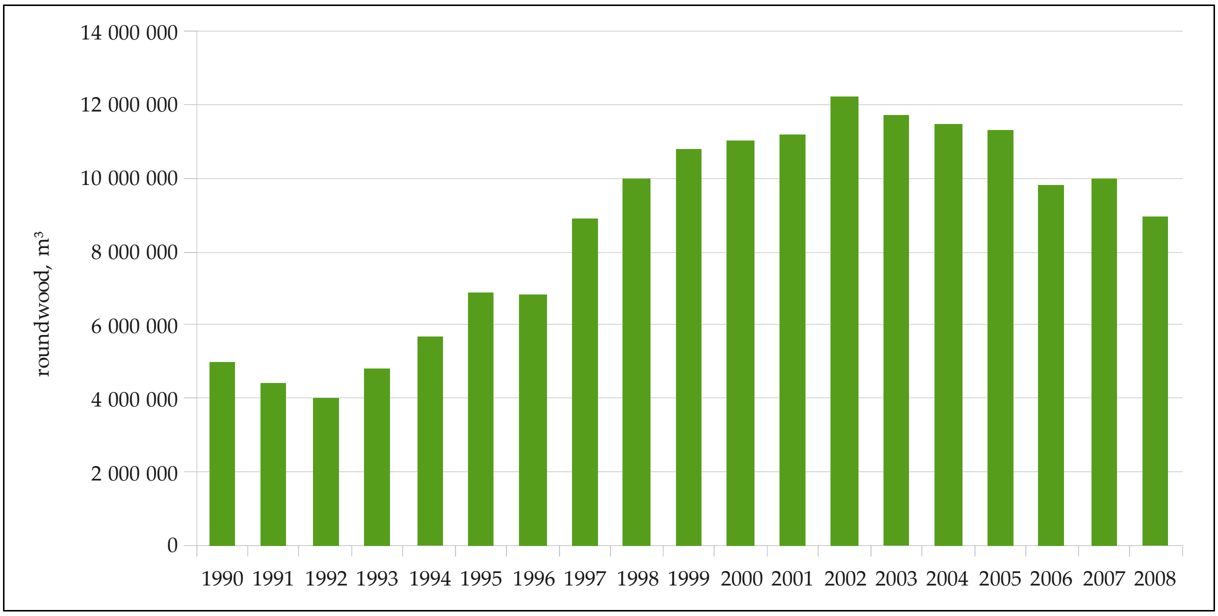

Figure 7.2.4 Annual harvesting stock of roundwood

The net emissions from forest lands were -29 212.96 Gg in Latvia in 2008. The most of the emissions are associated with commercial felling (Figure 7.2.5). Both, the harvesting related emissions and removals in living biomass increased during the reporting period. Emissions were constant during the time due the fact that the area of drained soils didn't change. However, emissions from re-wetting of soil due to collapse of drainage systems are not taken in account due to a high level of uncertainties in data provided by the NFI. It is also complicated to estimate if the re-wetting is permanent or periodic therefore new methodology will be elaborated to estimate effect of re-wetting. According to the existing data, emissions from decay of living biomass due to re-wetting, if instant oxidation method is considered, can be compared with emissions from biomass burning.

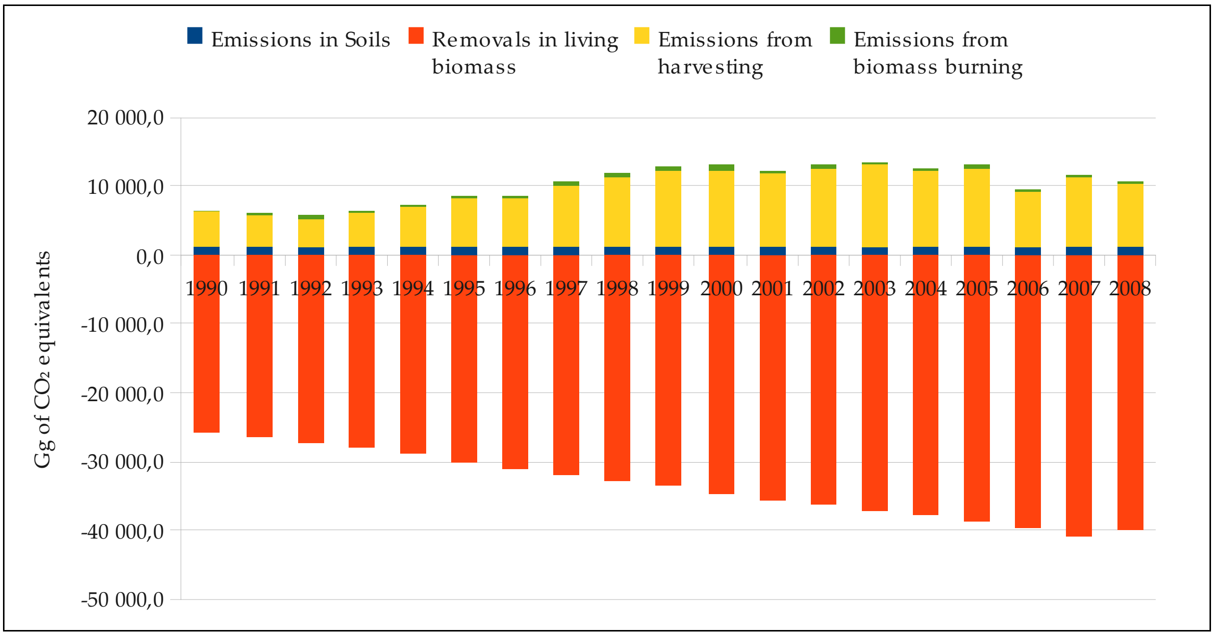

Figure 7.2.5 Structure of emissions and removals in the forest lands

Emissions associated with the biomass burning on the Forest land are calculated in the category the Forest land remaining forest land due to the fact, that there is no distinguish in statistics, if the forest fire takes place in the forest land remaining forest land or recently afforested farmland.

In case of on-site incineration of slash during commercial harvesting, all emissions also are applied to the Forest land remaining forest land's category, because no commercial harvesting takes place in young stands on afforested farmlands.

Estimation of on-site incineration is based on expert judgement, that about 50 %[74] of slash is left for incineration and 66 % of them are actually incinerated[75]. Fraction of biomass oxidized on-site is assumed 90 % in average. Amount of the slash according to different studies on forest biofuel production is assumed 20.2 % of harvesting stock. In 2008 amount of slash left for incineration was 362 th.m^3 (Figure 7.2.6). As soon as activity data from the NFI will be available, calculations of emissions associated with incineration of slash will be improved.

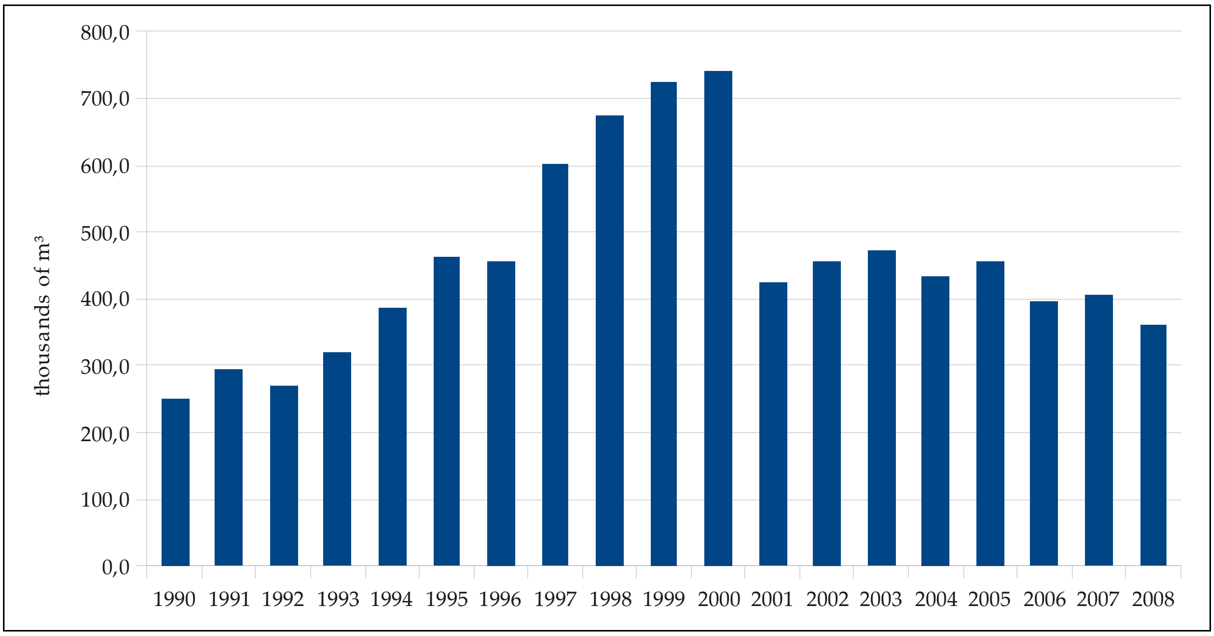

Figure 7.2.6 Biomass incinerated on-site during the commercial felling

Area of forest wildfires are provided by the State forest service (Figure 7.2.7). Alternative solution is to use data provided by the NFI, however these data will be useful only after completion of the second round of measurements, because current figures shows only volume of damaged biomass and not a reduction of volume due to a forest fires, therefore both, overestimations and underestimations of emissions are possible. Methodology for estimation of the forest wildfires related emissions using the NFI sample plots are under development.

74 30 % after 2001.

75 Līpiņš L., Assessment of wood resources and efficiency of utilization of wood (*Koksnes izejvielu resursu un to izmantošanas efektivitātes novērtējums*), 2004.

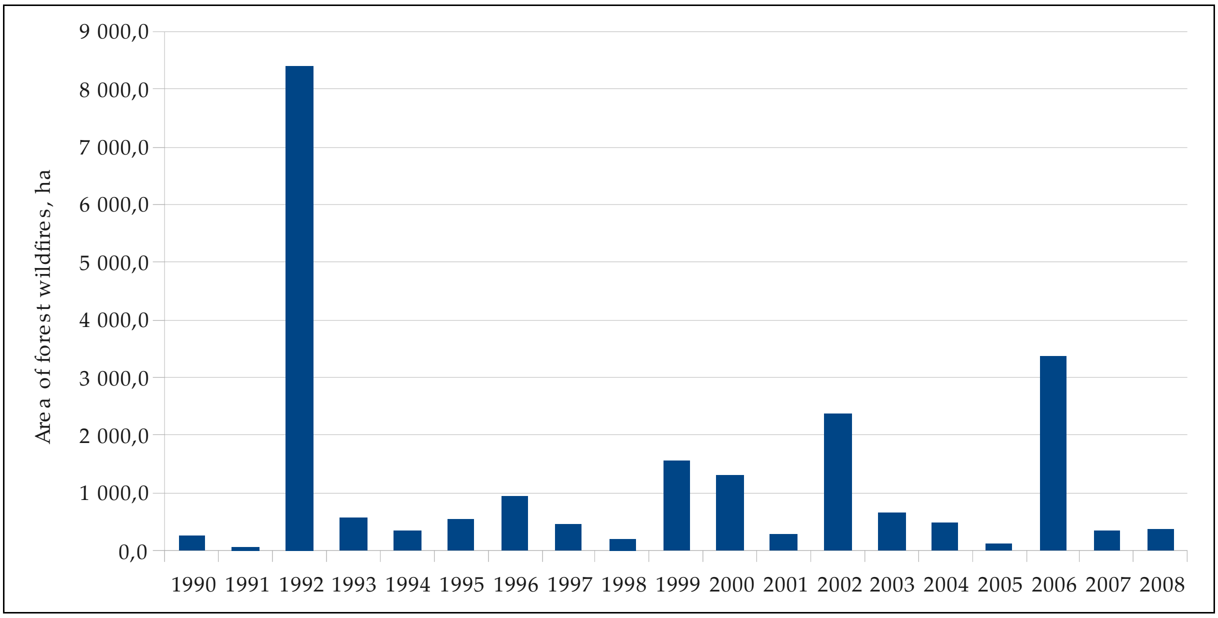

Figure 7.2.7 Area of forest wildfires

Calculation of dead wood in forest land was done by combination of data provided by NFI and UNECE[76]. Regression equation was elaborated to calculate changes according to these data (Figure 7.2.8). This temporary solution was introduced in the Latvia's National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2007. However due the different methodologies applied and due to a high level of uncertainties in is now excluded from the report as not a source until data from the second round of NFI will be available.

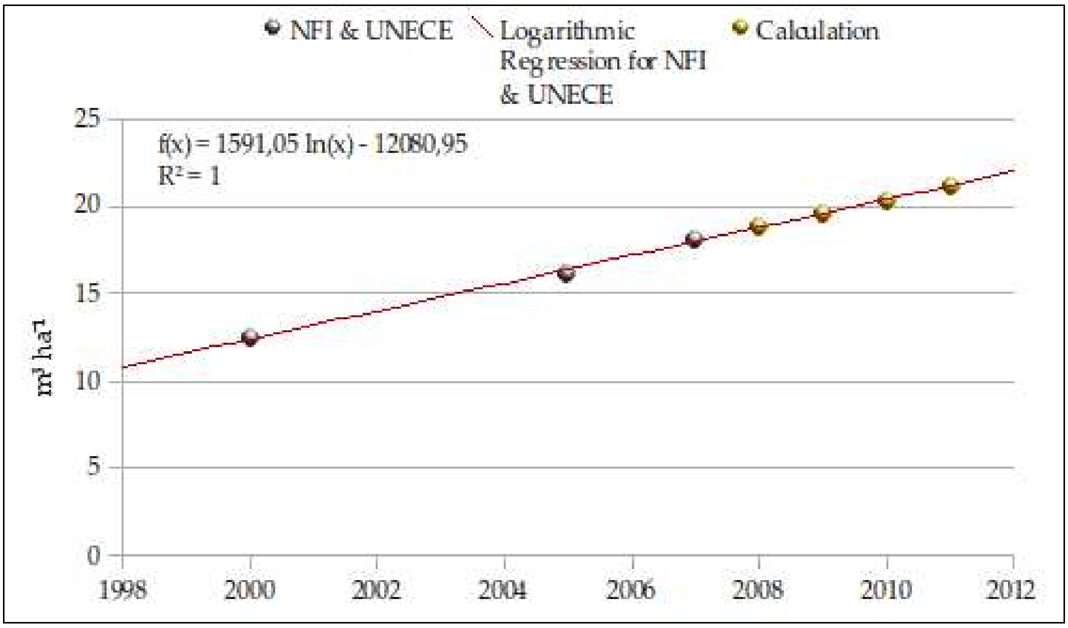

Figure 7.2.8 Regression equation for calculations of stock of dead wood in forests

7.2.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The area of forests comprises of the land of 0.1 ha with potential tree crown cover of more than 20 % and with the potential of trees to reach a minimum height of 5 m at maturity. Source data are provided by the NFI. The same rules are applied to the Forest land remaining forest and Land converted to forest.

[76] Ministry of Agriculture (2006) Inquiry on MCPFE quantitative indicators for SFM, national data reporting forms, 2006

The last category is identified by the age of dominant tree specie in the NFI category afforested farmlands – if age of the stand was above zero in 1990, it is moved to the Forest land remaining forest's category, otherwise it stays in the converted land category. Recalculation of age of forest marked as forests growing on farmlands is the reason, why area of managed forest increases since 1990.This approach is quite robust; however it leaves possibilities of underestimation of the conversion due to wrong identification of the land use type during a field visits. The total area of the Land converted to forest is shown in Figure 7.2.9.

Information about area of different categories of forest lands will be revised according to results of analysis of satellite images. This analysis will also allow estimating actual rate of deforestation since 1990, which in 5 years prospective (length of a cycle of the NFI) is statistically insignificant value and therefore is not reported yet. Methodology for estimation of historical area of forests is under development.

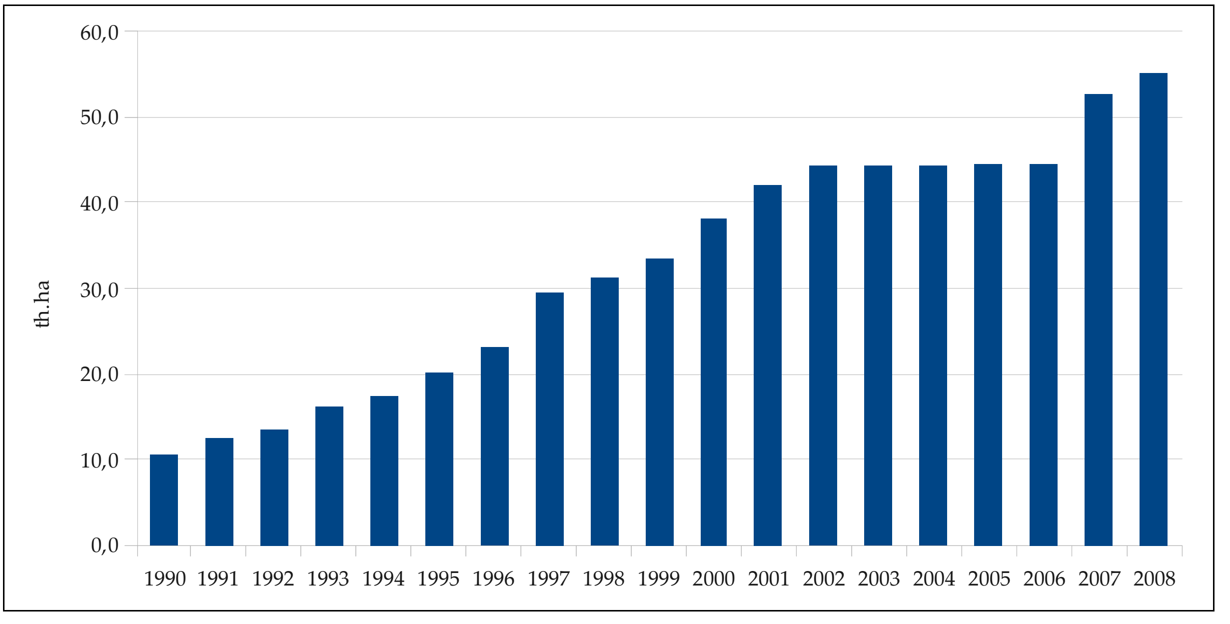

Figure 7.2.9 Total area of the Land converted to forest's category

7.2.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The FAO TBFRA 2000 definition is applied. Forest is a minimum area of land of 0.1 ha with potential tree crown cover of more than 20 % and with the potential of trees to reach a minimum height of 5 m at maturity. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 20 % or tree height of 5 m are included under forest, as well as areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest. For linear formations, a minimum width of 20 m is applied. Parks and yards are excluded regardless of whether they would meet the Forest land definition. The FAO forest land covers the nationally defined productive forest land, part of the poorly productive forest land and forest roads. Area estimates are derived from NFI data.

At the moment, some area estimates of annual deforestation area are available for the last 10 years, however these data don't provide information about emissions associated with the land use change. Total area of officially reported deforestation (*generally conversion to Settlements*) is statistically insignificant; therefore it is not possible to calculate emissions' data in mathematically correct way. Emissions from areas of the Forest land and Wetland converted to peat production are reported under Wetlands' category.

LSFRI Silava elaborated methodology for estimation historical fluctuations of land use changes on the base of data fixed during field visits of every NFI plot, including those, where woody vegetation were not found.

7.2.4 Methodological issues

Changes in carbon stock and GHG emissions are estimated according to the IPCC GPG LULUCF. Tier 1 and 2 methods are used; however a project application for National funding is elaborated to develop methodology for complete switch to Tier 2 and 3 methods. Default method (the carbon loss to be subtracted from the carbon removals for the reporting year) is used in calculations of removals and emissions of CO_2 in living biomass.

CO_2 removals and emissions from burning on-site in the forest are described more detailed in the Chapter Biomass burning.

Emissions from drained soils are calculated according to a Tier 1 method provided in the IPCC GPG LULUF. Emissions of N_2O from drained organic forest soils were calculated according to the Table 3a.2.1 Emission factor of 0.6 kg N_2O-N ha^{-1} yearly was applied to organic soils and emission factor of 0.06 kg N_2O-N ha^{-1} yearly was applied to mineral soils for calculations N_2O emissions. Emission factor 0.68 t C ha^{-1} yearly (Table 3.2.3 of the IPCC GPG LULUCF) was assumed for calculations of carbon stock changes in drained organic forest soils. Methodology on estimation and monitoring of carbon stock changes in drained mineral and organic forest soils is under development.

After finalization of second round of NFI it will be possible to switch to second method which is based on difference in biomass stock in certain time period (5 years). This method doesn't provide information about a current year, but it's much more precise, because of simpler calculation and smaller level of uncertainties.

Assumptions that have been made for calculations of increment of living biomass and emissions associated with the timber extraction are shown in Table 7.2.2. Basic wood density is assumed from the IPCC GPG LULUF Table 3A.1.9 Basic wood densities of stem wood for boreal and temperate species and local research results, where verified data available. For pine and spruce[77], for birch[78], for grey alder[79] and for aspen[80]. Weighted average densities of wood were calculated according to forest site specific data, where authors provided such information (Table 7.2.2). However density of trees varied in a very broad range (± 50 %) for all species, therefore uncertain level is rather high. It should be also noted, that biomass is calculated according to density of wood of the dominant tree specie, and therefore mixtures of tree species are considerably increasing uncertainty level of calculations.

Table 7.2.2 Average density of wood of different tree species

Specie	Density of wood
Pine	0.49
Spruce	0.42
Birch	0.62
Black alder	0.45
Grey alder	0.46

[77] Latvijas Valsts Koksnes ķīmijas institūts (2007) Skujkoku tievkoksnes un tās produktu kvalitāte un konkurētspēja atkarībā no koku augšanas apstākļiem, Pārskats par ZM Meža attīstības fonda un Lauku atbalsta dienesta finansēto pētījumu, Līgums Nr. 240707/S292, projekta vadītājs, LZA kor.loc. A. Treimanis.

[78] Latvijas Valsts Koksnes ķīmijas institūts (2006) Lapu koku tievkoksnes kvalitāte un konkurētspēja atkarībā no koku augšanas apstākļiem, Pārskats par ZM Meža attīstības fonda finansēto pētījumu, Līgums Nr. 240206/C-45, projekta vadītājs, LZA akadēmiķis U. Viesturs.

[79] Latvijas Lauksaimniecības universitāte Meža fakultāte (2007) Baltalkšņa audžu biomasas un ražības pētījumi, LR Zemkopības ministrija & Meža attīstības fonds, projekta vadītāja Olga Miezīte, Mg.silv., lektore.

[80] Latvijas Valsts Mežzinātnes institūts "Silava"Meža selekcijas, sēklkopības un ģenētikas darba grupa (2005) Pārskats par zinātniski pētnieciskā līgumdarba Apses selekcijas pētījumi kvalitatīvas koksnes izaudzēšanai izpildi, Zemkopības ministrija & Meža attīstības fonds, projekta vadītājs Arnis Gailis.

Specie	Density of wood
Aspen	0.39
Oak	0.65

For the recalculation of biomass from stem volume, weighted average of densities were calculated for every year according to species composition of yearly increment (Figure 7.2.10). However during all the time series weighted average of density of stem wood varied between 0.49 and 0.50 and average weighted for the whole time series was 0.50. More detailed information will be available as soon as specie specific biomass functions will be elaborated.

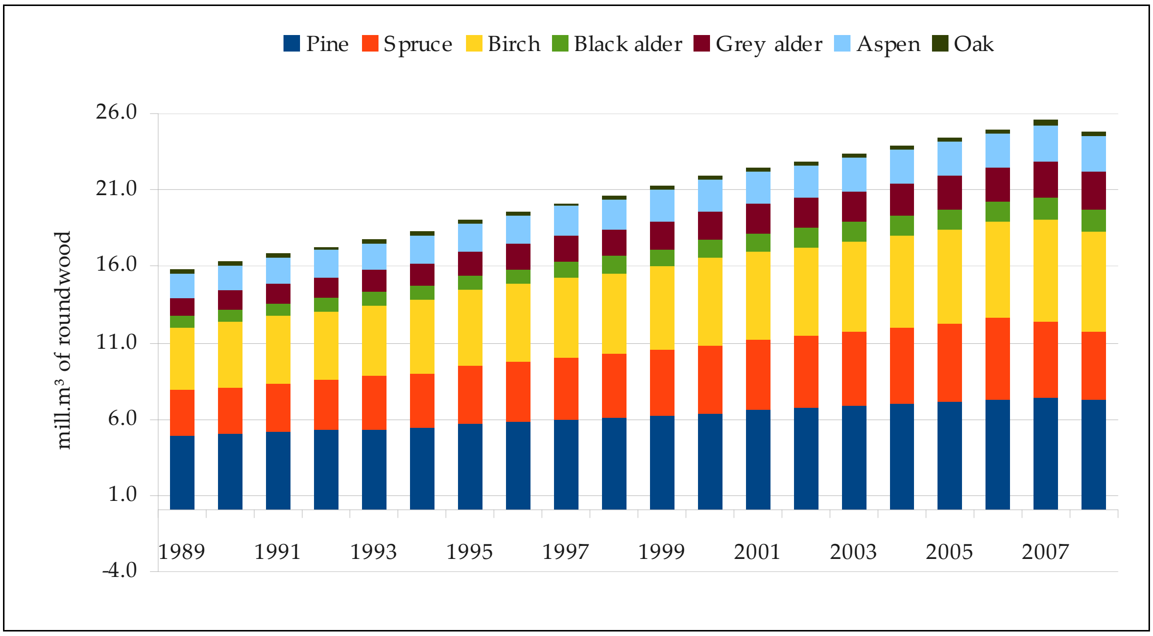

Figure 7.2.10 Structure of increment of roundwood (over-bark) in Latvia

Biomass expansion factor for conversion of merchantable volume to above-ground tree biomass was taken from the IPCC GPG LULUF Table 3A.1.10 Default values of biomass expansion factors (BEFS), value corresponding to the Boreal broadleaved forest to be used in connection to growing stock biomass data (Equation 3.2.3). BEFS to be used in connection to increment data (Equation 3.2.5) according to the IPCC GPG LULUF Table 3A.1.10 were not used in calculations due to an expert judgement that these factors leads to considerable underestimation of the increment in historical data from 1990 to 2006, because recalculation of increment according to the methodology applied in the NFI is based on estimation of diameter of tree with following calculation of height and other secondary forest inventory values. Therefore there is no difference between calculations of above-ground biomass from increment or growing stock.

Root-to-shoot ratio appropriate to increments was taken from the IPCC GPG LULUF Table 3A.1.8 Average below-ground to above-ground biomass ratio (root-to-shoot ratio) in natural regeneration by a broad category, value corresponding to conifer forest & plantation (Table 7.2.3). This value according to an expert judgement and available literature references is the most relevant to the practice. However as soon as biomass functions will be elaborated and verified these values will be revised. The methodology of elaboration of biomass functions for the most common tree species is under development in LSFRI Silava.

Table 7.2.3 Factors and parameters used for calculations of change in carbon stock in living biomass

Basic wood density (weighted average 1990-2008)	0.5 ($t_{d.m.}$ m^{-3})
Biomass expansion factor for conversion of merchantable volume to above-ground tree biomass	1.30 (dimensionless)
Root-to-shoot ratio appropriate to increments	0.32 (dimensionless)
Fraction of carbon in dry matter	0.5 (t C $t_{d.m.}^{-1}$)

Harvesting stock was recalculated to emissions using the same BEFS as increment (Table 7.2.3). The fraction of total harvest left to decay in the forest was taken from the IPCC GPG LULUCF Table 3A.1.11 Default values for fraction out of total harvest left to decay in the forest, value corresponding to temperate semi natural forests (0.15 dimensionless).

7.2.5 Uncertainties and time-series consistency

Uncertainties are estimated on the base of expert judgement. Uncertainty of soil carbon (CO_2) and nitrogen (N_2O) are estimated according to data obtained within the scope of the international forest soil monitoring project BioSoil and values provided in the IPCC GPG LULUCF. Total level of uncertainty of emissions from soil is 90 %.

Data about increment of living biomass and forest area are very precise (a standard error for the area of forest is 0.73 % for the Forest land remaining forest and 4.43 % for the Land converted to forest corresponding in total to 25.96 th. ha, a standard error of timber increment is 1.03 % for the Forest land remaining forest and 15.99 % for the Land converted to forest corresponding in total to 0.27 mill.m^3 yearly in 2008). A standard error of harvesting stock according to forest regulations should be within 10 %. However, in contrast to data provided by the NFI and the State forest service, BEFS and root-to-shoot factors utilized in further calculations have high level of uncertainty; therefore total level of uncertainties of the net emissions from living biomass is assumed within 30 % according to the expert judgement.

Areas of land-use categories and growing stock increment estimates are based on NFI assessments. The definitions of national land classes and tree measurement techniques have remained the same in different inventories[81].

7.2.6 Source-specific QA/QC and verification

Quality control procedures named in IPCC GPG LULUCF, Table 5.5.1 were done for all calculations. Calculations concerning Forest Land were compared with similar calculations made for elaboration of the forest management decision making models and information provided by the State forest service.

National Forest Inventory data have gone through the following QC measures:

- Field gauges and instruments were checked and calibrated.
- New instruments were tested to find possible differences in measurement results compared with the old ones.
- Before field surveying, field personnel has had a training period to ascertain that observers are able to use the equipment correctly that observers do measurements and classifications correctly that the guidelines and instructions are understood correctly.
- Verification measurements were carried out during field seasons.

[81] Increments of living biomass from 1990 to 2006 are recalculated according to measurements implemented between 2004 and 2007, therefore these data are consistent, however, with considerably higher level of uncertainty due to additional assumptions according to mortality of trees and forest regeneration practices after clear-cuts.

- From field data it was checked that all sample plots are measured that no required information is missing to find errors (if found, they were corrected) the compatibility with different data variables the compatibility with sample plot, tally tree and sample tree data.
- Calculated results were compared with the results of previous inventories. If big or unexpected changes were found, reasons for them were clarified and explained.

Work on improvement of tree height and timber functions used in calculations in the NFI and development of verification tools continues therefore changes in the input data provided by the NFI are possible. Reviewers of the NFI are informing the team working on the GHG inventory about changes occurring in the NFI and GHG inventory is updated according to these changes.

The NFI team applies a quality manual and QA/QC measures to all work stages. Documentation is in Latvian, brief descriptions of NFI methods and measurements are available in the Latvia's National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2006.

The data based on forest statistics were produced by the Latvian State Forest Research Institute "Silava". Data descriptions are available (at the moment in Latvian) including the applied definitions, methods of data compilation, reliability and comparability.

It was confirmed that all data used in this section cover whole land area of Latvia.

7.2.7 Source-specific recalculations

Increment of living biomass in the category Forest land remaining forest and Land converted to forest was recalculated according to updated information about area of forests and actual increments of growing stock. Removals in dead biomass were excluded from the calculation, to avoid overlapping with removals in living biomass, until better methodology will be elaborated.

Emissions of N_2O from drained forest soils were calculated for the whole time series.

7.2.8 Source-specific planned improvements

For the 2011 submission Latvia will improve the area estimation and estimation of carbon stock changes from forests. LSFRI Silava elaborated a proposal for national funding to cover all the issues of the GHG reporting in LULUCF sector. The project should be completed in 2012. Information about land use balance, including historical land use changes, should be available already in 2010. The objectives of the project are to produce methods to estimate areas for all land-use changes and carbon stock changes on these land areas. These methods will produce area estimates for areas remaining in same use and for converted areas for the UNFCCC reporting as well as a method for reporting under the Kyoto Protocol. Other objectives are to enhance the estimation of carbon stock changes in living tree biomass applying the country specific biomass functions and to improve the uncertainty estimation on carbon stock changes in living tree biomass. Estimations will be based mainly on the NFI sample plots.

7.3 CROPLAND (CRF 5.B)

7.3.1 Description

Under the Cropland's category emissions from organic soils and lime applications are reported (Figure 7.3.1). The net emissions from croplands were 304.7 Gg in Latvia in 2008. Lime applications were quite constant during the reporting period, except 2002 and 2003, when due to a regulatory (support for liming of farmlands) or other reasons use of liming material considerably increased (Figure 7.3.2). Area of orchards wasn't separated any more since reporting of net emissions from the Grassland's category for the period 1990-2007 due to a switch to the data on biomass increment provided by the NFI, where all woody vegetation is summarized together.

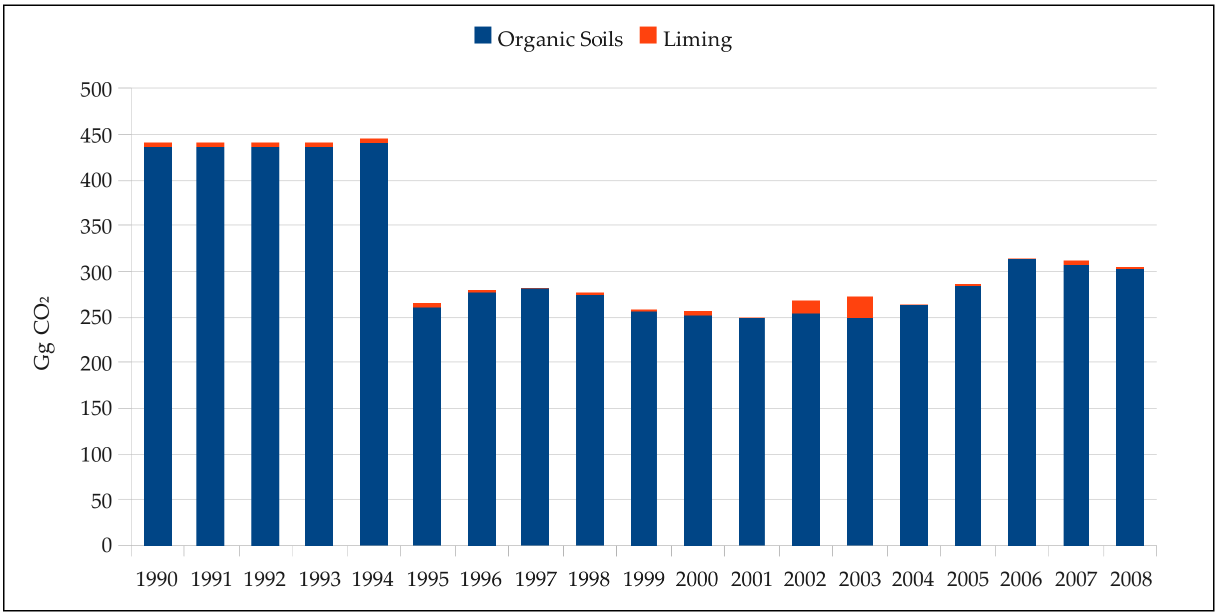

Figure 7.3.1 Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in the Cropland

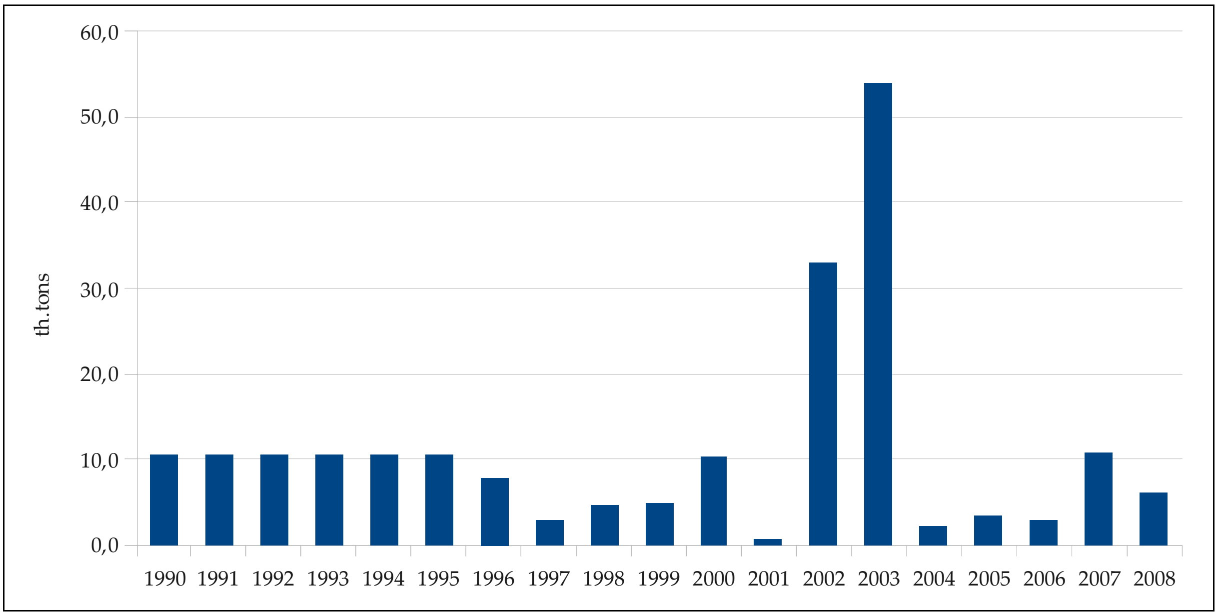

Figure 7.3.2 Application of liming material in the Cropland

The total area of croplands is estimated according to the information provided by the Central statistical bureau. Information about increment of woody biomass is provided by the NFI – measurement results from sample plots covered by woody vegetation fitting to the croplands' definition.

Area of croplands covered by woody vegetation is calculated from an estimation of area represented by a single plot of the NFI. All sample plots measured from 2004 to 2007 were used for recalculation of increment of biomass on settlements from 1990 to 2006. The average area represented by one permanent NFI sample plot is 400 ha[82] or 1.25 ha m^{-2}. The same assumption is used also in case of the Grassland's, Wetland's, Settlement's and Other land's categories.

No removals are reported in this category to avoid an overestimation. Figures of yearly increment of timber volume in this category provided by the NFI are shown in Figure 7.3.3 to verify that living biomass in this category is not a source. Note that only a few sample plots covered with woody vegetation fitting to the Grassland's category exists in the NFI database, therefore the data about area and increment has very high level of uncertainty. Completion of the second round of the NFI in 2012 will provide information with considerably smaller level of uncertainty of increment of growing stock on the base of calculation of stock changes in 5 years period. However information provided by the NFI is sufficient to consider that removals in living biomass in the Cropland's category can be excluded from reporting as not a source already now.

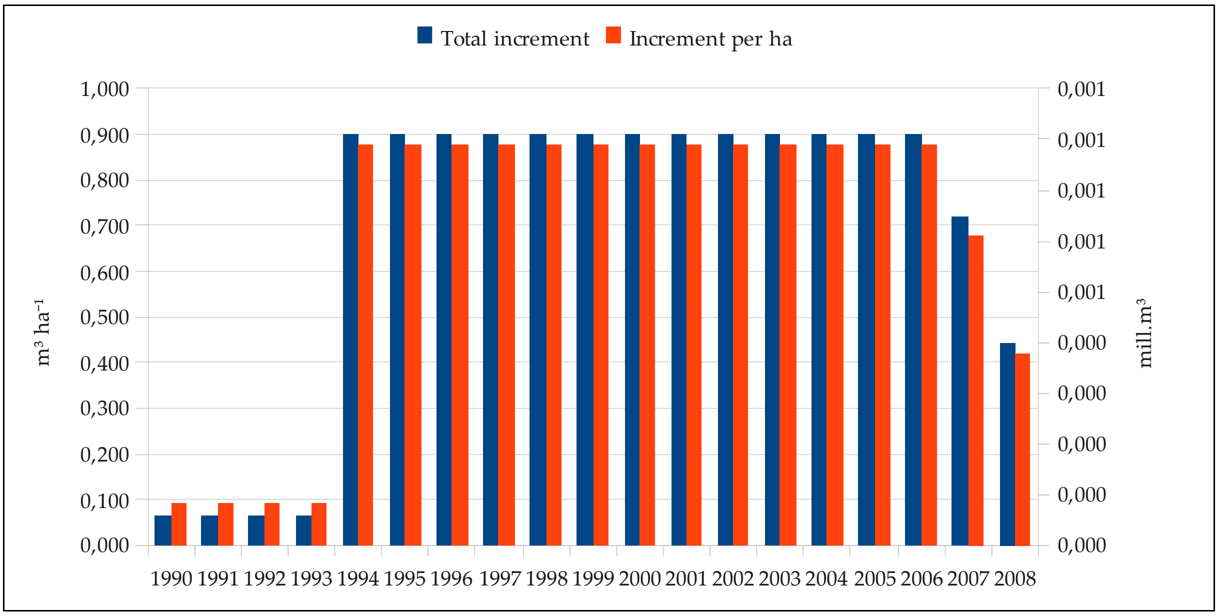

Figure 7.3.3 Increment of growing stock of timber on the Cropland

7.3.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The area of cropland comprises of the area under cereals, grass (≤ 5 years), other arable crops and permanent horticultural crops. Greenhouses and kitchen gardens are also classified as Croplands although emissions from them are not reported. The CO_2 emissions from cultivation of organic soils and agricultural lime application are reported under the category CO_2 emissions from the Cropland remaining cropland. Only emissions from the Cropland remaining cropland have been calculated since no reliable estimates for areas converted to cropland are available.

The total area of croplands reported by the Central statistical bureau and area of croplands on organic soils estimated on the base of expert judgement is shown in Figure 7.3.4.

[82] Ministry of Agriculture of Republic of Latvia (2004) Instruction – Methodology of the statistical forest inventory and calculation of secondary forest stand characteristics (*Meža statistiskās inventarizācijas veikšanas un mežaudzes sekundāro parametru aprēķināšanas metodika*).

Considerable decrease of total area of croplands as well as area of croplands on organic soils in 1995 is associated with moving of the National land use statistics to other methodology of land use definition. There is a linear correlation between sum of land use changes of croplands and grasslands and area of other lands in Latvia (R^2 = 0,98) (Figure 7.3.5).

Methodology for estimation of actual area of croplands and historical changes of land use, including estimation of area of organic soils starting from 1990, is under development. The net of the NFI sample plots and remote sensing based LANDSAT image analysis will be utilized for this task.

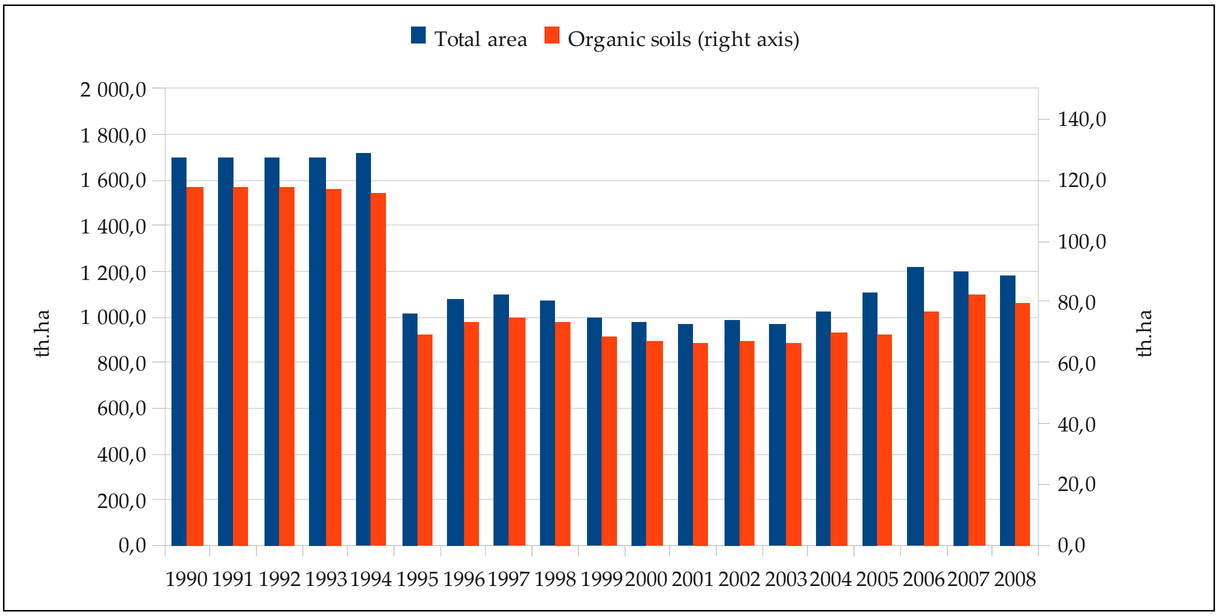

Figure 7.3.4 Total area and area of organic soils in the Cropland's category

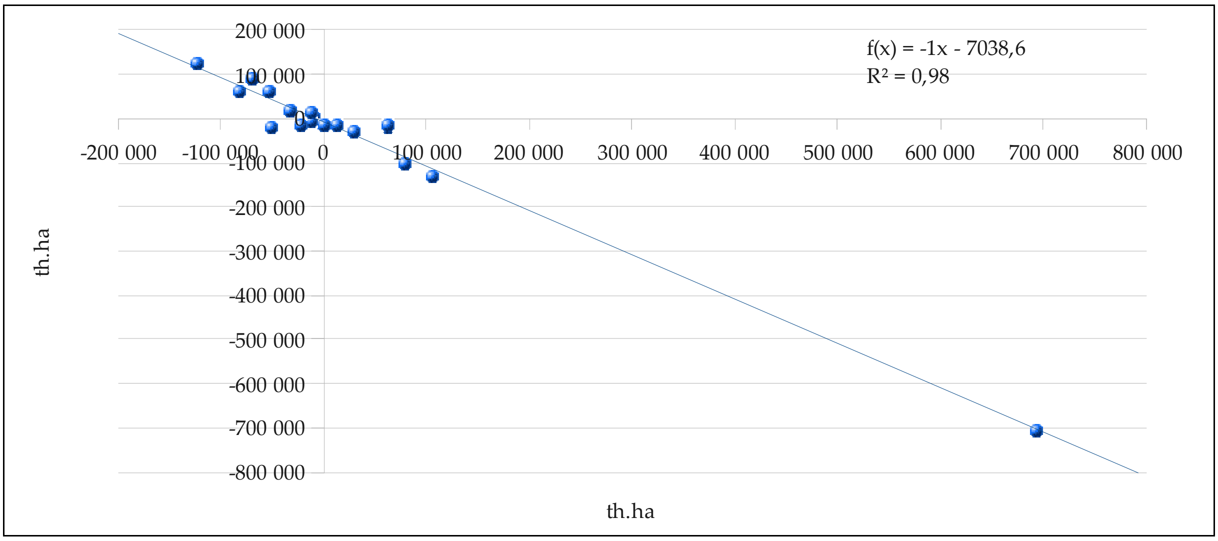

Figure 7.3.5 Correlation between yearly fluctuations of area of sum of croplands and grasslands and other lands after extraction of afforested areas.

7.3.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The Cropland refers to the official area of arable land, including orchards. The area is reported by the Central statistical bureau on the base of information gathered by the State land service. Area of arable lands is recalculated in 2008, excluding lands, where production of crops doesn't take place in practice.

7.3.4 Methodological issues

Emissions from organic soils were calculated using equation 3.3.5 of the IPCC GPG LULUCF. CO_2 emissions from liming have been calculated using equation 3.3.6 of the IPCC GPG LULUCF. In both cases Tier 1 method is applied.

For calculation of emission from organic soils emission factor is taken from Table 3.3.5 Annual emission factors (EF) for cultivated organic soils, emission factor for Cold temperate climate 1.0 ton C ha^{-1} yearly. For agricultural lime application overall emission factor of 0.12 was used to estimate CO_2 emissions, without differentiating between variable compositions of lime material.

7.3.5 Uncertainties and time-series consistency

Uncertainty in the area of organic croplands in 2008 was estimated at 30 % based on expert judgement. The uncertainty estimate for the CO_2 emission factor for organic soils is 90 % according to the IPCC GPG LULUCF. For emissions associated with the lime application uncertainty was estimated at 90 % based on expert judgement. This estimate is preliminary and could be revised by developing a more detailed model for the estimation of uncertainties.

The time series of emissions from croplands is not consistent because of limited information about historical area of croplands and, particularly, organic soils. Experts assumes, that actual area of drained organic soils in the Cropland's category should be considerably smaller, because of decomposition of organics and abandonment of wet a low valued croplands during last 20 years, therefore the most of them actually belong to the category Grassland, Wetland, Forest land or Other land. However these assumptions should be evaluated to avoid underestimation of emissions from drained croplands. Information about total area of croplands and organic soils in croplands will be provided by the NFI as soon as field measurements of depth of peat layer will be introduced.

7.3.6 Source-specific QA/QC and verification

The QA/QC plans for the Croplands' category includes the QC measures based on the IPCC (IPCC 2000, Table 8.1, p. 8.8-8.9). These measures are implemented every year during the inventory. Potential errors and inconsistencies are documented and corrections are made if necessary. The files and documents used in preparation of the inventory are archived annually and back-up copies are made weekly.

7.3.7 Source-specific recalculations, if applicable, including changes made in response to the review process

Changes in carbon stock in living biomass in the Cropland's category were calculated and reported in the Latvia’s National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2007. Further investigation of uncertainties in this category approved that reporting of removals in the Cropland's category can lead to overestimation; therefore these removals were excluded from estimation. Area of organic soils and emissions of CO_2 from drained organic soils were recalculated according to an expert judgement about area of organic croplands in Latvia. However these data will be revised again as soon as the NFI field measurement data will be available.

7.3.8 Source-specific planned improvements

Area of the Cropland, including area of croplands on organic soils, will be reporting according to a the field measurement data provided by the NFI. The category specific biomass expansion factors will be elaborated and incorporated into the NFI to estimate removals in living and dead biomass in the croplands. A monitoring network with 5 years cycle will be established on the base of the NFI to follow up to the carbon stock changes in soil. Therefore net emissions in all pools in this category will be reported on a stock change basis.

7.4 GRASSLAND (CRF 5.C)

7.4.1 Description

Under the Grassland's category emissions from organic soils and biomass burning are reported (Figure 7.4.1). The net emissions from grasslands were 8.77 Gg in Latvia in 2008. Several extraordinary pikes of emissions associated with burning of grass (for instance, in 2006) are associated with considerably larger area of fires initiated by favourable climatic conditions in 2006 (Figure 7.4.2).

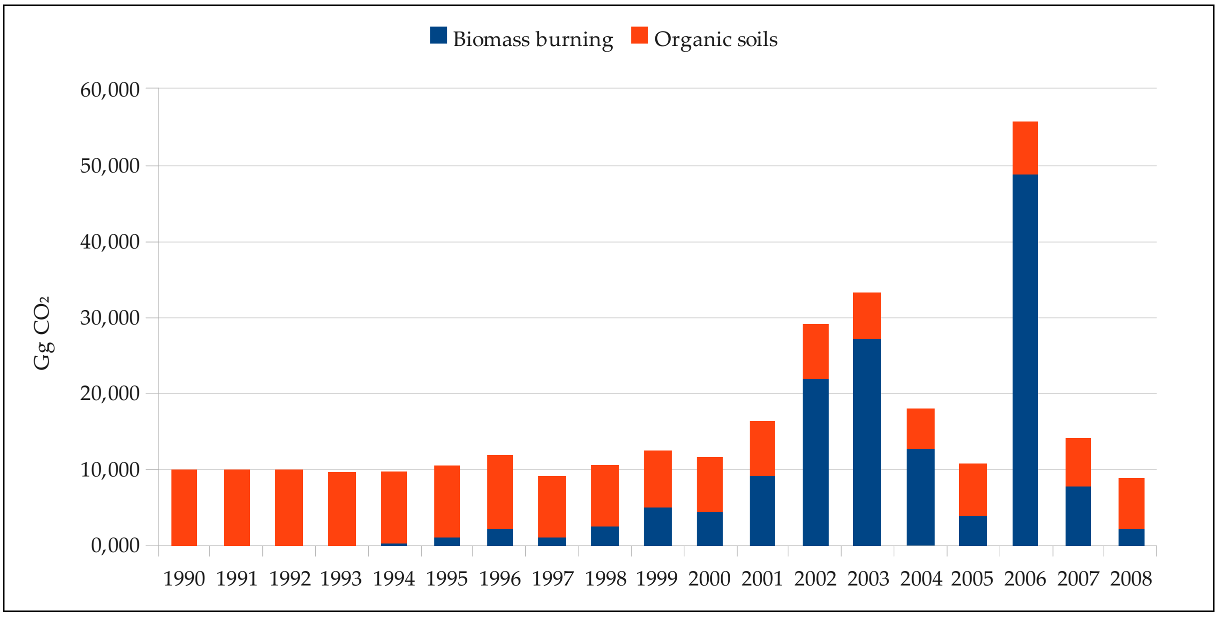

Figure 7.4.1 Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in the Grassland

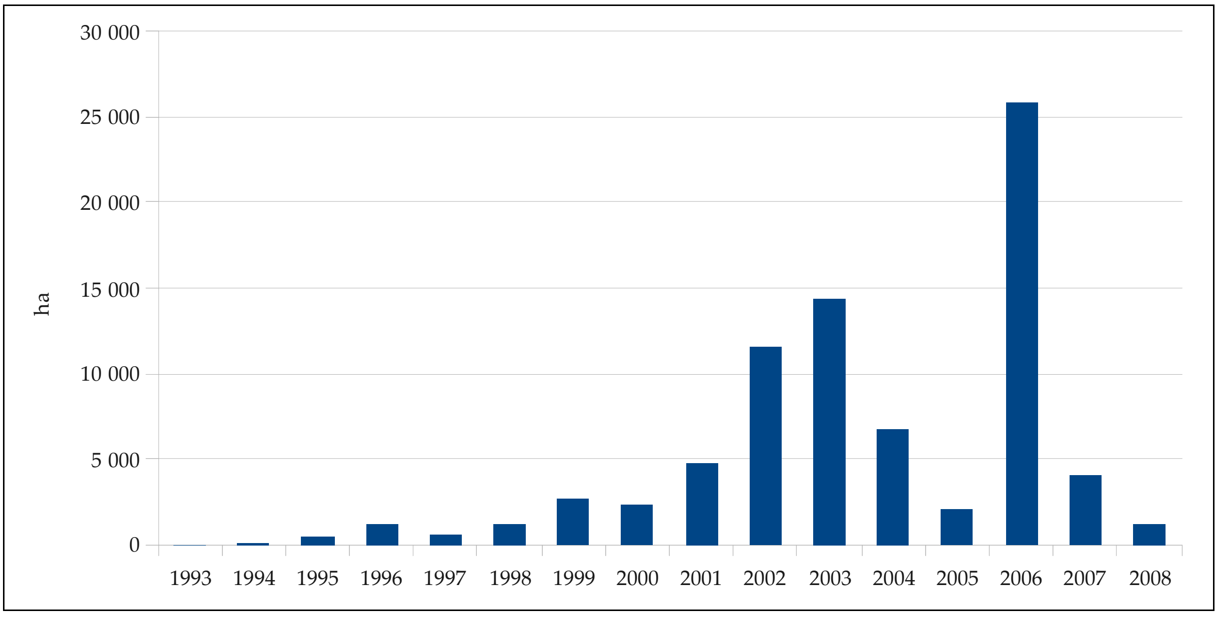

Figure 7.4.2 Statistics of artificial biomass burning in the Grassland

The total area of grasslands is estimated according to the information provided by the Central statistical bureau. Information about increment of woody biomass is provided by the NFI – measurement results from sample plots covered by woody vegetation fitting to the grasslands' definition. Area of grasslands covered by woody vegetation is calculated from an estimation of area represented by a single plot of the NFI.

All sample plots measured from 2004 to 2007 were used for recalculation of increment of biomass on settlements from 1990 to 2006. The average area represented by one permanent NFI sample is 400 ha[83] or 1.25 ha m^{-2}.

No removals are reported in this category to avoid an overestimation. Figures of yearly increment of timber volume in this category provided by the NFI are shown Figure 7.4.3. Constantly growing increment of timber volume in grasslands can be explained by the undisturbed development of woody vegetation in grasslands during last 20 years, however these data needs further evaluation before putting them into the inventory report.

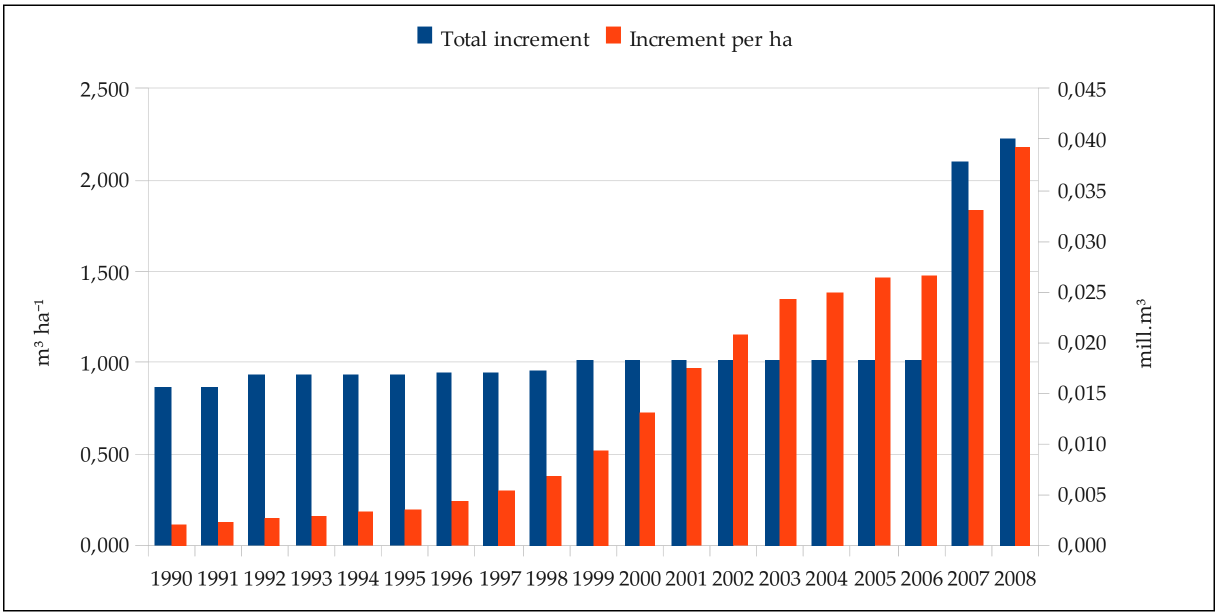

Figure 7.4.3 Increment of growing stock of timber on the Grassland

7.4.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Current approach of estimation of the area of the Grassland will be changed to geographically and historically representable data of the sample plot based NFI as soon as these data will be available. It is planned to complete calculation of actual area of the Grassland during the first quarter of 2010. After that the NFI database will be updated by adding remarks about current land use. Historical data of land use changes will be calculated using remote sensing technology by digital screening of LANDSAT satellite image series representing situation in 1990, 1995, 2000 and 2005. Actual field measurement data will be used for tuning up functions of the image analysis. Implementation of this work is planned for the second half of 2010.

The total area of the Grassland reported by the Central statistical bureau and area of grasslands on organic soils estimated on the base of expert judgement is shown in Figure 7.4.4.

[83] Ministry of Agriculture of Republic of Latvia (2004) Instruction – Methodology of the statistical forest inventory and calculation of secondary forest stand characteristics (*Meža statistiskās inventarizācijas veikšanas un mežaudzes sekundāro parametru aprēķināšanas metodika*).

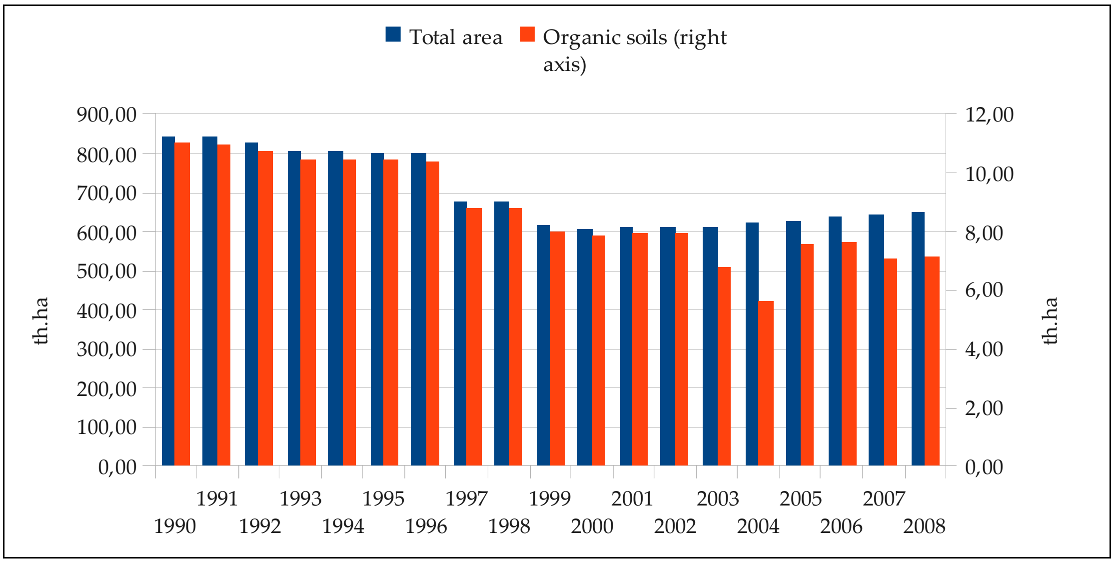

Figure 7.4.4 Total area and area of organic soils in the Grassland's category

7.4.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The grassland area is reported by the Central statistical bureau on the base of information gathered by the State land service. Area of grasslands corresponds to area of cultivated perennial grasses. The information is based on statistical reports about cultivation of farmlands. Abandoned arable lands are excluded from the list of arable lands and moved the category Other lands to secure consistency with the agriculture section in the report.

7.4.4 Methodological issues

Quantity of fuel burnt was calculated according to the IPCC GPG LULUCF Table 3.4.2 Default estimates for standing biomass grassland (as dry matter) and aboveground net primary production, classified by IPCC climate zones, a value for cold temperate wet climate – 2 400 kg ha^{-1}. Information about fires on the Grassland was obtained from the State Fire and Rescue Service. Emission factors corresponding to a moist-infertile grassland from IPCC GPG LULUCF Table 3A.1.16 Emission factors (g kg^{-1} dry matter combusted) applicable to fuels combusted in various types of vegetation fires were used to calculate emissions (Table 7.4.1).

Table 7.4.1 Emission factors for moist-infertile grasslands

GHG	Emission factor
CO_2	1 498
CO	59
CH_4	2
NO_2	4
N_2O	0.1

Fraction of the biomass combusted during grass burning was taken from the IPCC GPG LULUCF Table 3A.1.12 Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types, dimensionless. Factor for peat-lands (0.5) was applied in the calculations.

CO_2 emissions from drained organic soils were estimated according to the IPCC GPG LULUCF Table 3.4.6 Annual emission factors (EF) for managed grassland organic soils. Emission factor for cold temperate climate (0.25 tonnes C ha^{-1} yearly) was used.

7.4.5 Uncertainties and time-series consistency

Uncertainty in the area of organic grassland was estimated at 30 % based on expert judgement. The uncertainty estimate for the CO_2 emission factor for organic soils is 90 % according to the IPCC GPG LULUCF. For biomass burning uncertainty was estimated at 100 % based on expert judgement. This estimate is preliminary and could be revised by developing a more detailed model for the estimation of uncertainties.

The time series of emissions from grasslands is not consistent because of limited information about historical development of organic soils. Experts assumes, that actual area of drained organic soils in the Grassland's category should be considerably smaller, because of decomposition of organics and abandonment of wet a low valued grasslands during last 20 years, therefore the most of them actually belong to the categories Wetlands, Forest lands or Other lands. However these assumptions should be evaluated to avoid underestimation of emissions from drained grasslands. Information about actual area of organic grasslands will be provided by the NFI as soon as field measurements of depth of peat layer will be introduced.

7.4.6 Source-specific QA/QC and verification

The QA/QC plans for the Grassland's category includes the QC measures based on the IPCC (IPCC 2000, Table 8.1, p. 8.8-8.9). These measures are implemented every year during the inventory. Potential errors and inconsistencies are documented and corrections are made if necessary. The files and documents used in preparation of the inventory are archived annually and back-up copies are made weekly.

7.4.7 Source-specific recalculations

Changes in carbon stock in living biomass in the Grassland's category were calculated and reported in the Latvia's National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2007. Consultations with the ERT experts and further investigation of uncertainties in this category demonstrated that reporting of removals in the Grassland may lead to overestimation, therefore these removals were excluded from estimation. Area of organic soils and emissions of CO_2 from drained soils were recalculated as well according to an expert judgement about area of organic grasslands in Latvia. However these data will be revised again as soon as the NFI field measurement data will be available.

7.4.8 Source-specific planned improvements

Area of grasslands, including organic soils, will be reporting according to a field measurement data provided by the NFI. The category specific biomass expansion factors will be elaborated and incorporated into the NFI to estimate removals in living and dead biomass in the grasslands. A monitoring network with 5 years cycle will be established on the base of the NFI to follow up to the carbon stock changes in soil and litter. Therefore net emissions in all pools, except emissions related to the biomass burning, in this category will be reported on a stock change basis.

7.5 WETLANDS (CRF 5.D)

7.5.1 Description

According to the IPCC GPG LULUCF wetlands include land that is covered or saturated by water for all or part of the year and that does not fall into the forest land, cropland, and grassland or settlement categories[84]. Total area of wetlands is reported.

[84] 1.Penman J., Gytarsky M., Hiraishi T., Krug T., Kruger D., Pipatti R., Buendia L., Miwa K., Ngara T., Tanabe K., Wagner F. (eds) (2003) Good Practice Guidance for Land Use, Land-Use Change and Forestry, Institute for Global Environmental Strategies (IGES), 2108 -11, Kamiyamaguchi, Hayama, Kanagawa, Japan, 587.

Latvia reports CO_2 emissions associated with industrial peat extraction in this category. Information about peat extraction provided by the Central statistical bureau and other data sources[85] is shown in Figure 7.5.1. However, default activity data (area of industrial peatlands) provided in Table 3a.3.3 of the IPCC GPG LULUCF are used in calculation of emissions to avoid underestimation of emissions using alternative approach – calculation of are of industrial peatlands assuming that the peat extraction rate is 0.016 mill.t km^{-2}. Using the default data from Table 3a.3.3 area of industrial peatlands in Latvia is 27 000 ha every year; extraction rate calculations results in 3 246 ha in 2008. Emissions of CO_2 from drained industrial peatlands are reported under Table 5.D.1 Wetlands remaining wetlands as carbon stock changes. Emissions of N_2O are reported under Table 5(II) Non-CO_2 emissions from drainage of soils and wetlands. No emissions of CH_4 are reported in this category as there are no input data as well as default methodology in the IPCC GPG LULUCF. Aggregated emissions from industrial peatlands are equal for the whole time series due to lack of data about status of industrial peatlands prepared for extraction 20-40 years ago.

However there is no evidence of new industrial peatlands prepared for peat extraction after 1990, therefore risk of underestimation of emissions is minimal. Reported GHG emissions from industrial peatlands are 21.12 Gg CO_2 equivalents yearly (Figure 7.5.1).

Default IEF for nutrien poor organic soils (0.10 kg N_2O-N ha^{-1} yearly) from Table 3.A.3.4 is used for calculations of N_2O emissions from drained wetlands utilized for industrial peat production. Default IEF for nutrient poor organic soils (0.2 t C ha^{-1} yearly) is used in calculations of CO_2 emissions.

Estimation of emisions from industrial peat-lands will be improved in future by specification of information about area utilized for peat extraction, share of nutrient rich and poor peatlands and corresponding emissions of non-CO_2 emissions on the base of field measurement data implemented in 70ths and 90ths of the last century, but not evaluated jet in terms of carbon stock change. Both activity data and emission factors will be re-evaluated.

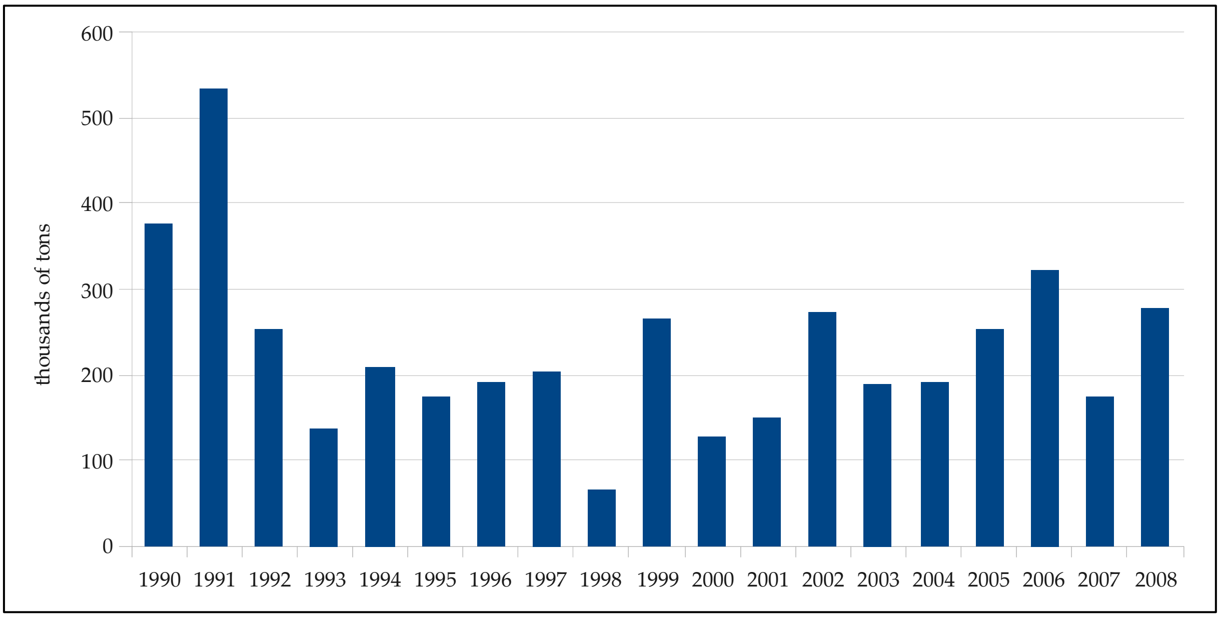

Figure 7.5.1 Peat extraction in Latvia, calculated to carbon

[85] Lazdiņš A., Strazdiņš U. (2004) Recommendations for renting peat-lands for peat extraction and recommendations for elaboration of peat-land management strategy (Kūdras atradņu nomas nosacījumi, ieteikumi kūdras izmantošanas stratēģijas izstrādāšanai), A/s “Latvijas valsts meži”, 93 pp.; Latvia's report on environment (Latvijas vides pārskats), 1998 (http://www.lva.gov.lv/produkti/soe98_lv/).

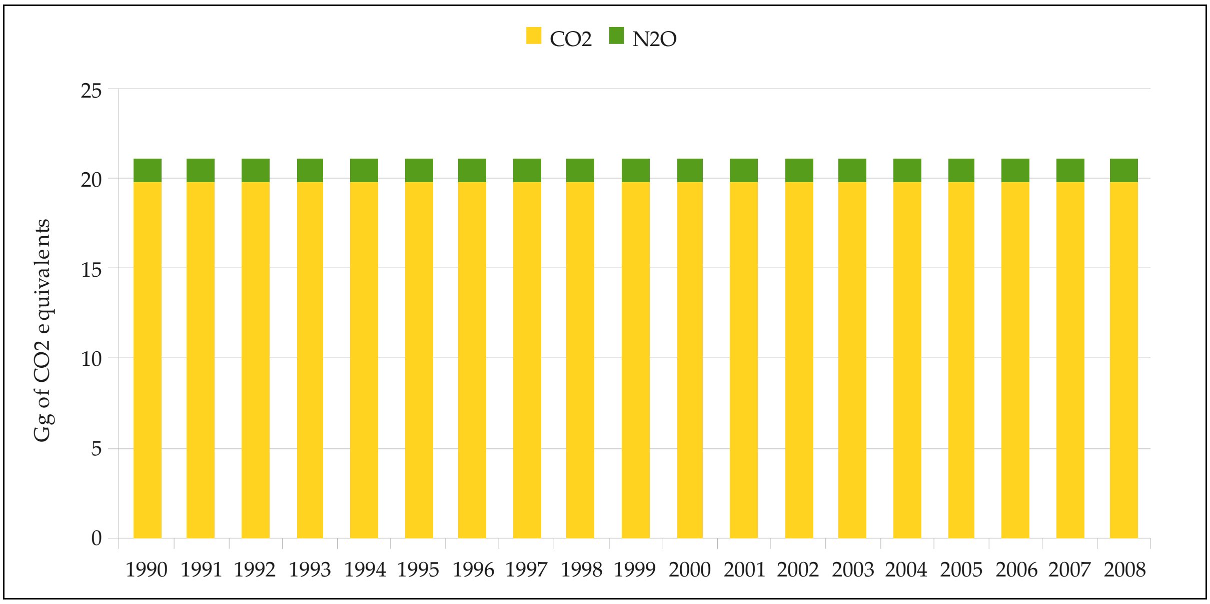

Figure 7.5.1 Emissions associated with industrial peat extraction

The total area of wetlands is estimated according to the information provided by the State land service. Information about increment of woody biomass is provided by the NFI – measurement results from sample plots covered by woody vegetation fitting to the wetlands' definition. Area of wetlands covered by woody vegetation is calculated from an estimation of area represented by a single plot of the NFI. Due to different number of plots measured every year, this number differs from year to year. All sample plots measured from 2004 to 2007 were used for recalculation of increment of biomass on settlements from 1990 to 2006.

No removals are reported in this category to avoid an overestimation. Estimations of yearly increment of timber volume in this category provided by the NFI are shown Figure 7.5.2. Considerable higher increment of timber volume in 2008 can be explained by coincidence (different structure of sample plots in a compare to a next and previous years). It is above the uncertainty level of the increment. These results will be validated in further reporting.

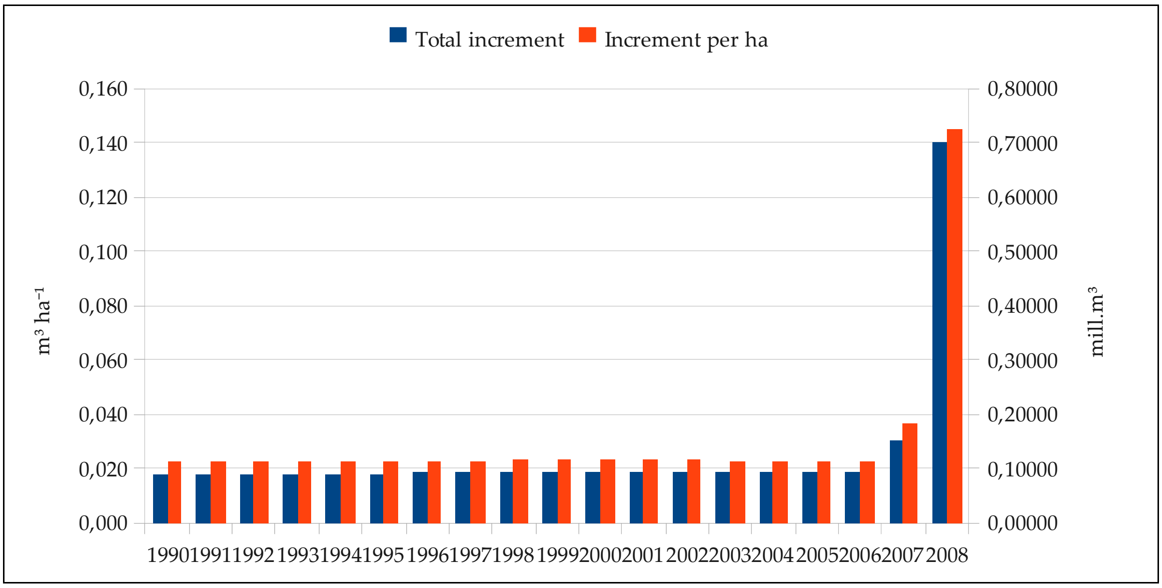

Figure 7.5.2 Increment of growing stock of timber on the Wetland

7.5.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Current approach of estimation of the area of the Wetlands is temporary solution, because it doesn't provide geographical and land use category representation of historical land use changes. It is planned to complete calculation of actual area of the Wetlands during the first quarter of 2010. After that the NFI database will be updated by adding remarks about current land use. Historical data of land use changes will be calculated using remote sensing technology by digital screening of LANDSAT satellite image series representing situation in 1990, 1995, 2000 and 2005. Actual field measurement data will be used for tuning up functions of the image analysis. Implementation of this work is planned for the second half of 2010.

The total area of the Wetlands reported by the State land service and area of wetlands covered by woody vegetation reported by the NFI is shown in Figure 7.5.3. Fluctuations of total area of the Wetlands in the data provided by the State land service are generally caused by methodological issues and not by actual land use changes.

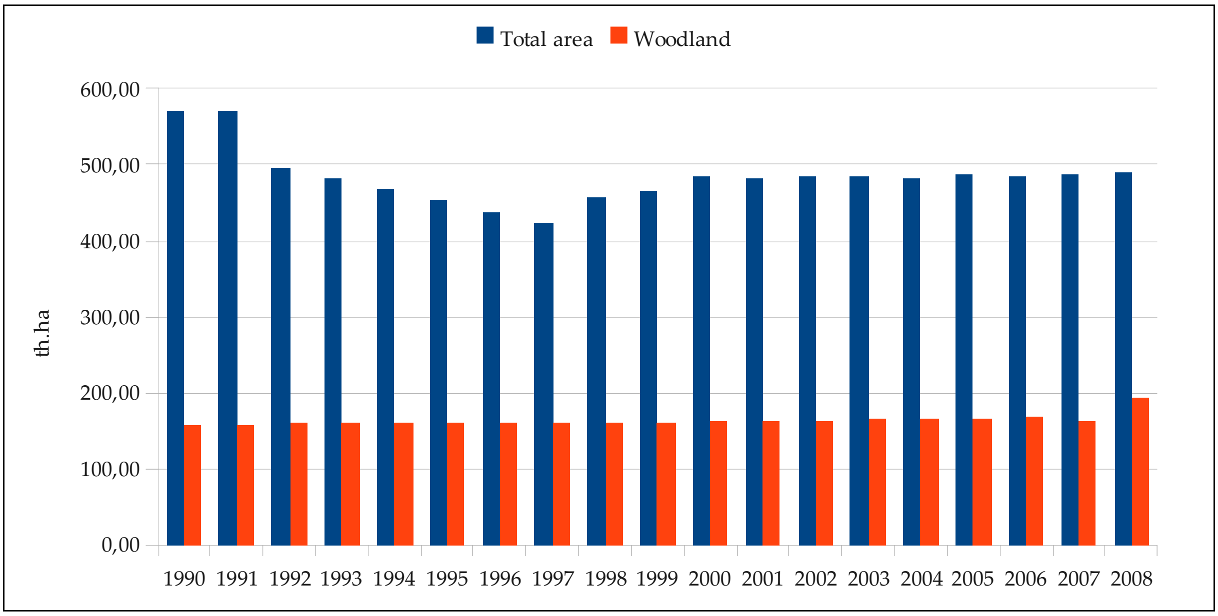

Figure 7.5.3 Total area and area covered by woody vegetation in the Wetlands' category

7.5.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Wetlands include peat-lands which do not fulfils the definition of Forest land, Cropland or Grassland. The area of Wetlands is estimated from the State land service data. Note that emissions are reported only from the industrial peat extraction areas as required in the GPG LULUCF (IPCC 2003).

Classification of wetlands in the NFI and other national regulations of the land use are equal, however the NFI provides much more detailed information, particularly, about removals in woody vegetation.

7.5.4 Methodological issues

Factor for calculation of carbon content in peat used in calculations is 53.5 %[86]. This factor relates to unpublished data available locally in different sources; however it doesn't represent trends in production of so called “grass” and “moss” peat, which have considerable differences in carbon content. The Central statistical bureau provides information about production of peat with 40 % relative moisture, therefore before calculation to carbon content data about peat extraction were recalculated to dry mass. Note that these factors are not used for calculations of emissions and removals, but only for informative purpose to characterize extracted peat and, indirectly, industrial peatlands.

7.5.5 Uncertainties and time-series consistency

Uncertainity level of CO_2 and N_2O emission factors assumed 95 %[87] according to the IPCC GPG LULUCF. Uncertainty level of area estimations assumed 90 % according to the expert judgement.

Uncertainty level for peat extraction according to the expert estimation is 10 %, however it takes in account only amount of produced peat and area. The information will be updated as soon as more detailed information will be collected in the NFI. Complete consistency of the time-series of the area of the Wetlands and transitions between different land use categories, including are converted to peat workings, will be secured after implementation of LANDSAT image analysis. From this point it will be possible to recalculate actual emissions associated with drainage of peat-lands for peat extraction.

7.5.6 Source-specific QA/QC and verification

Quality control procedures named in IPCC GPG LULUCF (IPCC, 2003) were done, particularly, data about peat extraction were compiled from different sources as well as emission factors provided by different authors were compared.

7.5.7 Source-specific recalculations

As soon as data on biomass removals were available from the NFI, changes in carbon stock in living biomass in the Wetlands' category were calculated and reported in the Latvia’s National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF)1990-2007. Consultations with the ERT experts demonstrated that reporting of removals in the Wetlands can lead to overestimation of removals, therefore living biomass was excluded from estimation. Instead of that emissions related to peat extraction were calculated on the base of information about extracted peat volume. Information in this category is not complete and will be updated in future.

7.5.8 Source-specific planned improvements

The most important task for the next reporting period is estimation of actual area of wetlands as well as industrial peatlands, including historical land use changes. This information will be used to estimate actual emissions associated with industrial drainage of peat-lands.

LSFRI Silava is elaborating methodology for estimation of land use and carbon stock changes in the Wetlands' category on the base of the NFI measurements. All carbon pools will be estimated in this category. The methodology will also contain principles for calculation of emissions from land use conversion.

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86 R. Zevenhoven et.al. (1996) Pressurized gasification properties of fossil fuels, bio-fuels and wastes. In: Finnish-Swedish Flame Days 1996, September 3-4, Naantali, Finland, pp. 1-31, Abo Akademi University, Combustion Chemistry Research Group, Turku/Abo.

87 According to lognormal distribution.

7.6 SETTLEMENTS (CRF 5.D)

7.6.1 Description

Areas of settlements comprise nationally defined build-up land, supplementary infrastructure, roads and separating bands. Area of settlements is estimated according to the information provided by the State land service, information about increment of woody biomass is provided by the NFI – measurement results from sample plots covered by woody vegetation fitting to the Settlements' definition, including forest infrastructure categorized as settlements. Area of settlements covered by woody vegetation is calculated from an estimation of area represented by a single plot of the NFI. Due to different number of plots measured every year, this number differs from year to year. However, all sample plots measured from 2004 to 2007 were used for recalculation of increment of biomass on settlements from 1990 to 2006.

No removals are reported in this category assuming that it is not a source to avoid an overestimation. Estimations of yearly increment of timber volume in this category provided by the NFI are shown Figure 7.6.1. Considerable higher increment of timber volume in 2007 can be explained by coincidence – different structure of sample plots in a compare to a next and previous years. It is below the uncertainty level of the increment.

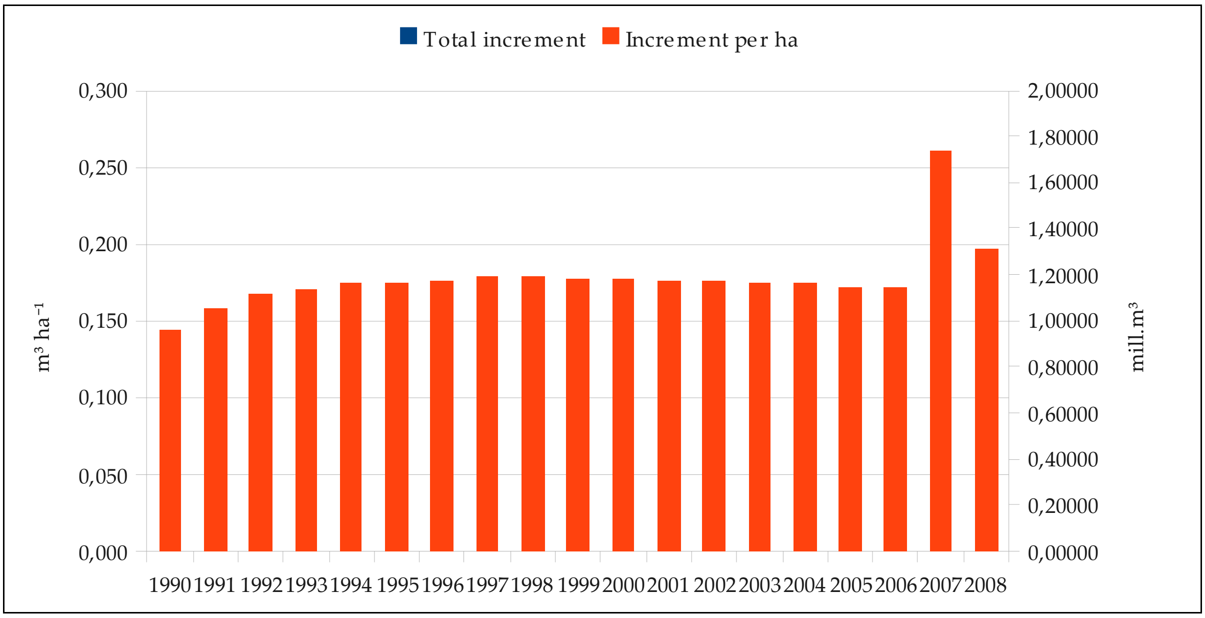

Figure 7.6.1 Increment of growing stock of timber on Settlements

The emissions from land conversion to Settlements are not reported. The method to estimate land transitions from other land-use categories to Settlements is under development.

7.6.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Current approach of estimation of the area of Settlements is temporary solution, because it doesn't provide geographical and land use category representation of historical land use changes. It is planned to complete calculation of actual area of Settlements during the first quarter of 2010. After that the NFI database will be updated by adding remarks about current land use. Historical data of land use changes will be calculated using remote sensing technology by digital screening of LANDSAT satellite image series representing situation in 1990, 1995, 2000 and 2005. Actual field measurement data will be used for tuning up functions of the image analysis. Implementation of this work is planned for the second half of 2010 and it strongly depends from availability of funding.

The total area of Settlements reported by the State land service and area of settlements covered by woody vegetation reported by the NFI is shown in Figure 7.6.2. Fluctuations of area of the Settlements in the data provided by the State land service are generally caused by methodological issues and not by actual land use changes.

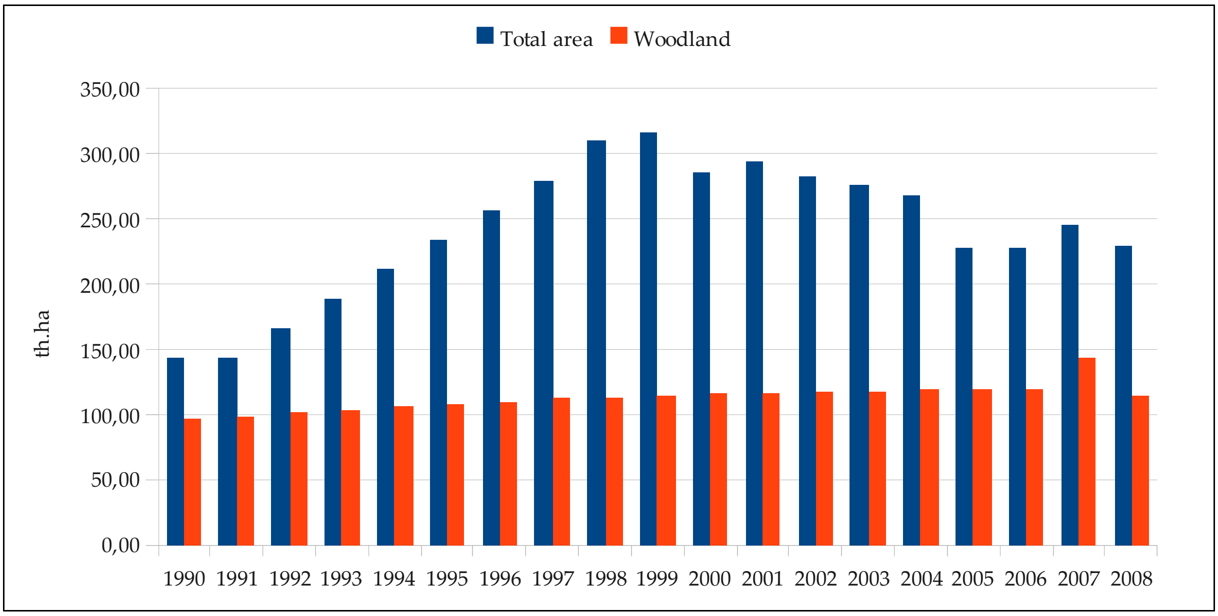

Figure 7.6.2 Total area and area covered by woody vegetation in the Settlements' category

7.6.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The area of settlements is estimated according to the data provided by the State land service. Only the total area of Settlements is reported. According to the regulation No 562 (21.08.2007) of Cabinet of Ministers of Republic of Latvia Settlements are land below buildings, yards and service infrastructure as well as land under roads, rail-roads, streets and separating bands. Classification of settlements in the NFI and other national regulations of the land use are equal, however the NFI provides much more detailed information.

7.6.4 Methodological issues

No removals or emissions are reported in this category to avoid overestimation during recalculation from timber volume estimated by the NFI to the total increment of biomass. Methodology for estimation of annual carbon stock changes in the Settlements using information obtained by the NFI is under preparation.

7.6.5 Uncertainties and time-series consistency

Level of uncertainties is considerably high – for increment of living above-ground timber volume for the whole time series it is in average 63 %, therefore it is not reported yet. The information will be updated as soon as better methods will by elaborate. Time-series used for calculation of increment of living biomass are consistent and can be geographically identified as the same NFI sample plots are used in calculations in the whole period. However currently the NFI represents only area of Settlements covered by woody vegetation from 2004 to 2008. Complete consistency of the time-series of the area of the Settlements and transitions between different land use categories will be secured after implementation of LANDSAT image analysis.

7.6.6 Source-specific QA/QC and verification

Not applicable.

7.6.7 Source-specific recalculations

As soon as data on biomass removals were available from the NFI, changes in carbon stock in living and dead biomass in Settlements were calculated and reported in the Latvia’s National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF)1990-2007. Further investigations and consultations with the ERT experts demonstrated that reporting of removals in the Settlements may lead to overestimation, therefore these removals were excluded from estimation.

7.6.8 Source-specific planned improvements

LSFRI Silava is elaborating methodology for estimation of land use and carbon stock changes in the Settlements' category on the base of the NFI measurements. Only living biomass will be estimated in this category, taking in account, that increment of carbon stock in dead biomass as well as in soil is unpredictable. The methodology will also contain principles for calculation of emissions from land use conversion to Settlements.

7.7 OTHER LANDS (CRF 5.F)

7.7.1 Description

Area of this land-use category is estimated on the base three sources – Central statistical bureau, State land service and NFI. The Central statistical bureau provides area of lands categorized as Other lands, which aren't farmlands or forest lands (1 459.3 mill. ha in 2008). Then area of wetlands and settlements are excluded according to data provided by the State land service. Finally difference between actual forest area in the NFI and data provided by the Central statistical bureau is used to calculate area of Other land.

Information about increment of woody biomass in Other lands is provided by the NFI – measurement results from sample plots covered by woody vegetation fitting to the Other lands" definition, including forest lands categorized as Other land. Area of Other land covered by woody vegetation is calculated from an estimation of area represented by a single plot of the NFI. Due to different number of plots measured every year, this number differs from year to year. However, all sample plots measured from 2004 to 2007 were used for recalculation of increment of biomass on settlements from 1990 to 2006.

No removals are reported in the Other lands' category assuming that it is not a source to avoid an overestimation. Estimations of yearly increment of timber volume in this category provided by the NFI are shown Figure 7.7.1. Considerable higher increment of timber volume in 2007 and 2008 can be explained by coincidence – different structure of sample plots in a compare to a next and previous years. It is below the uncertainty level of the increment.

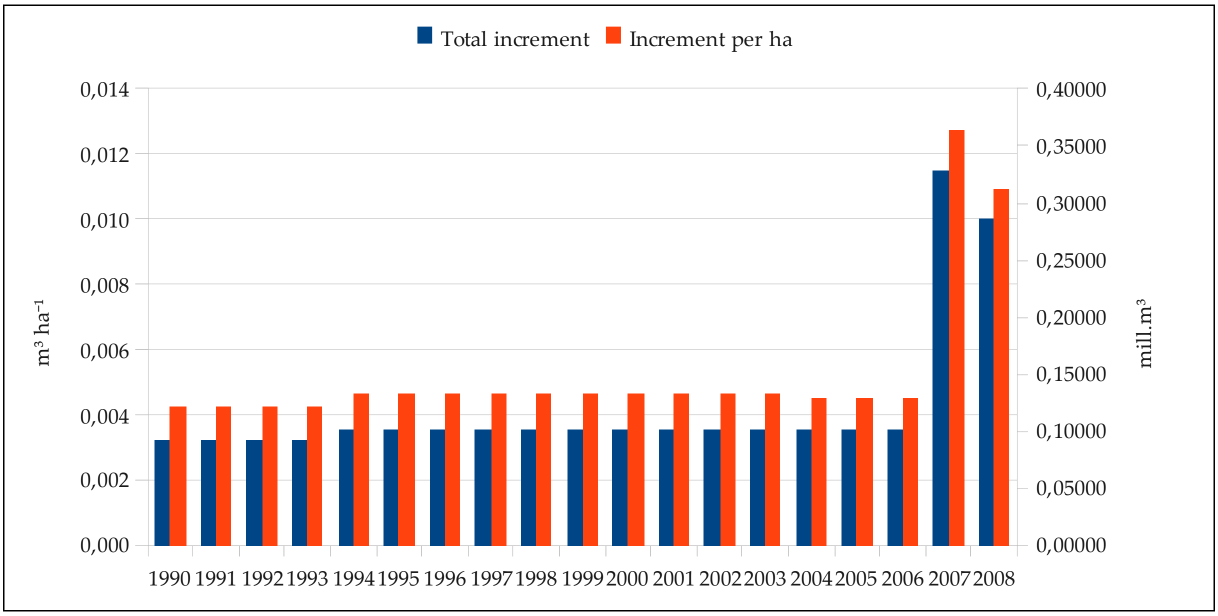

Figure 7.7.1 Increment of growing stock of timber on Other lands

The emissions from land conversion to Other lands are not reported. The method to estimate land transitions from other land-use categories to Other lands is under development, however it should be taken in account, that the main reason for conversion to Other land use category is abandonment, therefore there are no artificially induced emissions.

7.7.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Current approach of estimation of the area of the Other lands is temporary solution, because it doesn't provide geographical and land use category representation of historical land use changes. LSFRI Silava is working on elaboration of methodology for estimation historical fluctuations of land use changes on the base of data fixed during field visits of every NFI plot, including those, where woody vegetation were not found. It is planned to complete calculation of actual area of the Other lands during the first quarter of 2010. After that the NFI database will be updated by adding remarks about current land use. Historical data of land use changes will be calculated using remote sensing technology by digital screening of LANDSAT satellite image series representing situation in 1990, 1995, 2000 and 2005. Actual field measurement data will be used for tuning up functions of the image analysis. Implementation of this work is planned for the second half of 2010.

The total area of Other lands and area of settlements covered by woody vegetation reported by the NFI is shown in Figure 7.7.2. Fluctuations of the total area of Other lands are generally caused by methodological issues (accounting of area of Cropland and Grassland) and not by actual land use changes.

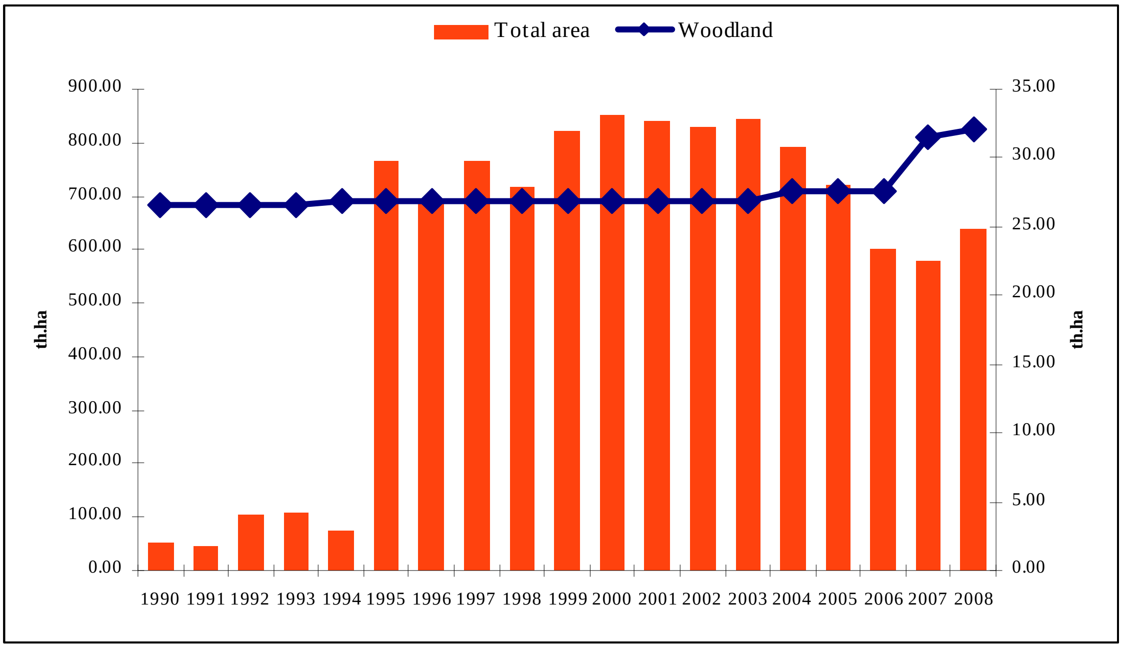

Figure 7.7.2 Total area and area covered by woody vegetation in the Other lands' category

7.7.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The area of Other lands is estimated according to the data provided by the Central statistical bureau, State land service and NFI. These data are obtained mathematically by accounting differences between the evaluated data sources. Classification of the Other lands in the NFI and other national regulations of the land use are equal, however the NFI provides much more detailed information. Other land according to the regulation No 562 (21.08.2007) of Cabinet of Ministers of Republic of Latvia includes dunes, cemeteries, glades, firebreaks, parks, glens, steep banks, slopes, if they don't fit to Forest land or Wetland definition, as well as land which is used for extraction of mineral deposits. Abandoned farmlands, which aren't accounted as the Cropland or Grassland are also moved to the Other land category. The area of Other lands reported by the State land service and Central statistical bureau differs from the area reported here, because certain part of abandoned farmlands is already afforested and therefore moved to the Forest land category. Only the total area of Other land is reported.

As soon as better methodology will be available the category Other lands will be split into Other lands remaining other lands and Lands converted to other lands. The second group will represent abandoned lands in transitional stage (like abandoned croplands before they fit to the forest definition), therefore it will be possible to complete land use change matrix.

7.7.4 Methodological issues

Latvia does not report emission and removals in the category Land converted to other land. The activity data for conversion areas pursuant to the IPCC land use categories is not yet available. The method to estimate converted areas is under development. Also the method to estimate emissions for all conversion categories needs to be further developed.

7.7.5 Uncertainties and time-series consistency

Level of uncertainties is considerably high – for increment of living above-ground timber volume for the whole time series it is in average 42 %. The information will be updated as soon as better methods will by elaborate. Time-series used for calculation of increment of living biomass are consistent and can be geographically identified as the same NFI sample plots are used in calculations in the whole period.

However currently the NFI represents only area of the Other lands covered by woody vegetation from 2004 to 2008. Complete consistency of the time-series of the area of the Other lands and transitions between different land use categories will be secured after implementation of LANDSAT image analysis.

7.7.6 Source-specific QA/QC and verification

Not applicable.

7.7.7 Source-specific recalculations

As soon as data on biomass removals were available from the NFI, changes in carbon stock in living and dead biomass in the Lands converted to other lands were calculated and reported in the Latvia's National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2007. Further investigations and consultations with the ERT experts demonstrated that reporting of removals in the Other lands' category may lead to overestimation, therefore these removals were excluded from estimation. The area of the other lands was moved from the category of converted lands to the category of Other lands remaining other lands due to lack of information about actual land use changes. Information will be updated as soon as the NFI will provide recalculation of land use on the base of the measurement data.

7.7.8 Source-specific planned improvements

LSFRI Silava is elaborating methodology for estimation of land use and carbon stock changes in the Other lands' category on the base of the NFI measurements. Living biomass, dead biomass and soil carbon stock changes will be reported under the category Lands converted to other lands.

7.8 BIOMASS BURNING (CRF 5 (V))

7.8.1 Description

This source category includes greenhouse gas emissions (CO_2, CH_4, N_2O) and other air emissions (NO_x and CO) from biomass burning on forest land comprising wildfires and controlled burning as well as biomass burning (grass fires) in the Grassland's category. At the moment complete statistics on burned biomass are not available. The area statistics on wildfires are compiled by the State forest service and they are based on information given the local units. In the statistics all wildfires are classified as forest fires and for this reason it is not possible to separate wildfires on wetlands and other land from fires on forest land. Similarly it's not possible to separate biomass burning on Grassland and Other land. Classifying land area by IPCC land-use category, forest fires can happen on Forest land, Wetlands and Other land. All wildfires are reported under the category Forest land remaining Forest land.

Emissions from biomass burning are represented by incineration of slash during forest logging operations. The information is based on the expert judgement[88] and it is outdated for the moment, because on-site biomass burning is used very rear nowadays in logging operations, however due to a lack of better data, these emissions are reported in the inventory.

Total aggregated emissions from biomass burning in 2008 were 338.3 Gg of CO_2 equivalents (Figure 7.8.1).

[88] Līpiņš L. (2004) Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resursu un to izmantošanas efektivitātes novērtējums).

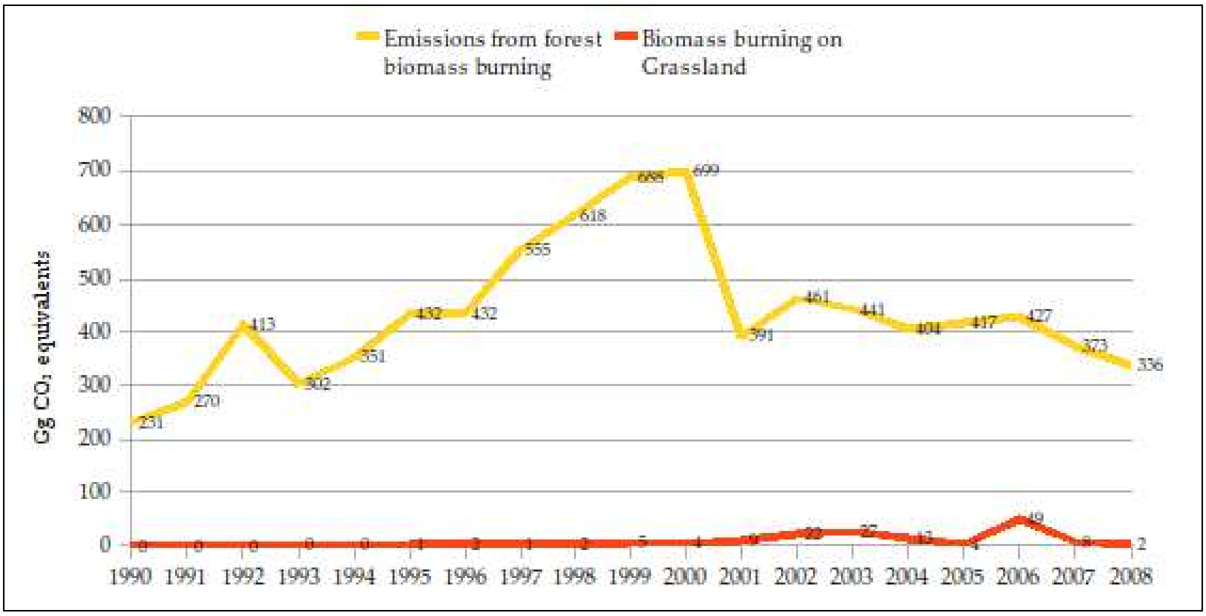

Figure 7.8.1 Aggregated emissions from biomass burning

Significant linear regression found between area of forest wildfires and grassland burning (R^2 = 0.59, Figure 7.8.2), which indirectly shows that both data collected by independent institutions are trustable.

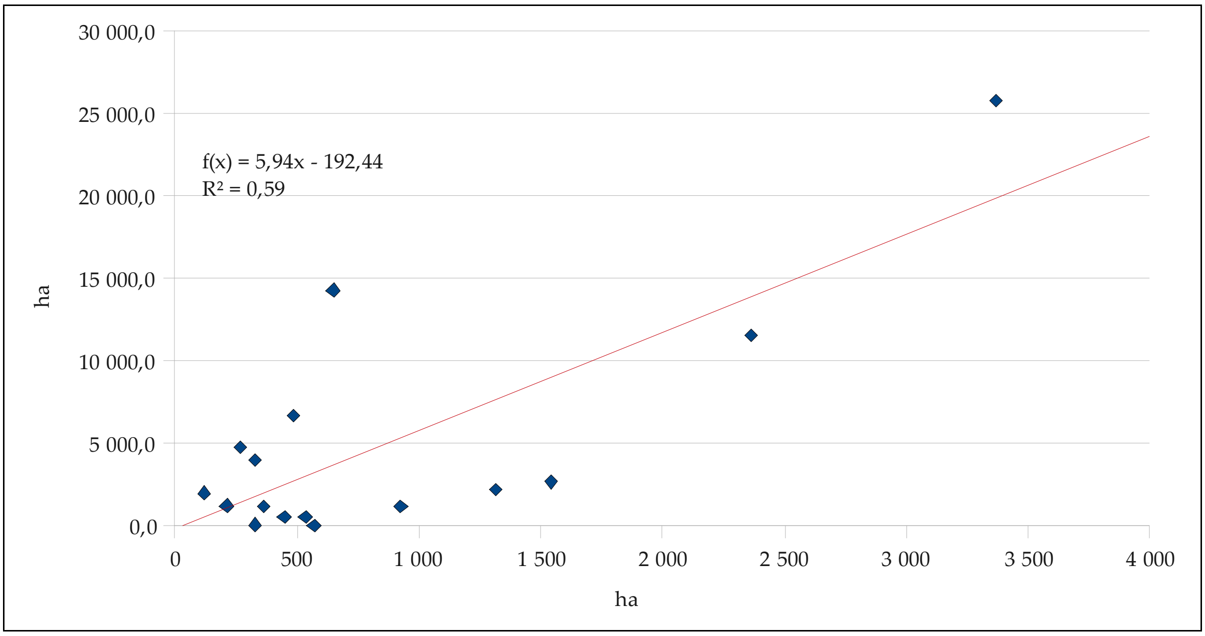

Figure 7.8.2 Emissions from biomass burning and correlation between areas of forest wildfires and areas of grassland burning

7.8.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Area of forest wildfires in time period between 1990 and 2008 is provided by the State forest service, amount of burned biomass[89] is calculated accordingly to the data provided by the NFI – area of forests corresponding to sample plots, where fire damages are detected, and volume of damaged trees.

[89] Trees damaged by fire

7.8.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Biomass burning relies to Forest land and Grassland.

7.8.4 Methodological issues

Tier 1 and 2 methods of calculation provided in the IPCC GPG LULUCF were utilized. Emissions from wildfires were calculated using equation 3.2.20 of the IPCC GPG LULUCF.

Emissions from controlled burning were calculated using equation 3.2.19 and emission ratios were taken from Table 3A.1.15 of the IPCC GPG LULUCF.

Weighted average wood density from the Table 7.2.2 was used in calculation. The same BEFS as in case of increment of living biomass and emissions from forest logging operations were used. Underground biomass is not taken in account in this calculation.

For emission calculation from controlled burning of slash in forest default emission factors according IPCC GPG LULUCF are used (Table 7.8.1).

Table 7.8.1 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[90]. The following assumptions have been made for slash calculation, which was burned[91]:

- Slash on-site burning 50% in period from 1990 to 1999, the rest 50% left to decay;
- Starting from 2001 – slash 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. Assumptions that have been made for calculation are shown in Table 7.8.2.

Table 7.8.2 Factors and parameters used for calculations of change in carbon stock in living biomass

Weighted average wood density	0.5 ($t_{d.m.}$ m^{-3})
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 $t_{d.m.}^{-1}$)

For wildfires default factor (*for all boreal forest – 0.34*) from Table 3A.1.12 Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types were used to calculate the amount of burned biomass.

[90] Līpiņš L. (2004) Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resursu un to izmantošanas efektivitātes novērtējums).
[91] Source: State Forest Service

Emission factors for CH_4, CO, N_2O, NO_x and CO_2 are taken from Table 3A.1.16 Emission Factors (g kg^{-1} dry matter combusted) applicable to fuels combusted in various types of vegetation fires (Table 7.8.3).

Table 7.8.3 Emission factor for each GHG (g $kg_{d.m.}^{-1}$)

CO_2	CH_4	CO	N_2O	NO_x
1532	7.1	112	0.11	0.7

7.8.5 Uncertainties and time-series consistency

Uncertainty in activity data (area) for biomass burning is estimated at ± 10 % based on expert judgement. Uncertainty concerning combustion efficiencies in combined is 10 % according to the expert judgement. Uncertainties in emission factors (± 70 %) are based on the IPCC GPG LULUCF default values.

7.8.6 Source-specific QA/QC and verification

Quality control procedures named in IPCC GPG LULUCF Table 5.5.1 were done. Possible overlapping in emission/removal estimation with other sources has been checked as far as it is possible on the base of existing data. Land areas of wildfires and controlled burning were reviewed with latest statistics. It was confirmed that all data used in this section cover whole land area of Latvia.

7.8.7 Source-specific recalculations

No recalculations were done for the reporting period 1990-2008, however as soon as combustion efficiencies, amount of biomass incinerated on-site and amount of biomass damaged in forest fires will be estimated, these data will be recalculated for the whole time series.

7.8.8 Source-specific planned improvements

A new methodology on calculation of biomass losses during forest fires is under development in the LSFRI Silava. Information from the second cycle of the NFI measurements will be used to monitoring and to represent statistically area and amount of burnt biomass of wildfires as an average of 5 years period. Information provided by the State forest service will be used for quality assurance. Slash burning will be evaluated within the scope of NFI by remarking harvesting sites where slash burning will take place. Amount of incinerated slash will be calculated as a function from extracted timber biomass. Both methods need to be verified in practice.

7.9 NON - CO_2 EMISSIONS (CRF 5 (I-III))

7.9.1 Description

Direct N_2O emissions from fertilization of forest land are reported as not applicable because no forest fertilization takes place in Latvia. It is forbidden by the FSC and PEFC forest certification systems. Emissions from applications of fertilizers on farmlands in reported in the agriculture's section. Similarly, a non-CO_2 emission from drainage of soils is not reported because new drainage systems aren't built; only reconstruction of existing drainage systems takes place.

Taking into account constant reduction of area of croplands, emissions from land conversion to cropland (CRF 5 III) aren't reported as not applicable.

Parties do not have to prepare estimates for categories contained in Appendixes 3a.2, 3a.3 and 3a.4 of IPCC Good Practice Guidance for LULUCF. At this point sufficient information is not available to prepare Latvia's estimates.

7.9.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

No information is available about disturbances or other measures related to the CRF 5 (I-III), however as soon as more detailed data about historical land use change will be provided by the NFI, the time series will be recalculated.

7.9.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Not applicable.

7.9.4 Methodological issues

No calculations are done up to now.

7.9.5 Uncertainties and time-series consistency

Not applicable.

7.9.6 Source -specific QA/QC and verification

Not applicable.

7.9.7 Source-specific recalculations

No recalculations have been carried out.

7.9.8 Source-specific planned improvements

The work on harmonization of land use changes is going on and it will be possible reevaluate actual emissions related to the CRF 5 (I-III) as soon as this work will be done.

7.10. HARVESTED WOOD PRODUCTS (CRF 5.G)

7.10.1 Description

The category Harvested Wood Products (HWP) is supposed to include basically the carbon balance of all wood products which are in use in Latvia, calculated by the Stock Change Approach (SCA). However, due to lack of information about assortment structure as well as a share of different assortments utilized locally, this category is not reported in the inventory.

7.10.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Not applicable.

7.10.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Not applicable.

7.10.4 Methodological issues

The instant oxidation method is used to estimate emissions from harvested wood products. Emissions are reported in the Forest land section.

7.10.5 Uncertainties and time-series consistency

Not applicable.

7.10.6 Source-specific QA/QC and verification

Not applicable.

7.10.7 Source-specific recalculations

No recalculations were done.

7.10.8 Source-specific planned improvements

Introduction of the HWP worksheet model of the 2006 IPCC Guidelines into calculations of the HWP related emissions is planned for 2011, when reliable information about inflow and outflow of timber materials will be available. However it's still unclear if it will be possible to secure consistence of the time series and which method is the most favourable in terms of availability and reliability of the input data. Tier 2 method (First order decay) will be evaluated for the HWP reporting.

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. 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 10 non-hazardous waste polygons and two polygons for hazardous waste got A category permit according to IPPC directive. Biogas collection and use for energy production from biodegradable wastes and sludge is set as one of priorities in Latvia.

Main activity data sources for GHG emissions calculations in Waste sector are databases "3-Wastes"[92], "2-Water"[93] and data from CSB.

Data on hazardous waste in Latvia have been collected and compiled by LEGMC 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 LEGMC 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. Both LEGMC "2-Water" and CSB data are used as activity data for emission calculation - CSB and "2-Water" data for CH_4 emission from domestic waste water handling and N_2O emission from industrial waste water handling, and CSB for CH_4 emission from industrial waste water handling and N_2O from domestic waste water handling

GHG emissions from Waste sector have been increased since 1990. In 2008, emissions were approximately 8.7% higher than in 1990. In 2008, emissions from the Waste sector were 916.88 Gg CO_2 equivalents; it contributes about 7.7% of total GHG emissions (excluding LULUCF).

[92] http://oas.vdc.lv:7779/la/atkr/red/mar$www_atkr.atkr_la
[93] http://oas.vdc.lv:7779/la/udens/skat/pls

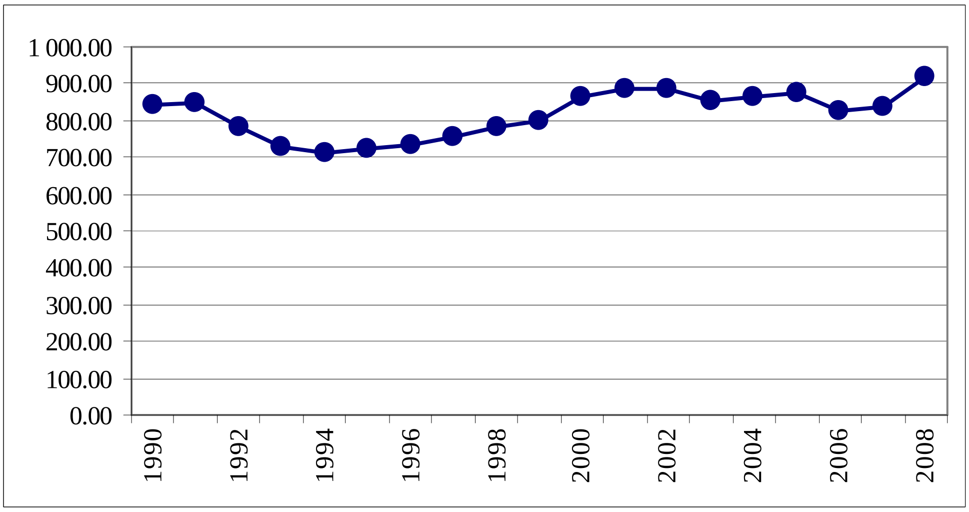

Figure 8.1.1 Total emissions from Waste sector in CO_2 equivalent (Gg)

Fluctuations in total GHG emissions in waste sectors could be explained with changes of economical situation in last 20 years. Some industry sectors were almost closed in the middle of 90-ties. Biggest influence to total emission trend gives GHG emissions from Waste water handling.

Key categories

Table 8.1.1 Key categories in Waste sector 2008 (excluding LULUCF)

Source category	Gas	Level assessment (%)	Trend assessment (%)
6.A Solid waste disposal	CH_4	5	6
6.B Waste water handling	CH_4	2	1

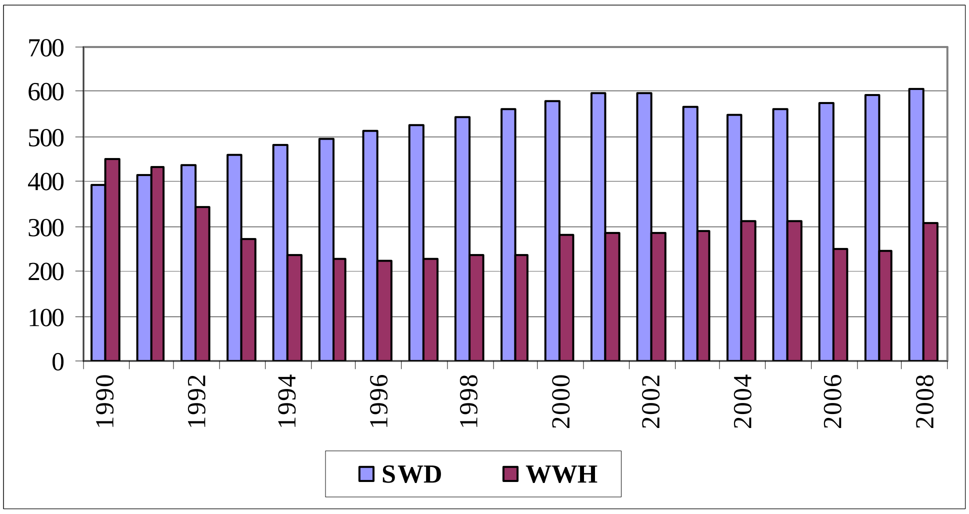

Figure 8.1.2 Emissions from SWD and WWH sectors in CO_2 equivalent (Gg)

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).

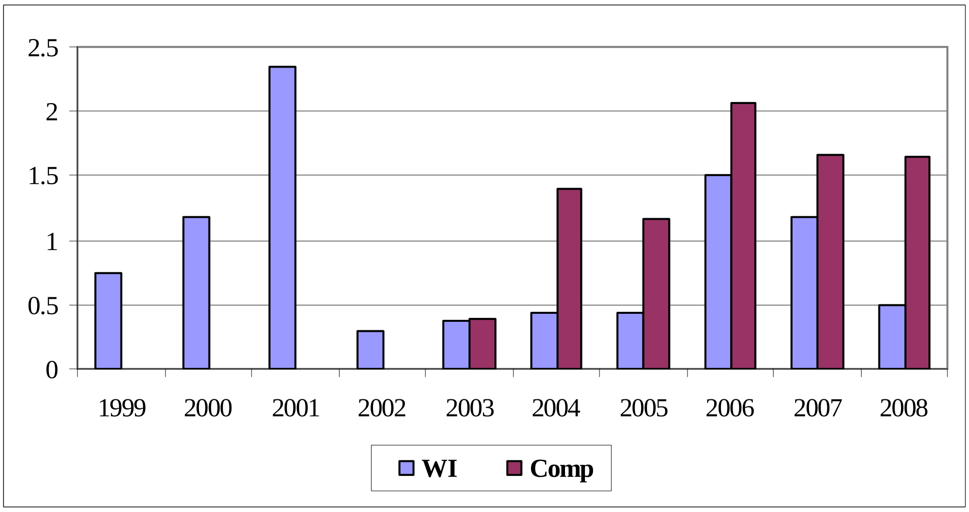

Figure 8.1.3 Emissions from WI and Composting sectors in CO_2 equivalent (Gg)

According to the information from LEGMC[94] the total generated amount of waste are shown in Table 8.1.2.

Table 8.1.2 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**
2007	1386.57	31.56	**1418.13**
2008	1368. 79	46.40	**1415.19**

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 guidelines and EMEP 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. Emissions from waste incineration with energy recovery are counted under Energy sector.

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.

[94] http://www.meteo.lv/public/28759.html

8.2 SOLID WASTE DISPOSAL ON LAND (CRF 6.A)

8.2.1 Source category description

CH_4 emissions from solid waste disposal are a key source. According to level assessment in 2008, when LULUCF not included, CH_4 emissions from solid waste disposal on land contributes about 5% of emissions, when LULUCF is included – 1%. According to trend assessment in 2008, when LULUCF not included, CH_4 emissions from solid waste disposal on land contributes about 6 % of emissions, if LULUCF is included – 1%.

Table 8.2.1 Reported emissions under subcategory Solid Waste Disposal on Land

CRF	Source	Emissions reported
6.A 1	Managed Waste Disposal on Land	CH_4, NMVOC
6.A 2	Unmanaged Waste disposal Sites	Not occurring
6.A 3	Other	Not occurring

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). 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. The base year for disposed amount estimation is 1996, when research[95] about biggest landfills was done. According this research 1 801 713 m^3 wastes were disposed in 29 biggest landfills. It is not all wastes disposed in Latvia that year, but biggest part, because wastes from all biggest towns were disposed in these landfills. To calculate waste weight coefficient 0,2 must be used, but as we know that 1 801 713 m^3 is not all amount, and then 0,3 is used. It is calculated that in 1996 – 540 513 tonnes are disposed. Waste amounts 1997 – 2001 was estimated like equal growth till 2002 amount. Amounts 1970 – 1995 were estimated according to GDP and population changes.

According to information in landfill research, number of active waste disposal sites decreased from 558 in 1997 to 56 in 2008. Data about waste disposal on land for 2002 - 2008 are taken from database "3-Wastes". All calculations are done for unsorted wastes, because waste composition is hard to estimate for previous years.

Table 8.2.2 Estimated Disposed amounts from 1970 – 2002

Year	Population	Disposed waste amount (Gg)	GDP/capita (in Ls by 2000 prices)
1970	**2351903**	535.10	1794
1971	2400000	540.51	1794
1972	2400000	540.51	1794
1973	2400000	540.51	1794
1974	2400000	540.51	1794
1975	2400000	540.51	1794
1976	2400000	540.51	1794
1977	2400000	540.51	1794
1978	2400000	529.41	1794
1979	**2502816**	540.51	1794
1980	2502816	538.34	**1794**
1981	**2514640**	529.46	1800
1982	2550000	533.40	1850
1983	2550000	527.00	1900

[95] "Research about solid waste management in Latvia", 1998, Ltd GEO Consultants

Year	Population	Disposed waste amount (Gg)	GDP/capita (in Ls by 2000 prices)
1984	2550000	530.62	2000
1985	2550000	521.34	**2076**
1986	**2587716**	527.49	2200
1987	2600000	529.25	2300
1988	2600000	522.96	2400
1989	2666567	535.78	2500
1990	2668140	576.15	2543
1991	2600000	566.25	2300
1992	2600000	568.96	2100
1993	2600000	572.31	1900
1994	2600000	597.64	1700
1995	**2500580**	518.74	**1451**
1996	**2469531**	**540.51**	**1600**
1997	**2444912**	558.00	1700
1998	**2420789**	576.00	1800
1999	**2399248**	594.00	1900
2000	**2377383**	614.00	**1975**
2001	**2364254**	632.00	**2149**
2002	**2345768**	**658.00**	**2304**

Figures in bold is primary data from National statistics[96]. All other years are estimated according to these figures. Disposed amount are estimated according to GDP and population changes. Population amounts for year 1971 -1978, 1982 – 1985, 1987 – 1988, 1991 – 1994 are round off, because correct figures are not available. GDP data from 1970 – 1979 are taken the same as 1980. 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 8.2.1.

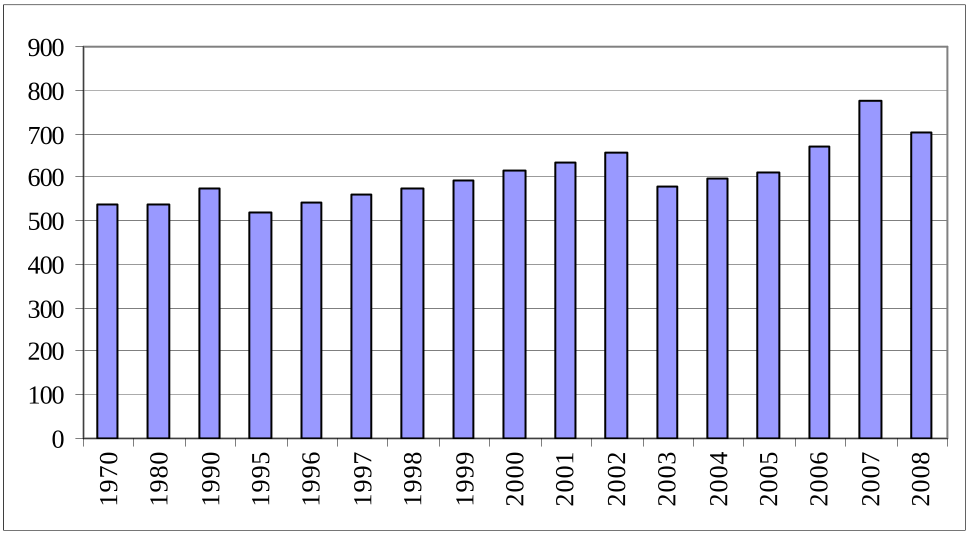

Figure 8.2.1 Disposed waste amounts in Latvia (Gg)

Since October 2002 CH_4 recovery from landfills are in progress. For 2008 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.

[96] Statistical Yearbook of Latvia 2004, CSB, 2005

In SIA Liepajas RAS methane collection also is developed in old landfill Skede and in new polygon Kivites. In total 5.274Gg of CH_4 was collected and recovered. Recovered methane amount is presented in Figure 8.2.2.

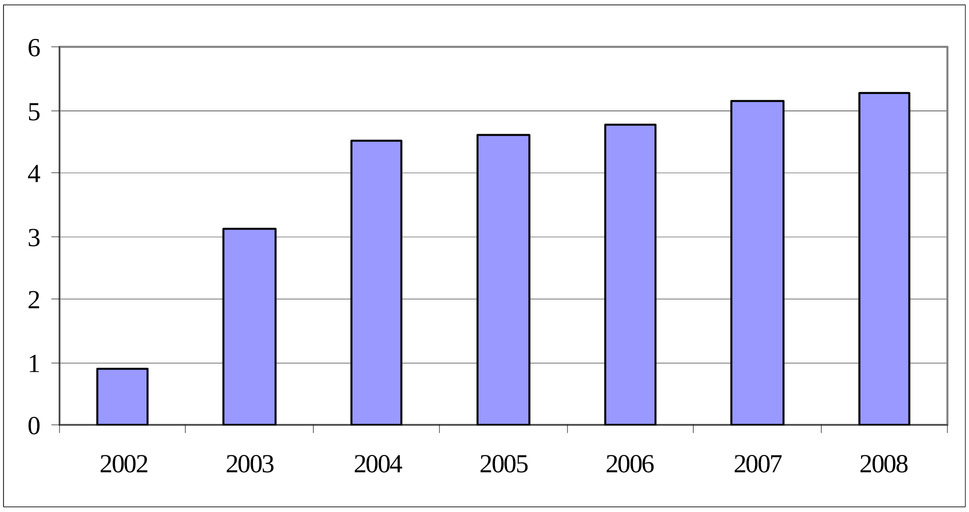

Figure 8.2.2 Recovered CH_4 from waste landfills (Gg)

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 8.2.3.

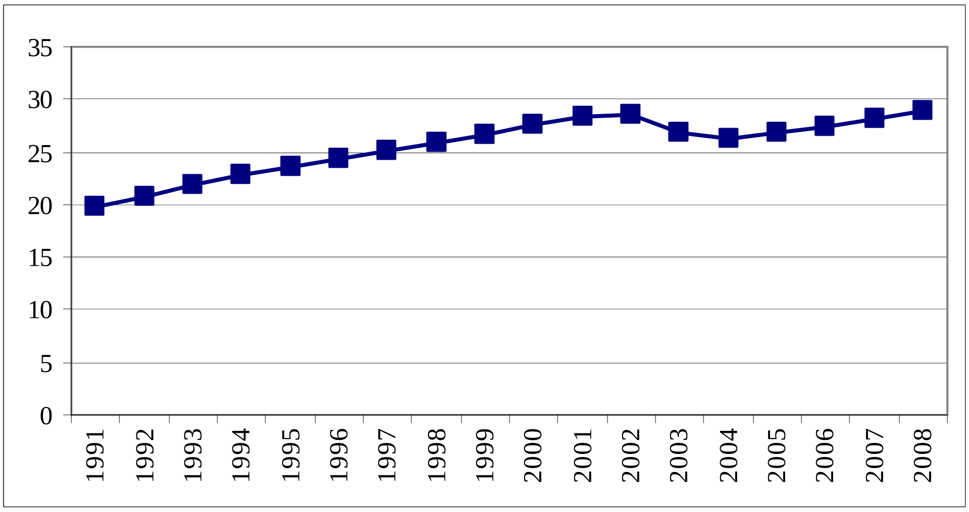

Figure 8.2.3 CH_4 emissions from waste landfilling (Gg)

8.2.2 Methodological issues

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

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

$$CH_{4\,\text{generated in year t (Gg/yr)}} = \sum_x [\,(A*k*MSW_{L(x)}*Lo(x))*e^{-k(t-x)}]$$

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

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 *– methane real emission;*
A *– normalisation factor $A=(1-e^{-k})/k$*
k- *methane generation coefficient (1/y) (0.05);*
x *– calculation starting year;*
t *– inventory year;*
R (t) *– methane recovery in year t;*
OX *– oxidation factor (default 0)*

All emissions factors are default factors from IPCC GPG 2000, because Latvia hasn't national emission factors.

8.2.3 Uncertainties and times series consistency

To calculate CH_4 emissions from SWD many emission factors are used. According to IPCC GPG 2000 for each factor uncertainty is estimated as:

DOC – 20%;
DOCf – 30%;
MCF – 10%;
CH_4 fraction F – 5%;
k – 40%.

$$EF_{uncert.} = \sqrt{DOC^2 + DOCf^2 + MCF^2 + F^2 + k^2}$$

Combined uncertainty for emission factors from SWD is 52%.

Uncertainty for activity data is estimate as 20 %. For all years same methodology and coefficients for calculation are used (Tier 2). Amount of disposed wastes are estimated in different ways for time period since 1970. There are no other possibilities for Latvia, because waste statistics are available only from 2001.

8.2.4 Source-specific QA/QC and verification

QA/QC procedure for waste disposing is done. Mistakes, found in emission calculation during QA/QC procedure, were corrected within this submission. Time series consistency check for IEF on 10% changes was done. 4 inconsistencies between years were found.

Disposed waste amount from year 2002 is taken from waste data base "3-Wastes". Data in this data base before entering are checked by Regional Environmental Boards.

8.2.5 Source-specific recalculation

Methane emissions from waste disposal are recalculated for all reporting period. Data about waste disposed amounts were changed for years 1970 – 2001. According to FOD Tier2 method each year emissions changes leaves the impression to all other years.

Table 8.2.3 Changes according to recalculations

Year	Reported emissions from SWD in 15.04.2009. (CH_4 Gg)	Reported emissions from SWD in 15.01.2010. (CH_4 Gg)	Changes, %
1990	13.26	18.72	+41.18
1995	18.53	23.56	+27.15
2000	23.58	27.56	+16.88
2006	24.48	27.43	+12.05
2007	25.38	28.18	+11.03

8.2.6 Source specific planned Improvements

Estimate more precise data from disposed amount in year 1996. Then disposed amount for all years will have some small changes.

8.3 Wastewater Handling (CRF 6.B)

8.3.1 Source category description

The emission sources cover handling of collected and uncollected domestic waste water for CH_4 and N_2O emissions, as well as industrial waste water for CH_4 and N_2O emissions.

Table 8.3.1 Reported emissions under the subcategory Waste Water Handling in the Latvian Inventory

CRF	Source	Emission reported
6.B 1	Industrial waste water	CH_4, N_2O
6.B 2	Domestic and commercial waste water	CH_4, N_2O
6.B 3	Other	Not occurring

LEGMC data show that 265 million m³ of wastewater in 2008 was discharged, from which 189 million m³ were treated by different wastewater treatment plants, ~78% from which were biological plants.

Increase of amount discharged waste water is due to change in national statistics – the procedure of data collecting was changed and it could be a reason for some inaccuracies in data.

CH_4 emission from wastewater handling is a key source according to level assessment in 2008, when LULUCF not included, contributing about 2% of emissions. CH_4 emission is not key source when LULUCF is included. According to trend assessment in 2008, when LULUCF not included, CH_4 emissions from wastewater handling contributes about 1% of emissions, but is not key source, if LULUCF is excluded.

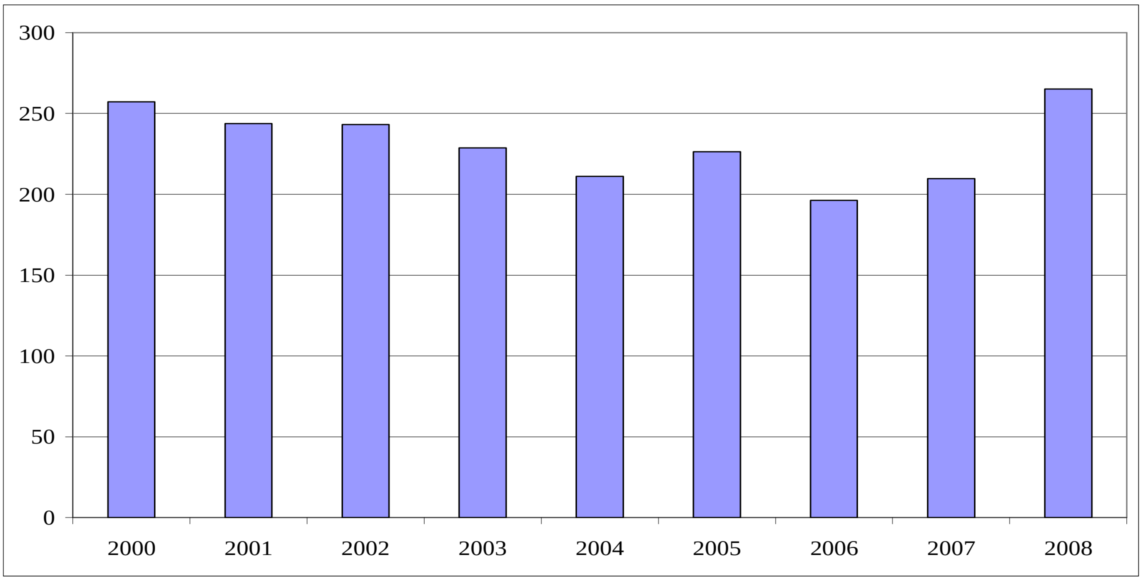

Figure 8.3.1 Amount of discharged waste water in last nine years (mio m^3)

In most cases urban waste water is treated in aerobic systems in Latvia. However, the accurate breakdown of amount aerobic and anaerobic processes during treatment of municipal waste water is unknown. Therefore, data on type of treatment plant and its treatment level is available within national database "2-Water", and all the treatment plants is distributed by the its type and level of treatment.

Due to change of calculation approach, there is no longer recovery of methane considered to have a place in Latvia.

Because of Latvia's climate sludge fields produce negligent amounts of methane (research by "Alabastrs, Ltd", 2003), therefore calculations of CH_4 emissions from domestic sewage sludge were not carried out.

The Industrial Waste Water Handling is the main source of the CH_4 emissions from Wastewater Handling sector. Emission from Domestic Waste Water Handling is lower, reaching ~32 % (2008) from total CH_4 emission from Waste Water Handling sector.

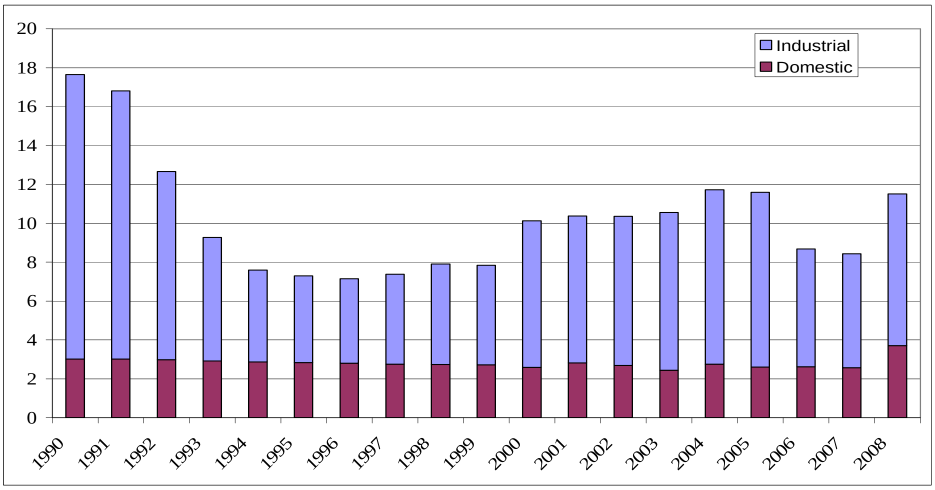

Figure 8.3.2 Emissions of methane from Waste Water Handling (total), Gg

Fluctuations of methane emission from Industrial Waste Water Handling are connected with fluctuations of amount of production produced. Significant decrease in methane emission in period 1993 – 1999 is due decreasing of economic activity after collapse of Soviet Union.

Increase of methane emission from Domestic Waste Water Handling sector in 2008 is due to changes in procedure of activity data collection. This can be reason for decrease of quality and credibility for data of 2008.

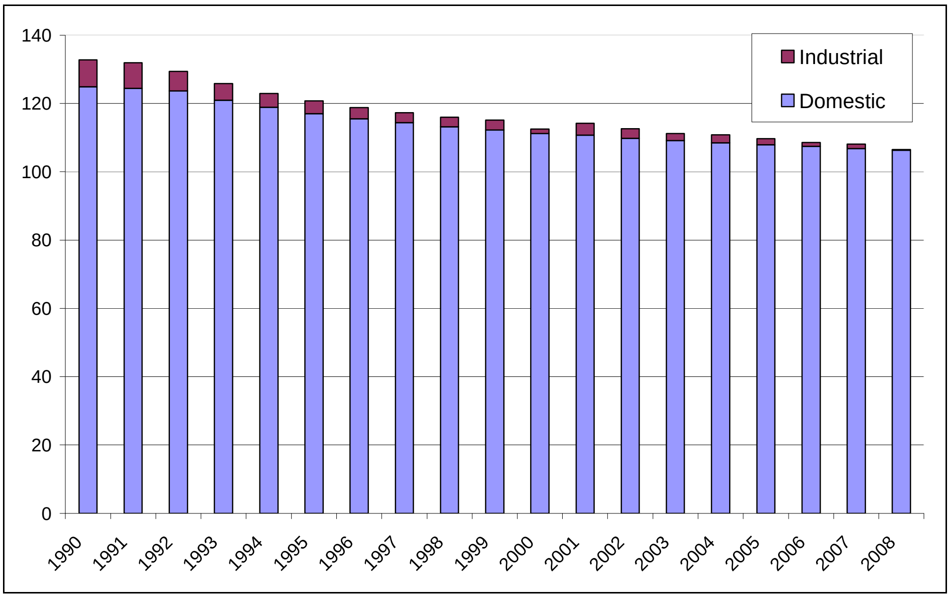

Figure 8.3.3 Emissions of N_2O from Waste Water Handling (total), Gg

8.3.2 Methodological issues

Emissions from Domestic Waste Water Handling are based on amount of BOD_5 (biochemical oxygen demand, 5-day test) produced by national population. However, different methane conversion factors (MFC) are applied depending of type and level of treatment of certain treatment plant. Uncollected and untreated load are calculated, using maximum value of MCF. Data on treatment type and level of certain waste water treatment plant serving certain number of population is available in national data base “2-Water”, collecting treatment plant-level data on water abstraction and use, treatment and discharge. Distribution of national population by type and level of waste water treatment was extrapolated for period, uncovered by water statistics (1990-1999).

IPCC default formula from “2006 IPCC Guidelines for National Greenhouse Gas Inventories” report was used for calculation of CH_4 emission from Domestic Waste Water Handling sector:

$$WM = \sum_i P_i \bullet D \bullet SBF \bullet EF \bullet MCF_i \bullet 365 \bullet 10^{-12} \text{ Tg of } CH_4,$$

where:
P_i – number of population, served by certain type of treatment;
D – organic load of BOD_5 (60 g/pers/day);
SBF – easy degradable part of BOD_5, SBF = 0.5;
EF – emission factor, EF = 0.6 kg CH_4/kg BOD_5;
MCF_i – anaerobically degradable part of BOD_5 for certain type of treatment.

However, since activity data is distributed by type and level of treatment, method is considered as Tier 2 method.

Table 8.3.2 Activity data for Domestic Waste Water Handling – number of population served by certain type or level of treatment

Year	Well-managed, biological treatment	Poor-managed, biological treatment	Non-biological treatment	Not connected and not treated
Criteria for identification of treatment type	Biological treatment with secondary or higher treatment level	Biological treatment with treatment level lower than secondary	Mechanical and chemical treatment; treatment level does not matter	No treatment
1990	1755610	51996	43022	817258
1991	1748912	51178	42858	814140
1992	1738809	51499	42610	809437
1993	1700929	50377	41682	791804
1994	1671330	49500	40957	778025
1995	1644689	48711	40304	765623
1996	1624171	48104	39801	756072
1997	1607895	47621	39402	748495
1998	1591958	47149	39012	741076
1999	1577719	46728	38663	734448
2000	1610665	72328	71693	620653
2001	1509397	53122	38318	763417
2002	1537912	42886	40176	724794
2003	1585042	32937	18181	695320
2004	1481646	32017	18602	786938
2005	1519684	40155	37360	709235
2006	1502517	43111	38452	710510
2007	1505448	46965	38135	690757
2008	1118270	120264	37256	995104
MCF applied	**0**	**0.3**	**0.8**	**0.8**

Emissions from Industrial Waste Water Handling are based on load of COD (chemical oxygen demand) in industrial waste water. Assumptions from IPCC Guidelines 2006 are used to estimate amount of waste water generated per unit of certain production type as well as load of COD in it. Amount of certain industrial production is available from Latvian Central Statistical Bureau (CSB).

Methane emission from Industrial Waste Water Handling is calculated using Tier 1 method from "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories":

$$WM = \sum_i P_i \bullet V_i \bullet C_i \bullet PFM \bullet 10^{-9} \text{ Tg } CH_4,$$

where:
P_i – amount of certain industry production, t;
V_i – amount of waste water generated per certain unit of industry production, m^3/t;
C_i – organic load in waste water of certain industry sector (COD), g/l or kg/m^3;
PFM – emission factor of CH_4, kg CH_4/kg COD.

Activity data (amount of certain industrial production) was taken from national statistics – data base of Latvian Central Statistics Bureau.

Default IPCC emission factor (*PFM*) – 0.25 kg CH_4/kg COD was used.

Table 8.3.3 Current assumptions used for calculation of CH_4 emission from Industrial Waste Water Handling

Production type	Assumptions used from IPCC Guidelines 2006)	
	Generation of waste water, m^3 per tone of production	Organic load of waste water, COD g/l (or kg/m^3)
Milk	7	2.7
Meat	13	4.1

Production type	Assumptions used from IPCC Guidelines 2006)	
	Generation of waste water, m^3 per tone of production	Organic load of waste water, COD g/l (or kg/m^3)
Fish	13	2.5
Beer	6.3	2.9
Fruits and vegetables	20	5
Sugar	11	3.2
Plastics	0.6	3.7
Organic chemicals	67	3

However, amount of waste water generated and its organic load in terms of COD regarding production of paper and pulp were taken from national water statistics (data base "2-Water").

Emissions from Industrial Waste Water Handling are calculated as follows in table.

Table 8.3.4 Calculation example for 2008 of emission of CH_4 from Industrial Waste Water Handling (4 types of production) – activity data, assumptions, emission factors and results

Product name	Amount of production, th.t/a	Amount of waste water per production unit, m^3/t	Amount of waste water, th.m^3/a	Conc.of COD in waste water, g/l or	Load of COD, t/a	Emission factor, kg CH_4/ kg COD	Emission of CH_4, t/a
	a	b	c = a*b	d	e = c*d	f	g = e*f
Milk	270	7	1890	2.7	5103	0.25	1276
Meat	168	13	2184	4.1	8954	0.25	2239
Fish	130	13	1690	2.5	4225	0.25	1056

Amount of N_2O emission from Domestic Waste Water Handling is calculated, using IPCC default equation from "2006 IPCC Guidelines for National Greenhouse Gas Inventories". It is based on amount of nitrogen, generated from the protein consumption by national population. Number of national population is taken from national statistics (CSB) while value of protein consumption is found in literature[97].

$$WM = P \bullet O \bullet EF \bullet Frac_{Nprot} \bullet \frac{44}{28} \bullet 10^{-6} \text{ Gg } N_2O,$$

where:
P – number of national population;
O – amount of protein, produced by population, kg protein/person/year;
EF – emission factor, kg N_2O-N/kg N;
$Frac_{Nprot}$ – nitrogen fraction in protein, kg N/kg protein.

Default value for nitrogen fraction in protein – 0.16 kg N/kg protein – is used in calculation. Default IPCC value for emission factor – 0.01 kg N_2O-N/kg N – was used as well. Both values were taken from 1996 IPCC Guidelines.

A small amount of N_2O is emitted during the release from the sewage system. The calculations employ total protein use of 0.051 kg per resident per day, or 18.615 kg per resident per year, and emission factor 0,16 kg N/kg protein, what gives emission 0.106 Gg of N_2O (2008).

N_2O emission from Industrial Waste Water Handling was calculated, using Tier 1 method from "2006 IPCC Guidelines for National Greenhouse Gas Inventories". Calculation is based on load of nitrogen in the industrial waste water:

[97] http://data.csb.gov.lv/DATABASE/rupnbuvn/Ikgad%C4%93jie%20statistikas%20dati/R%C5%ABpniec%C4%ABba/R%C5%ABpniec%C4%ABba.asp

$$WM = N_{ef} \bullet EF \bullet \frac{44}{28} \bullet 10^{-6} \text{ Gg } N_2O,$$

where:
N_{ef} – load of nitrogen, kg/year;
EF – emission factor, kg N_2O-N/kg N.

IPCC default value (0.005 kg N_2O-N/kg N) from IPCC 2006 Guidelines was used for calculation.

In comparison with previous report, following activities were taken during the recalculation of emission data:

1. Emission for period 1990-2000 was calculated, since in previous report only period 2001-2007 was covered.
2. In previous report, only food industry was taken in account. Now, in recalculation, other industry sectors were covered as well. Thus, the amount of emission has increased significantly.

N_2O emission from Industrial Waste Water Handling is negligible – 0.0002 Gg/a or 0.236 Mg/a (2008).

Emission of NMVOC was calculated and reported for first time. Default EMEP emission factor was used for this calculation – 15 mg of NMVOC per m^3 of waste water produced, what gives 3.9 Mg/a of NMVOC (2008).

8.3.3 Uncertainties and times series consistency

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

Table 8.3.5 Uncertainties for Waste Water Handling sector

Emission	Activity data	Emission factor
CH_4	2%* for Industrial Waste Water Handling; 10% for Domestic Waste Water Handling	30%**
N_2O	10% for Industrial Waste Water Handling; 10% for Domestic Waste Water Handling	30%**

* 2% - frame uncertainty of CSB;
**30% - default uncertainty from IPCC guidelines 2006.

Time series of emissions are inconsistent, since main source of emissions is Industrial Waste Water Handling and amount of production, which is activity data, varies a lot from year to year. Decrease of emissions from Industrial Waste Water Handling in period 1992 – 2001 can also be explained by decrease of national economic activity after collapse of Soviet Union in 1991.

Emissions from Domestic Waste Water Handling (both CH_4 and N_2O) are more consistent, since there are no large fluctuations in activity data as in case of Industrial Waste Water Handling.

8.3.4 Source-specific QA/QC and verification

Following procedures of quality assurance and quality control were carried out:

- Units of measurement were checked during comparison with results of previous reports;
- Number of national population was cross-checked with activity data, used in others sectors (solvents and waste disposal);
- Comments in CRF tables were checked in process of entering data of calculation and recalculation results in CRF tables.

Mistakes, found in emission calculation during QA/QC procedure, were corrected within this submission.

Consistency check regarding differences of IEFs larger than 10% was carried out using according function of CRF Reporter. In total, 20 differences were found, mostly regarding CH_4 emission from Industrial Waste Water Handling sector. The differences are caused by fluctuations of activity data (amount of certain types of production).

8.3.5 Source specific recalculations

Amount of methane emissions was recalculated due to following factors:

- Methane emissions from Domestic Waste Water Handling were recalculated using new approach by distributing treatment plants by their type and level of treatment, and use of corresponding methane conversion factors for each group of waste water treatment plants. Data changed for entire period.
- Recovery of methane from Domestic Waste Water Handling was considered not occurring, since methane tanks of UWWTP "Daugavgriva" process sewage sludge. Since amount of methane recovered was reported in previous inventories, and it is reported not occurring, it lead to data change in period from 1993 to 2007.
- Methane emissions from Industrial Waste Water Handling were recalculated due to wider range of activity data – additional types of industrial production were used for calculation. Data changed for entire period.
- N_2O emissions from Domestic Waste Water Handling were recalculated because new data on protein consumption was acquired. Data changed for entire period.
- N_2O emissions from Industrial Waste Water Handling were recalculated because of activity data update and acquiring activity data for longer period. Data changed for entire period.
- Data on NMVOC emission was reported for first time within UNFCCC National Inventory Report.

8.3.6 Source specific planned Improvements

The main improvements planned for next inventory is aimed mainly on improvement of precision on existing calculations, since consistency and quality of some time series of activity data is still quite low, as well as further recalculations due to updating of assumptions and applying more accurate factors.

8.4 WASTE INCINERATION (CRF 6.C)

8.4.1 Source category description

Data on amount of waste incinerated in Latvia can be found in databases that are created and maintained by LEGMC. 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.

Table 8.4.1 Reported emissions under subcategory Waste Incineration

CRF	Source	Emissions reported
6.C 1	Biogenic (cremation)	SO_2, NMVOC, CO, NOx
6.C 2	Other – non biogenic (industrial and hospital wastes)	CO_2, SO_2, NMVOC, CO, NOx

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*. 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 EMEP/EEA guidebook 2009 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 2008 incinerated amount of waste decrease due to hazardous waste incineration facility do not work in full capacity. CO_2 emissions from Waste Incineration are presented in Figure 8.4.1.

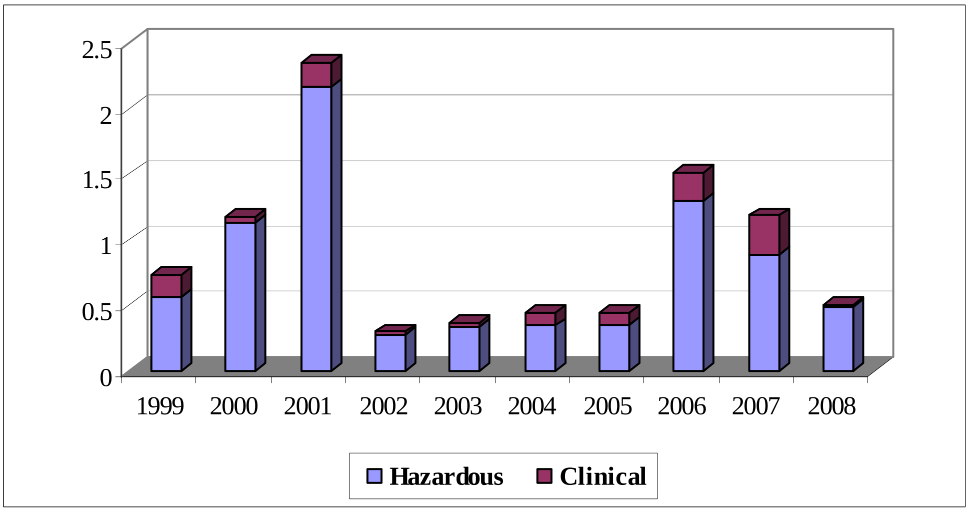

Figure 8.4.1 CO_2 emissions from Waste Incineration by waste type (Gg)

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.

CO_2 emissions were calculated using following IPCC GPG 2000 equation:

$$\mathbf{CO_2}_{\text{ emissions}} = \Sigma_i[\ IW_{ix} \text{ x } CCW_i \text{ x } FCF_i \text{ x } EF_i \text{ x } 44/12\ ] \text{ Gg/year,}$$

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 8.4.1).

Table 8.4.1 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

It isn't possible to estimate N_2O emissions from Waste Incineration without direct measurements. In Latvia these measurements in Waste Incineration facilities aren't done. Incinerated wastes are defined as clinical and hazardous (industrial) wastes. IPCC GPG 2000 and EMEP guidebooks don't provide factors for N_2O emission calculation.

Table 8.4.2 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
2007	0.5405	0.350861	0.891361
2008	0.29975	0.012361	0.312111

Indirect gases (NMVOC, CO, SO_2, NOx) are calculated from waste incineration according to EMEP/EEA emission inventory guide book 2009.

Table 8.4.3 Emission factors for indirect gases

	Clinical wastes (kg/Mg)	Hazardous waste (kg/Mg)
NMVOC	0.7	7.4
CO	2.8	0.07
SO_2	1.4	0.047
NOx	1.4	0.87

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/EEA emission inventory guide book 2009.

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 - 2008 in Riga crematorium is available (assumed to be 1750), therefore emissions are identical for these years:

Table 8.4.4 Emission factors and emissions for indirect gases from cremation

	Emission factor (kg/body)	Emissions (Gg)
NMVOC	0.013	0.00002275
CO	0.141	0.00024675
SO_2	0.544	0.000952
NOx	0.309	0.00054075

8.4.3 Uncertainties and times series consistency

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 %, Times series for incineration begins from 1999, For previous years data are not available, There is no any believable information available, that waste incineration without energy recovery occurs in Latvia before 1999.

8.4.4 Source-specific QA/QC and verification

QA/QC procedure for waste incineration is done. Mistakes, found in emission calculation during QA/QC procedure, were corrected within this submission. Time series consistency check for IEF on 10% changes was done. Inconsistencies between years were not found.

Incinerated wastes amounts are taken from waste data bases. Data in this data bases before entering are checked by Regional Environmental Boards.

8.4.5 Source-specific recalculations

Emissions for indirect gases are recalculated according to EMEP/EEA emission inventory guide book 2009.

8.4.6. Source specific planned Improvements

No planned improvements.

8.5 OTHER (CRF 6.D) – COMPOST PRODUCTION

8.5.1 Source category description

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.

Table 8.5.1 Reported emissions under subcategory Other (compost production)

CRF	Source	Emissions reported
6.D	Compost production	CH_4, N_2O

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.

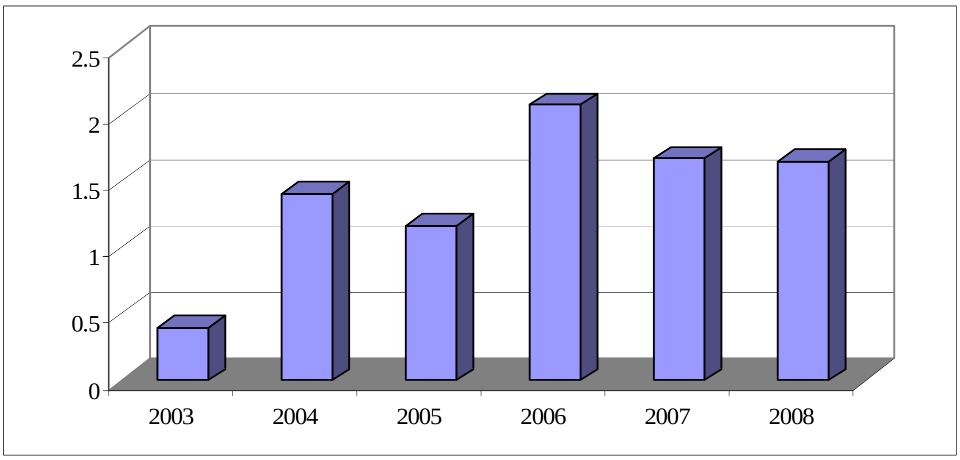

Figure 8.5.1 Total emissions from waste composting in CO_2 equivalent (Gg)

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 8.5.2 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
2007	9.416	0.037664	0.0028248
2008	9.282	0.037128	0.0027846

8.5.3 Uncertainties and times series consistency.

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%, Time series for composting begins in 2003, for previous years data are not available, because industrial composting do not happening in Latvia, Composting in private garden occurs all time in Latvia, but there is no any estimation available on these amounts.

8.5.4 Source-specific QA/QC and verification

QA/QC procedure for waste composting is done. Time series consistency check for IEF on 10% changes was done. Inconsistencies between years were not found.

Composted wastes amounts are taken from waste data bases. Data in this data bases before entering are checked by Regional Environmental Boards.

8.5.5. Source-specific recalculations

No recalculations.

8.5.6. Source specific planned Improvements

No planned improvements.

CHAPTER 9: OTHER (CRF 7)

Latvia does not report any emissions under the Other sector.

CHAPTER 10: RECALCULATIONS AND IMPROVEMENTS

10.1 EXPLANATIONS AND JUSTIFICATIONS FOR RECALCULATIONS, INCLUDING KP-LULUCF INVENTORY

The changes in the inventory since the previous submission (Table 10.1) to the UNFCCC (15.04.2009) were done according to:

- recommendations by ERT during in - country review in 2009;
- recommendations by ERT included in FCCC/IRR/2007/LVA (14 December 2008), FCCC/ARR/2006/LVA (24 April 2008);
- recommendations by ERT during Centralized review (2008);
- corrections of activity data by CSB;
- using of new methodology for LULUCF and Agriculture, Waste;
- using of COPERT IV for 1990 - 2008 for Road transport.

Table 10.1 Overall impacts of recalculations on national emissions

	2009 submission		2010 submission		Difference	
	Total (including LULUCF)	Total (excluding LULUCF)	Total (including LULUCF)	Total (excluding LULUCF)	Total (including LULUCF)	Total (excluding LULUCF)
1990	5 768.447	26 455.789	5 260.88	26 678.91	-9%	0.84%
1991	3 267.662	24 522.539	1 945.77	24 737.09	-40%	0.87%
1992	-1 770.651	19 826.301	-3 937.76	19 965.24	122%	0.70%
1993	-4 855.329	15 938.854	-7 955.20	16 074.98	64%	0.85%
1994	-5 953.458	13 975.509	-10 020.98	14 046.48	68%	0.51%
1995	-5 176.711	12 492.653	-11 553.80	12 571.05	123%	0.63%
1996	-6 324.459	12 561.694	-12 504.95	12 621.94	98%	0.48%
1997	-4 658.245	11 971.780	-11 691.85	12 043.79	151%	0.60%
1998	-4 024.136	11 445.632	-11 835.15	11 521.53	194%	0.66%
1999	-3 977.963	10 666.386	-12 656.75	10 736.07	218%	0.65%
2000	-4 111.942	10 020.716	-14 289.76	10 102.54	248%	0.82%
2001	-4 273.917	10 660.482	-19 236.45	10 739.48	350%	0.74%
2002	-3 437.064	10 667.640	-15 039.39	10 739.98	338%	0.68%
2003	-2 845.314	10 847.011	-15 272.31	10 916.04	437%	0.64%
2004	-3 859.811	10 832.699	-17 125.07	10 944.44	344%	1.03%
2005	-3 324.255	11 130.463	-17 031.37	11 213.20	412%	0.74%
2006	-6 193.917	11 621.446	-20 873.69	11 671.48	237%	0.43%

Detailed description on recalculations and information about planned improvements is described in the sectoral Chapters 3-9. The reasoning and impact of the recalculation for the years 1990 – 2007 can also be found in CRF tables 8(a)s1-8(a)s2 and 8(b) of the relevant years.

Energy (excluding Transport):

Changes in activity data

Natural gas consumption for year 1990 – 2007 was recalculated as data of natural gas characterization from only natural gas provider a/s "Latvijas Gāze" was obtained – net calorific value changes year by year.

Landfill gas and Sewage sludge gas activity data were changed due to updated information received from Latvia's landfills and wastewater treatment plant.

Activity data for 1A5b sector was updated due to precise statistical information availability.

Improvements regarding methodology and emission factors

CO_2 emission factor for natural gas was changed for all years according to country specific natural gas characterizations reported by natural gas provider.

Transport:

Changes in activity data

Road transport

IPE in cooperation with consulting company "Road transport research" produced data for the period 1990 – 2007 to make recalculation of emissions with COPERT IV model for years 1990-2007.

Domestic Navigation

Emissions were calculated from diesel oil consumption and from gasoline consumption for motor boat.

Improvements regarding methodology and emission factors

Road transport

For emission calculation from Road transport the COPERT IV model was used.

Railwaysa and Domestic Navigation

Emission factors were corrected according to EMEP/CORINAIR Guidelines.

Aviation

Emissions were calculated separately for LTO and cruise activities by implementing T1 methodology and IPCC emission factors.

Industrial proceses:

Changes in activity data, methodology and emission factors

Mineral Products

According to recommendation of Industrial processes expert within in-country review 2009 the CO_2 emissions from lime production were reallocated.

Iron & Steel

Carbon conversion factor was précised for all years in time series. Carbon content in crude steel and in crude iron used in electric arc furnaces was corrected according to steel production plant's information for 2007. Used raw material data for 2007 was corrected as different percentage to divide raw materials used in open heart furnaces and electric arc furnaces was used.

Consumption of Halocarbons and SF_6

Data of whole sector was recalculated according to recommendations of ERT 2009. The emission estimation methodology was completely changed and now Revised 1996 IPCC and IPCC GHG 2000 are fully used for emission estimation.

Solvent and other product use:

Changes in activity data:

Under category 3C for 1998 -2001 NMVOC emissions was corrected because of previously mistaken activity data input.

Agriculture:

Changes in activity data:

Enteric Fermentation

Annual milk yield per cow (kg) was corrected for 1994 according to updated information from CSB.

Agricultural soils

In the calculations of crop residue Maize, for silage and forage, Crops for green feed and silage and Fodder roots production are included as recommended ERT.

For submission 2010, Latvia recalculated area of Histosols using arable land according to ERT recommendation during in-country review 2009.

Enteric Fermentation

- *Cattle*

For Dairy cattle and Non-dairy cattle CH_4 emission factors was recalculated. Specific emission factors were calculated according to Equation 4.14 in the IPCC Good Practice Guidance (IPCC 2000).

Manure management

N_2O emissions were recalculated for period 2004 – 2007 due to small corrections in distribution of Animal Waste Management Systems.

Agricultural soils

N_2O emissions from N-fixing crops and Crop residue was recalculated according to IPCC GPG 2000 Tier 1b method.

LULUCF:

Changes in activity data

Changes in activity data are generally associated with repeated evaluation and harmonization of land use matrix.

Waste:

Changes in activity data

There are no any changes in activity data for waste incineration (CRF 6C) and composting (CRF 6D). According to waste disposal (CRF 6A) new estimation about disposed amounts in 1970 – 2001 are done. The base year for estimation is 1996, where data about disposed amount in biggest landfills were available. Methane recovery is not in such level to recompense methane emissions.

There are changes in activity data regarding industrial waste water handling sector (both emissions CH_4 and N_2O).

Improvements regarding methodology and emission factors

For indirect gases (CO, NMVOC, NOx, SOx) emissions calculations EMEP Guidebook 2009 are used. For the first time NMVOC emissions from waste landfilling are calculated, emissions are calculated since 1990.

There are no any changes in methodology and emission factors for waste incineration, disposal and composting. N_2O emissions factors for waste incineration in IPCC 2006 guidelines are not suitable in Latvia's case.

Methodology was changed to estimate emissions of CH_4 and N_2O from domestic waste water handling sector.

PART II: SUPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

CHAPTER 11: KP-LULUCF

11.1. GENERAL INFORMATION

This Annex includes the supplementary information required under Article 7, paragraph 1. The information is presented in the same order as the reporting requirements are addressed in the Annex of Decision 15/CMP.1.

11.1.1. Definition of forest and any other criteria

The National Forest Inventory (NFI) of Latvia is the main data provider for the greenhouse gas reporting. Consequently and for reason of consistency, the applied forest definition for the reporting is harmonized the definition used within the NFI. The selected parameters are presented in Table 10.1.1. The only contrasting parameter in the national regulation is potential height of trees of the dominant specie; according to the Forest law potential height of trees should be at least 7 m to be identified as forest. Additional criteria defined by the Forest law is width of rows of trees of artificial or natural origin – they should be at least 20 m wide to be considered as a forest.

Comparison of forest area according to 5 and 7 m height criteria didn't make any changes in the inventory.

Table 1 Selected parameters defining forest in Latvia for the reporting

Parameter	Range	Value
Minimum land area	0.05 ± 1 ha	0.1 ha
Minimum crown cover	10 ± 30 %	20 %
Minimum height	2 ± 5 m	5 m

11.1.2. Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

For the commitment period 2008-2012 Latvia chooses to account Forest Management as activity under Article 3.4 of the Kyoto Protocol in accordance with the Annex to the Decision 16/CMP.1., but does not elect Cropland management, Grazing land management and Revegetation. Latvian institutions led by Ministry of Agriculture are developing the necessary information collection and processing system.

Method for identification of land areas Ministry of Agriculture according to Latvia's national system for GHG emission inventory is responsible for reporting regarding LULUCF activities.

The main source for land use data is the NFI. Specific information about forest land provided by the Latvian State Forest Research Institute "Silava".

Forest management areas are determined statistically within squares of 4 km grid according to the methodology of the NFI provided in the Latvia's National Inventory Report Submitted under United Nations Convention on Climate Change and the Kyoto Protocol Common Reporting Formats (CRF) 1990-2006[98] in 2008.

[98]http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/x-zip-compressed/lva_2007_nir_26nov.zip

11.1.3. Description of how the definitions of each activity under Article 3.3 and each elected activity under Article 3.4 have been implemented and applied consistently over time

The area of forest land reported for Afforestation/Reforestation and Deforestation under the Kyoto Protocol is equal to the area reported for Land use changes from and to forests in the UNFCCC greenhouse gas inventory taking the different time frame into account. All LUC from and to forests are considered to be human induced and AR activities will be reported together.

The information about ARD areas is based on the NFI, which was carried out in the period 2004-2008 by the LSFRI Silava, therefor data on the land use changes are based on 5 years period. A second cycle of the NFI is started in 2009. During the second cycle data including calculation models will be verified and updated. Since the beginning the NFI uses a permanently marked grid system[99]. For this reason ARD activities will be assessed at the same grid points and sample plots at each inventory period. Methodology of evaluation of historical land use change, generally related to deforestation is under development. Remote sensing approach will be used to estimate dynamics of the land use changes in the NFI plots in a 5 years period since 1990. Therefore deforestation is not reported yet due to a missing historical data. Currently afforestation is considered during field visits be an expert judgment – field worker visiting the NFI's plots has to decide if it is forest on farmland or more than one generation of forests developed in a particular place. Further during data processing, forests on farmlands are separated according to age of dominant specie in a stand – if it was less than zero in 1990, sample plot is marked as belonging to the activities listed in Article 3.4 of the Kyoto protocol, if trees were older than zero years in 1990, sample plot is marked as belonging to the activities listed in Article 3.4 of the Kyoto protocol. Reforestation is not reported yet due to a lack of data; however expert estimations demonstrate that this land management approach is not used in Latvia. As soon as historical data from remote sensing analysis will be available, all time series of land use as well as all carbon pools will be recalculated.

11.1.4. Description of precedence conditions and/or hierarchy among Article 3.4 activities, and how they have been consistently applied in determining how land was classified

Latvia elected to report about forest management activities within the scope of the Article 3.4 of the Kyoto protocol. The methodology of estimation of historical land use is under development, therefore consistent land use matrix with evaluation of land use changes since 1990 will be provided in the next reporting period. Land use matrix will be based on the NFI; every NFI's sample plot including those without woody vegetation will be marked according to the initial land use in 1990 using remote sensing approach and any land use changes will be fixed within 5 years cycles (for the periods 1991-1995, 1996-2000 and 2001-2005 using remote sensing approach and, starting from the first NFI field measurement cycle (2004-2008), on the base of field measurement data).

11.2. LAND-RELATED INFORMATION

11.2.1. Spatial assessment unit used for determining the area of the units of land under Article 3.3

A statistical approach is used to estimate the total area of ARD units following Reporting Method 1 of the IPCC GPG LULUCF. The spatial assessment unit for the submission of the Kyoto Protocol LULUCF tables 2010 covers the entire territory of Latvia.

[99] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/x-zip-compressed/lva_2007_nir_26nov.zip

The methodology for reporting is based on the NFI which uses a permanently below ground marked 4 x 4 km grid across all of Latvia with four permanent sample plots of 500 m^2 size at each grid point. Details are described in the instruction of the NFI[100]. ARD activities are accounted as long as the forest definition is met (minimum assessment unit 0.1 ha). At each permanent sample the ARD area is assessed. The sizes of the sub-areas with different land use at the permanent sample plots need to be larger than 1/10 (> 30 m^2) of the total sample plot area to be assessed. If this precondition is met the polygone that divides the different areas of land uses within the sub-plot is measured using polar-coordinates. At a site, sketches are drawn and the polygone data are entered into the geographic information system of the portable input device. If the former border line can be recognized in the follow-up NFI, it is kept. Note, that only the first cycle of the NFI is complete, therefore both, methodologies and output data will be revised during the second cycle.

11.2.2. Methodology used to develop the land transition matrix

The land transition matrix is based on the results of land use changes to forest derived from the NFI of the period 2004-2008. Methodology for estimation of earlier land use changes, including deforestation activities is under development in the LSFRI Silava. The assessment methods at the NFI grid points are described above. The land uses at the sub-areas of the permanent sample plot are assessed according to the following sub-categories (forest land with its sub-specifications and non-forest land, including cropland and orchards, grassland, forest on farmlands[101] with number of trees > 1 000 ha^{-1}, forest on farmlands[102] with number of trees < 1 000 ha^{-1}, swamps, river banks, areas bordering with lakes and ditches[103], agricultural ditches, roads, railroads, quarries, alluvial meadows[104], yards and cities, industrial communications like electrical lines, gas and oil pipelines etc.). Swamps and alluvial meadows are considered as wetlands; quarries, river banks as well as areas bordering with lakes and ditches are considered as other lands; the rest is considered as settlements. The results of the measured land-use changes from and to forests at the sample plots within an NFI will be extrapolated statistically according to the representativeness of the NFI system for the whole area of Latvia. Currently available data is approximation based on an expert judgment during field visit, therefore figures of afforestation might change until the next reporting, because more detailed, remote sensing based data will be available.

11.2.3. Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

Geographical locations are identified by the coordinates of centers of the NFI sample plots. Every sample plot represents in average 400 ha of forests.

11.3. ACTIVITY-SPECIFIC INFORMATION

11.3.1 Methods for carbon stock change and GHG emission and removal estimates

11.3.1.1 Description of the methodologies and the underlying assumptions used

The methodologies and assumptions used for the reporting under the Kyoto Protocol Article 3.3. are described in chapters of the inventory devoted to the Forest Land.

[100] Ministry of Agriculture of Republic of Latvia (2004) Instruction – Methodology of the statistical forest inventory and calculation of secondary forest stand characteristics (*Meža statistiskās inventarizācijas veikšanas un mežaudzes sekundāro parametru aprēķināšanas metodika*).

[101] Considered as forest land in the inventory report as the afforested areas.

[102] Considered as forest land in the inventory report as the afforested areas, however usually no information about increment of trees is provided due to a small size of trees (trees with actual height below 2 m aren't measured in the inventory, only presence is remarked).

[103] Are separated from other categories because they are usually covered with rich woody vegetation but don't fit to the forest definition. These areas are not bordering with forests or characteristics of vegetation are contrasting with neighboring forest stands.

[104] Moist areas more relevant to wetlands, therefore they are excluded from the Grassland's category.

11.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

Methodology for estimation of soil and litter carbon pools is under development and data about carbon stock changes in these carbon pools will be available in 2011. The dead wood carbon pool is not reported as not a source to avoid double accounting with increment of living biomass. This carbon pool will be reintroduced into the inventory as soon as reliable data on changes of stock of the dead wood will be provided by the NFI. The first figures will be available at the end of 2010, however uncertainty level of these data should be evaluated further.

Biomass burning is reported according to the expert judgment from on-site incineration of slash during forest logging and from forest fires. Both figures have high level of uncertainties and therefore will be improved in future by verifying data from the second cycle of the NFI.

11.3.1.3 Information on whether or not indirect and natural GHG emissions and removals have been factored out

Indirect and natural GHG emissions/removals have not been factored out.

11.3.1.4 Changes in data and methods since the previous submission (recalculations)

No recalculations were performed since last submission.

11.3.1.5 Uncertainty estimates

A model based approach to assess the uncertainties of emissions/removals of the ARD units is planned for 2011.

11.3.1.6 Information on other methodological issues

The methods used to estimate emissions/removals from ARD activities are of the same tier method as those used for the UNFCCC reporting.

11.3.1.7 The year of the onset of an activity, if after 2008

Not relevant for this submission, as the reported year is 2008.

11.4 ARTICLE 3.3

11.4.1 Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

Latvia uses a statistical approach to detect ARD (more details are provided above). The NFIs partially covered the period which is under consideration. Methodology for a remote sensing based evaluation of the land use changes since beginning of the reporting period is under development in the LSFRI Silava. Therefore, the NFIs in combination with the image analysis will provide a good estimate for the ARD activities before and after 1st January 1990. Currently reported data is approximation and will be improved in future.

11.4.2 Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

In Latvia temporarily unstocked areas (e.g. harvested area) remain forests and are not accounted as deforestation. NFI teams are trained to distinguish between forest management changes and Land Use Changes.

Afforestated areas fulfill the criteria for the forest definition of the Latvia's NFI which are:

- Minimum forest area 0.1 ha, ground coverage by woody species at least 20 % and minimum width of 20 m.
- Height of trees at the maturity age is higher than 5 m.

Deforested areas can be detected by two combined characteristics:

- The forest definition of Latvia's NFI has ceased to apply.
- There are significant visible changes in soil structure or ground vegetation which do not go with the natural succession of a forest (consequences of anthropogenic activities like ploughing, crop production, mowing or construction activities or natural abortion of the forest and its stand by e.g. landslides).

Exceptions are forest roads for forest management purposes within the forest. Private roads at the forest edge and public roads within the forest are classified as non forest.

Temporarily unstocked areas by forest management or forests with biotic and abiotic (windfall, fire, beetles) reduction of their crown coverage maintain the natural succession of ground vegetation and soil and therefore remain part of the forest.

It must be mentioned that the Latvia's forest management regulations forces stakeholders into guaranteeing the reestablishing the forests (according to the criteria of the forest definition) on such areas within a defined time span.

11.4.3 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

The Latvia's NFI uses a grid of permanent plots. Information from these plots is extrapolated to the entire forest area. Therefore, geographical information would be only available for the permanent plots which as each statistical approach are only a low percentage of the Latvia's forests.

11.5. ARTICLE 3.4

11.5.1 Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

Latvia reports no occurrence of harvesting on AR areas since 1990. Primarily due to the low age of these stands, the growth conditions in Latvia and legal aspects thinning and harvesting is not carried out in stands of the first age classes (age 1-20 years). The NFI assessment system of the growing stock changes at the ARD areas will detect any harvest at AR areas in the commitment period.

11.5.2 Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year

Not applicable.

11.5.3 Information relating to Forest Management

According to the Forest law forest management is sustainable utilization and management of forests and forest land resources so to preserve biodiversity, productivity and vitality of forests as well as ability to regenerate, while providing economic, social and cultural opportunities for the benefit of present and future generations. Therefore all forest, except strictly protected areas are considered as managed forests.

CHAPTER 12: INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 BACKGROUND INFORMATION

The standard electronic format tables are included in the submission for the second time (see "SEF_LV_2010_1_10-20-35 13-1-2010.xls" attached to the submission). The SEF tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Finnish registry 31.12.2009 as well as information on transfers of the units in 2009 to and from other Parties of the Kyoto Protocol.

12.2 SUMMARY OF INFORMATION REPORTED IN THE SEF TABLES

At the beginning of the 2009 there were 116612408 AAUs in the Latvia's national holding account and 2752354 EUAs converted from AAUs in the entity holding accounts. At the end of 2009 76211269 AAUs were left in National holding account, 2954236 EUAs_AAUs and 248729 CERs were held in the entity holding accounts.

2639647 EUAs_AAUs and 103271 CERs were surrendered by Latvia's operators and retired to Latvia's national retirement account.

The registry did not contain any RMUs, t-CERs or l-CERs and no units were in the Article 3.3/3.4 net source cancellation accounts and the t-CER and l-CER replacement accounts.

Total of 82 157 152 Kyoto protocol units were stored in the ETR accounts at the end of 2009.

Latvia's assigned amount is 119 182 130 tonnes CO_2 eq.

12.3 DISCREPANCIES AND NOTIFICATIONS

There weren't any notifications received in the reporting period 2009 as Latvia and Latvia's ETS participants are not participate in any Kyoto mechanisms – joint implementation or Clean Development Mechanisms.

There weren't any transactions that were rejected and / or terminated with the response codes that are considered to be a discrepancy for the purpose of the reporting. Only 3 transactions in Latvia's ETR were rejected and 13 were terminated but with the response codes that don't corresponded to the response codes of discrepant transactions.

12.4 PUBLICLY ACCESSIBLE INFORMATION

The information required to be publicly accessible by the decisions 13/CMP/1 is available in the user interface of the Latvia's ETR – https://etrlv.lvgmc.lv, as well as in the webpage of LEGMC - http://www.meteo.lv/public/30209.html.

Following information is publicly accessible through the user interface of the registry:

- Transaction info
- List of accounts opened in Latvia's ETR.

There are no limitation of holding Kyoto protocol units in the operators and person holding accounts with the exception of AAUs that could be held only in party accounts.

There no registered Joint Implementation projects in Latvia

Additional information that is required to be publicly available by Commission Regulation No 2216/2004 is available on the LEGMC web page (partially only in Latvian).

All the documentation of the Latvia's operators – GHG permits, annual GHG reports, verification reports and approving or rejecting decision of Regional environment boards, ordinance of MoE of additional allowances allocation for the new or existing installations from national reserve

The results of the Greenhouse Gas (GHG) emission allowances trading in Latvia in 2008 is also published in LEGMC webpage. The results of 2009 trading period – allocated, verified and surrendered allowances and compliance status will be published only after 15th of May 2010.

National allocation plan for Latvia and pricelist for Latvia's ETR participations is also published in LEGMC webpage as well as all the information necessary to apply for the account opening including application form for operators and persons.

All the legislation of the EU ETS and Latvia's ETS is also available on Latvia's ETR section of LEGMC webpage.

The Decision 280/2004/EC of the European Parliament and of the Council requires EU member states to provide information on the legal entities authorised to participate in the mechanism under Articles 6, 12 and 17 of the Kyoto Protocol in the National Inventory report. This information is provided in the Annex 6.

12.5 CALCULATION OF THE COMMITMENT PERIOD RESERVE (CPR)

Latvia's assigned amount is 119182130 tonnes CO2 eq.

National commitment period reserve for Latvia is estimated as 100 % the most recent inventory multiplied with 5 years:

$$CPR = 5 * 11901.6052290488\ CO_2\ eq. = 59508.0261452442\ Gg\ CO_2\ eq.$$

or 59 508 026 tonnes CO_2 eq.

12.6 CALCULATION OF THE COMMITMENT PERIOD RESERVE (CPR)

Latvia has elected accounting of all KP-LULUCF activities at the end of commitment period. No information on the accounting of the KP-LULUCF is therefore included in the SEF tables. In the Table 12.6.1 data on accounting of the KP-LULUCF activities based on the reporting year 2008 are given.

Latvia's cap value is 6233.33 Gg CO_2 equivalents for the whole commitment period.

Table 12.6.1 Information table on accounting activities under Article 3.3 and 3.4 of the Kyoto protocol

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Emissions removals in the base year	Net emissions/removals(1)		Accounting Parameters	Accounting Quantity
		2008	Total(6)		
	(Gg CO_2 equivalent)				
A. Article 3.3 activities					
A.1. Afforestation and Reforestation					-62.92
A.1.1. Units of land not harvested since the beginning of the commitment period(2)		-62.92	-62.92		-62.92
A.1.2. Units of land harvested since the beginning of the commitment period(2)					NA,NO
Harvested lands		NA,NO	NA,NO		NA,NO
A.2. Deforestation		NA	NA		NA
B. Article 3.4 activities					
B.1. Forest Management (if elected)		-29201.92	-29201.92		-6233.33
3.3 offset(3)				0.00	0.00
FM cap(4)				6233.33	-6233.33
B.2. Cropland Management (if elected)		NA	NA	0.00	0.00
B.3. Grazing Land Management (if elected)		NA	NA	0.00	0.00
B.4. Revegetation (if elected)		NA	NA	0.00	0.00

CHAPTER 13: INFORMATION ON CHANGES IN NATIONAL SYSTEM

Since Latvia's Initial report under the Kyoto Protocol (2006) was submitted the following changes are occurred:

- The New regulation No. 157 was approved and adopted by Cabinet of Ministers on 17 February 2009. The regulation determines responsibilities and functions of institutions that are involved in the preparation of the national inventory, inter alia Quality Control/Quality Assurance procedures.
- Status and name was changed for Latvian Environment, Geology and Meteorology Agency. The new name is: State limited Liability Company "Latvian Environment, Geology and Meteorology Centre" established in the commercial 07.07.2009.

Main objectives of the centre:

- collect and process environmental information;
- carry out environmental monitoring and inform the society on the environmental situation;
- ensure the geologic supervision of earth entrails' resources and rational use of the earth entrails;
- realize the State policies in the spheres of geology, meteorology, climatology, hydrology, air quality, and cross-border air pollution influence.

Detailed description of national inventory system is presented in the section 1.2.

CHAPTER 14: INFORMATION ON CHANGES IN NATIONAL REGISTRY

During 2009 Latvia took part in "CR project" to change the used ETR software to Community Registry (CR) software developed by European Commission. The project was started at the beginning of the 2009 with signing the memorandum of understanding with the participants of the project and signing the contact with EC of using the CR software

Before the registry software change and database migration so called GRETA registry system software Greta was used for the Latvia's ETR. GRETA software was developed by DEFRA (Department for Environment, Food and Rural Affairs of UK).

The decision for the change was based mainly on the need to take more a robust, less expensive, and better supported software into use. Also, the user interface of the CR software is more user-friendly and certain repetitive operations are more easy and flexible to carry out.

Whereas Greta software was a closed system (apart from the user interface components) based on .NET and Microsoft technologies (MS IIS and MS SQL database), the CR is an open-source software (based on J2EE, using WebLogic and Oracle database), provided free-of-charge for EU members states. Due to the fact, that the CR software is open source, all developments and fixes carried out by any countries for the CR software are freely available for others as well. The access to the source code of the software also enables more efficient problem solving and localizations.

In addition, some of the heaviest functionalities related to registry activities, which require a lot of processing, are more optimized in the CR software than in the GRETA software, thus making it easier to perform these activities.

For the new CR software completely different ETR infrastructure was built.

For previous GRETA ETR software all the servers and network equipment as well as security equipments were maintained by LEGMC. For new CR software system all the servers,

licenses, network and security equipments were established and are maintained by LEGMC contractor and technical administrator of Latvia's ETR Finnish Company "Innofactor Oy".

The process of changing the registry software from Greta software to CR registry has included the following high-level steps:

- Erecting of new technical infrastructure of Latvia's ETR including two environments – test and production environment, licenses for software and equipment, network and security equipment;
- Creating the needed migration scripts, in order to transfer the registry database from GRETA to CR;
- Testing the CR internally;
- Completing the official ITL and CITL acceptance tests (Annex H and ETS test, respectively) with the localized CR software;
- Performing Go-live and database migration test in test environment and checking in the CR test environment all the data after the database migration, recording all the issues and correcting of them;
- Performing the Go-live migration for the production registry instance.

The description of the functions of national registry and its conformity with the Data Exchange Standard (DES) under the Kyoto Protocol in accordance with the Guidelines in the Annex of the Decision 15/CMP.1 on reporting of supplementary information under Article 7, paragraph 2 are given in Table 14.1 below

Detailed information has been included in Registry Readiness Questionnaire and additional readiness documentation attached to the submitted Questionnaire and in Standard Independent Assessment Report attached to this submission.

Table 14.1 Functions of the national registry and its conformity with DES

Registry Administrators	1) Helēna Rimša Primary Latvian Emission Trading Registry administrator Latvian Environment, Geology and Meteorology Centre Address: Maskavas street 165, Riga, LV-1019 Tel.: +371 67032026 e-mail: Helena.Rimsa@lvgmc.lv 2) Jeļena Lazdāne Secondary Latvian Emission Trading Registry administrator Latvian Environment, Geology and Meteorology Centre Address: Maskavas street 165, Riga, LV-1019 Tel.: +371 67032015 e-mail: Jelena.Lazdane@lvgmc.lv
Parties with which Latvia cooperates by maintaining the registry in a consolidated system	Latvia's ETR technical infrastructure maintenance company and ETR technical administrator is Finnish company "Innofactor Oy". The Latvia's ETR national registry is not a part of any consolidated registry system. However, the VPN connection to the ITL is shared with "CR project" participants.
Database structure and capacity of the national registry	The registry system, based on CR software, uses an Oracle 9I relational database dedicated data model for supporting the registry operations. Current total capacity is 8 GB, and current database size is 808 MB.
Conformity with DES	The CR registry system was developed for the EU Emissions Trading Scheme by the European Commission. The scheme requires the Member States registries to be compliant with the UN Data Exchange Standards (DES) specified for the Kyoto Protocol.

	The system contains the functionality to perform issuance, conversion, external transfer, (voluntary) cancellation, retirement and reconciliation processes using XML messages and web services as specified in the UN DES document. In addition, it also contains: 24-hour clean-up, transaction status enquiry, time synchronization, data logging requirements (including transaction log, reconciliation log, internal audit log and message archive) and the different identifier formats specified in the UN DES document. The registry development team has been in close contact with the ITL administrator and development team within the UNFCCC Secretariat during the development of the ITL functions.
Procedure to minimise discrepancies in issuance, transfer, cancellation and retirement of registry units	In order to minimise discrepancies between the registry and the transaction log, the following approach has been adopted for the registry system development under the EU ETS and UN DES: - Communication between the national registry and the ITL is via web services using XML messages – as specified in the UN DES document. These web services, XML message format and the processing sequence are as specified in the UN DES document; - As far as possible, the registry validates data entries against the list of checks that are performed by the ITL – as documented in Annex E of the UN DES Annexes document – before forwarding the request to the ITL for processing. This will help to minimise the sending of incorrect information to the ITL for approval. This also holds for any incoming transaction or message relating to a transaction. The registry validates all communication using checks described in the DES and the EU ETS regulation before processing the request further. If any check fails, the process is terminated and rolled back according to the requirements; - All units that are involved in a transaction shall be earmarked internally within the registry, thereby preventing the units from being involved in another transaction until a response has been received from the ITL and the current transaction completed; - The web service that sends the message to the ITL for processing will ensure that an acknowledgement message is received from the ITL before completing the submission of the message. Where no acknowledgement message is received following a number of retries, the web service will terminate the submission and roll back any changes made to the unit blocks that were involved; - Where a 24-hour clean-up message is received from the ITL, the web service will roll back any pending transactions and the units that were involved, thereby preventing any discrepancies in the unit blocks between the registry and the ITL; - Finally, if an unforeseen failure were to occur, the data discrepancies between the registry and the ITL can be corrected via a manual intervention function within the registry. Following this, reconciliation will be performed to validate that the data is synchronised between the registry and the ITL.
Overview of security measures (including maintenance of the measures) for unauthorised manipulations and to prevent operator error	For the CR registry the following security measures have been taken: - Access to the registry is via digital certificate access. Username and password authentication can also be acquired by contacting the registry administrator; - The actions that a user can perform are controlled by a permissions system, hence preventing unauthorised access to restricted actions; - Access to the servers and the database, as well as other related material, is limited to personnel members of “Innofactor Oy” that have passed the safety inspection (Finnish Security Police (SUPO)). - Database manipulations can only be carried out by registry administrators from the user interface. A dedicated CR development team is available to make any further security enhancements as and
List of information publicly accessible through the user interface of the registry	The information required to be publicly accessible by the decisions 13/CMP/1 is available in the user interface of the Latvia’s ETR – https://etrlv.lvgmc.lv, as well as in the webpage of LEGMC - http://www.meteo.lv/public/30209.html. Following information is publicly accessible through the user interface of the registry: • Transaction info; • List of accounts opened in Latvia’s ETR. There are no limitation of holding Kyoto protocol units in the operators and person

	holding accounts with the exception of AAUs that could be held only in party accounts. There no registered Joint Implementation projects in Latvia Additional information that is required to be publicly available by Commission Regulation No 2216/2004 is available on the LEGMC web page (partially only in Latvian). All the documentation of the Latvia's operators – GHG permits, annual GHG reports, verification reports and approving or rejecting decision of Regional environment boards, ordinance of MoE of additional allowances allocation for the new or existing installations from national reserve The results of the Greenhouse Gas (GHG) emission allowances trading in Latvia in 2008 is also published in LEGMC webpage. The results of 2009 trading period – allocated, verified and surrendered allowances and compliance status will be published only after 15th of May 2010. National allocation plan for Latvia and pricelist for Latvia's ETR participations is also published in LEGMC webpage as well as all the information necessary to apply for the account opening including application form for operators and persons. All the legislation of the EU ETS and Latvia's ETS is also available on Latvia's ETR section of LEGMC webpage.
Internet address of the interface	https://etrlv.lvgmc.lv
Measures to safeguard, maintain and recover data to ensure the integrity of data storage and the recovery of registry services in the event of a disaster	In the event of a serious malfunction the following recovery procedures have been incorporated in the design of the registry system: - Locally information in the database is held over a raid-array structure with automatic error detection and recovery. Therefore, any single database failure would be alerted and the registry would automatically switch over to use information from the remaining uncorrupted databases; Data is also archived every 24 hours to an off-site recovery location, and this will also be used for

CHAPTER 15: INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

Latvia is Annex I country and within limits collaborates with developing countries to minimize adverse, social, environmental and economic impacts on the Parties.

Information about actions specified in Decision 15./CMP.1, paragraph 24 how Latvia gives priority to minimize the adverse impact of response measures in developing countries are presented in following table:

Action	Implementation in Latvia's policy
The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities.	Latvia is working in accordance with terms of EU market and its fiscal initiatives including those aiming energy price reforms. In 2010 government decided to phase out the market distortion related to VAT exemption on natural gas, introducing additional excise-duty. Natural gas is main fossil fuel in GHG-emitting energy sector hence its competition with biomass and other has been balanced.
Removing subsidies associated with the use of environmentally unsound and unsafe technologies.	No subsidies are given for environmentally unsound and unsafe technologies.
Cooperating in the technological development of non-energy uses of fossil fuels and supporting developing country Parties to this end.	Latvia does not have any support activities on this issue.
Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort.	Latvia does not have any support activities on this issue.
Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities.	Our developing policy support capacity building in developing countries, taking into account their needs.
Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.	Latvia does not have any support activities on this issue.

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ANNEXES TO THE NATIONAL INVENTORY REPORT

Annex 1: Key categories

Level Assessment year 2008, without LULUCF

	IPCC GHG Source and Sink Categories (LUCF not included)	Direct Greenhouse Gas	2008 Estimate, Gg CO2-eq	% Level Assessment	% Cumulative Total of Level Assessment
Energy	Mobile Combustion: Road Vehicles	CO2	3268.748	0.27	0.27
Energy	CO2 Emissions from Stationary Combustion-gas	CO2	3215.918	0.27	0.54
Energy	CO2 Emissions from Stationary Combustion-oil	CO2	834.437	0.07	0.61
Agriculture	Emissions from Agricultural Soils	direct-N2O	739.714	0.06	0.68
Agriculture	Emissions from Enteric fermentation in Domestic Livestock's	CH4	672.654	0.06	0.73
Waste	Emissions from Solid Waste Disposal Sites	CH4	607.199	0.05	0.78
Energy	CO2 Emissions from Stationary Combustion-coal	CO2	406.336	0.03	0.82
Agriculture	Emissions from Nitrogen Used in Agriculture	indirect-N2O	336.817	0.03	0.85
Energy	Mobile Combustion: Railways	CO2	242.471	0.02	0.87
Energy	Non-CO2 Emissions from Stationary Combustion-biomass	CH4	242.266	0.02	0.89
Waste	Emissions from Wastewater Handling	CH4	241.568	0.02	0.91
Industrial processes	Emissions from Cement Production	CO2	168.690	0.01	0.92
Agriculture	Emissions from Manure Management	N2O	154.917	0.01	0.94
Energy	Fugitive Emissions from Oil and Gas Operations	CH4	111.342	0.01	0.945
Agriculture	Pasture, Range and Paddock Manure	N2O	101.056	0.01	0.953
Industrial processes	Emissions from Consumption of HFCs	HFC	80.10	0.01	0.960
Agriculture	Emissions from Manure Management	CH4	79.58	0.01	0.97
Waste	Emissions from Wastewater Handling	N2O	65.97	0.01	0.97
Energy	Non-CO2 Emissions from Stationary Combustion-biomass	N2O	59.85	0.01	0.98
Industrial processes	Emissions from Solvent and other product use	CO2	49.06	0.00	0.98
Energy	Mobile Combustion: Road Vehicles	N2O	35.58	0.00	0.98
Energy	Mobile Combustion: Railways	N2O	29.98	0.00	0.99
Industrial processes	Emissions from other mineral products	CO2	22.70	0.00	0.99
Industrial processes	Emissions from Road Paving with Asphalt	CO2	21.18	0.00	0.99
Industrial processes	Emissions from Limestone and Dolomite use	CO2	20.76	0.0017	0.99
Energy	Manufacturing Industries and Construction (Other fuels)	CO2	17.85	0.00	0.99
Industrial processes	Emissions from Lime Production	CO2	11.65	0.00	0.99
Industrial processes	Emissions from Electrical equipment	SF6	10.08	0.00	1.00
Industrial processes	Emissions from the Iron and Steel Industry	CO2	8.67	0.00	1.00
Energy	Mobile Combustion: Road Vehicles	CH4	6.70	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-coal	CH4	6.31	0.0005	1.00
Energy	Mobile Combustion: Waterborne Navigation	CO2	5.47	0.00	1.00
Industrial processes	Solvent and Other Product Use	N2O	4.34	0.00	1.00
Energy	Mobile combustion (Other 1A5b)	CO2	3.39	0.00	1.00
Energy	Mobile Combustion: Aircraft	CO2	3.15	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-gas	CH4	3.08	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-oil	CH4	2.43	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-oil	N2O	2.29	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-coal	N2O	1.96	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-gas	N2O	1.72	0.00	1.00
Waste	Emissions from Compost production	N2O	0.86	0.00	1.00
Waste	Emissions from Compost production	CH4	0.78	0.00	1.00
Energy	Mobile Combustion: Waterborne Navigation	N2O	0.65	0.00	1.00
Waste	Emissions from Waste Incineration	CO2	0.50	0.00	1.00
Energy	Mobile Combustion: Railways	CH4	0.29	0.00	1.00

	IPCC GHG Source and Sink Categories (LUCF not included)	Direct Greenhouse Gas	2008 Estimate, Gg CO2-eq	% Level Assessment	% Cumulative Total of Level Assessment
Energy	Manufacturing Industries and Construction (Other fuels)	N2O	0.26	0.00	1.00
Energy	Manufacturing Industries and Construction (Other fuels)	CH4	0.13	0.00	1.00
Industrial processes	Emissions from the Iron and Steel Industry	CH4	0.06	0.00	1.00
Energy	Mobile Combustion: Aircraft	N2O	0.04	0.00	1.00
Energy	Mobile combustion (Other 1A5b)	N2O	0.02	0.00	1.00
Industrial processes	Emissions from Asphalt Roofing	CO2	0.02	0.00	1.00
Energy	Mobile Combustion: Waterborne Navigation	CH4	0.01	0.00	1.00
Energy	Mobile combustion (Other 1A5b)	CH4	0.00	0.00	1.00
Energy	Mobile Combustion: Aircraft	CH4	0.00	0.00	1.00
		Total of categories included in Latvia's KCA	**11901.61**		
		Total without LULUCF (from CRF Table Summary 2)	11 901.61		
		Difference (= total of missing categories)	0.00		

Level Assessment year 2008, with LULUCF

	IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	2008	2008, absolute values	Level Assess ment	Cumulative
LULUCF	Removals from Forest Land	CO2	-29386.55	29386.55	0.70	0.70
Energy	Mobile Combustion: Road Vehicles	CO2	3268.75	3268.75	0.08	0.78
Energy	CO2 Emissions from Stationary Combustion-gas	CO2	3215.92	3215.92	0.08	0.86
Energy	CO2 Emissions from Stationary Combustion-oil	CO2	834.44	834.44	0.02	0.88
Agriculture	Emissions from Agricultural Soils	direct-N2O	739.71	739.71	0.02	0.90
Agriculture	Emissions from Enteric fermentation in Domestic Livestocks	CH4	672.65	672.65	0.02	0.91
Waste	Emissions from Solid Waste Disposal Sites	CH4	607.20	607.20	0.01	0.93
Energy	CO2 Emissions from Stationary Combustion-coal	CO2	406.34	406.34	0.01	0.94
Agriculture	Emissions from Nitrogen Used in Agriculture	indirect-N2O	336.82	336.82	0.01	0.94
LULUCF	Emissions from Cropland	CO2	304.70	304.70	0.01	0.95
Energy	Mobile Combustion: Railways	CO2	242.47	242.47	0.01	0.96
Energy	Non-CO2 Emissions from Stationary Combustion-biomass	CH4	242.27	242.27	0.01	0.96
Waste	Emissions from Wastewater Handling	CH4	241.57	241.57	0.01	0.97
Industrial processes	Emissions from Cement Production	CO2	168.69	168.69	0.00	0.97
Agriculture	Emissions from Manure Management	N2O	154.92	154.92	0.00	0.98
LULUCF	Emissions from Forest Land	N2O	145.59	145.59	0.00	0.98
Energy	Fugitive Emissions from Oil and Gas Operations	CH4	111.34	111.34	0.00	0.98
Agriculture	Pasture, Range and Paddock Manure	N2O	101.06	101.06	0.00	0.99
Industrial processes	Emissions from Consumption of HFCs	HFC	80.10	80.10	0.00	0.99
Agriculture	Emissions from Manure Management	CH4	79.58	79.58	0.00	0.99
Waste	Emissions from Wastewater Handling	N2O	65.97	65.97	0.00	0.99
Energy	Non-CO2 Emissions from Stationary Combustion-biomass	N2O	59.85	59.85	0.00	0.99
Industrial processes	Emissions from Solvent and other product use	CO2	49.06	49.06	0.00	0.99
Energy	Mobile Combustion: Road Vehicles	N2O	35.58	35.58	0.00	0.99
Energy	Mobile Combustion: Railways	N2O	29.98	29.98	0.00	0.99
LULUCF	Emissions from Forest Land	CH4	28.00	28.00	0.00	1.00
Industrial processes	Emissions from other mineral products	CO2	22.70	22.70	0.00	1.00
Industrial processes	Emissions from Road Paving with Asphalt	CO2	21.18	21.18	0.00	1.00
Industrial processes	Emissions from Limestone and Dolomite use	CO2	20.76	20.76	0.00	1.00
LULUCF	Wetlands remaining Wetlands	CO2	19.80	19.80	0.00	1.00
Energy	Manufacturing Industries and Construction (Other fuels)	CO2	17.85	17.85	0.00	1.00
Industrial processes	Emissions from Lime Production	CO2	11.65	11.65	0.00	1.00
Industrial processes	Emissions from Electrical equipment	SF6	10.08	10.08	0.00	1.00
LULUCF	Removals from Grassland	CO2	8.68	8.68	0.00	1.00
Industrial processes	Emissions from the Iron and Steel Industry	CO2	8.67	8.67	0.00	1.00
Energy	Mobile Combustion: Road Vehicles	CH4	6.70	6.70	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-coal	CH4	6.31	6.31	0.00	1.00
Energy	Mobile Combustion: Waterborne Navigation	CO2	5.47	5.47	0.00	1.00
Industrial processes	Solvent and Other Product Use	N2O	4.34	4.34	0.00	1.00
Energy	Mobile combustion (Other 1A5b)	CO2	3.39	3.39	0.00	1.00
Energy	Mobile Combustion: Aircraft	CO2	3.15	3.15	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-gas	CH4	3.08	3.08	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-oil	CH4	2.43	2.43	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-oil	N2O	2.29	2.29	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-coal	N2O	1.96	1.96	0.00	1.00
Energy	Non-CO2 Emissions from Stationary Combustion-gas	N2O	1.72	1.72	0.00	1.00

	IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	2008	2008, absolute values	Level Assess ment	Cumulative
LULUCF	Wetlands remaining Wetlands	N2O	1.32	1.32	0.00	1.00
Waste	Emissions from Compost production	N2O	0.86	0.86	0.00	1.00
Waste	Emissions from Compost production	CH4	0.78	0.78	0.00	1.00
Energy	Mobile Combustion: Waterborne Navigation	N2O	0.65	0.65	0.00	1.00
Waste	Emissions from Waste Incineration	CO2	0.50	0.50	0.00	1.00
Energy	Mobile Combustion: Railways	CH4	0.29	0.29	0.00	1.00
Energy	Manufacturing Industries and Construction (Other fuels)	N2O	0.26	0.26	0.00	1.00
Energy	Manufacturing Industries and Construction (Other fuels)	CH4	0.13	0.13	0.00	1.00
LULUCF	Grassland remaining Grassland	CH4	0.06	0.06	0.00	1.00
Industrial processes	Emissions from the Iron and Steel Industry	CH4	0.06	0.06	0.00	1.00
Energy	Mobile Combustion: Aircraft	N2O	0.04	0.04	0.00	1.00
LULUCF	Grassland remaining Grassland	N2O	0.03	0.03	0.00	1.00
Energy	Mobile combustion (Other 1A5b)	N2O	0.02	0.02	0.00	1.00
Industrial processes	Emissions from Asphalt Roofing	CO2	0.02	0.02	0.00	1.00
Energy	Mobile Combustion: Waterborne Navigation	CH4	0.01	0.01	0.00	1.00
Energy	Mobile combustion (Other 1A5b)	CH4	0.00	0.00	0.00	1.00
Energy	Mobile Combustion: Aircraft	CH4	0.00	0.00	0.00	1.00
	Sum		-16976.78	41796.32		61.49
Total of categories included in Latvia's KCA			**-16976.78**	**41796.32**		
Total with LULUCF (from CRF Table Summary 2)			-16 976.78			
Difference (= total of missing categories)			0.00			

Trend Assessment year 2008, excluding LULUCF

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	Base year 1990	2008	Level Assessment	E Trend Assessment	F % Contribution to Trend	G Cumulative Total of Column F
CO2 Emissions from Stationary Combustion-oil	CO2	7421.27	834.44	0.07	0.466	0.32	0.32
Mobile Combustion: Road Vehicles	CO2	2351.55	3268.75	0.27	0.421	0.28	0.60
CO2 Emissions from Stationary Combustion-coal	CO2	2651.11	406.34	0.03	0.146	0.10	0.70
CO2 Emissions from Stationary Combustion-gas	CO2	5681.39	3215.92	0.27	0.131	0.09	0.79
Emissions from Solid Waste Disposal Sites	CH4	393.10	607.20	0.05	0.082	0.06	0.84
Emissions from Enteric fermentation in Domestic Livestock	CH4	2147.55	672.65	0.06	0.053	0.04	0.88
Non-CO2 Emissions from Stationary Combustion-biomass	CH4	167.29	242.27	0.02	0.032	0.02	0.90
Emissions from Nitrogen Used in Agriculture	indirect-N2O	1033.87	336.82	0.03	0.023	0.02	0.92
Emissions from Manure Management	N2O	551.63	154.92	0.01	0.017	0.01	0.93
Emissions from Consumption of HFCs	HFC	0.00	80.10	0.01	0.015	0.01	0.94
Emissions from Wastewater Handling	CH4	370.40	241.57	0.02	0.015	0.01	0.95
Pasture, Range and Paddock Manure	N2O	358.39	101.06	0.01	0.011	0.01	0.955
Non-CO2 Emissions from Stationary Combustion-biomass	N2O	34.10	59.85	0.01	0.008	0.01	0.96
Emissions from Manure Management	CH4	279.52	79.58	0.01	0.008	0.01	0.97
Emissions from Limestone and Dolomite use	CO2	118.97	20.76	0.00	0.006	0.00	0.97
Emissions from Wastewater Handling	N2O	79.85	65.97	0.01	0.006	0.00	0.97
Emissions from Agricultural Soils	direct-N2O	1601.56	739.71	0.06	0.005	0.00	0.98
Emissions from Solvent and other product use	CO2	55.70	49.06	0.00	0.005	0.00	0.98
Mobile Combustion: Road Vehicles	N2O	26.36	35.58	0.00	0.005	0.00	0.98
Non-CO2 Emissions from Stationary Combustion-coal	CH4	59.64	6.31	0.00	0.004	0.00	0.99
Emissions from Road Paving with Asphalt	CO2	9.60	21.18	0.00	0.003	0.00	0.99
Emissions from Lime Production	CO2	0.00	11.65	0.00	0.002	0.00	0.99
Fugitive Emissions from Oil and Gas Operations	CH4	274.05	111.34	0.01	0.002	0.00	0.99
Emissions from Electrical equipment	SF6	0.00	10.08	0.00	0.002	0.00	0.99
Mobile Combustion: Railways	CO2	525.35	242.47	0.02	0.002	0.00	0.99
Emissions from other mineral products	CO2	69.18	22.70	0.00	0.002	0.00	0.99
Non-CO2 Emissions from Stationary Combustion-oil	N2O	19.50	2.29	0.00	0.001	0.00	1.00
Emissions from Cement Production	CO2	366.12	168.69	0.01	0.001	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-coal	N2O	16.48	1.96	0.00	0.001	0.00	1.00
Mobile Combustion: Waterborne Navigation	CO2	1.01	5.47	0.00	0.001	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	CH4	13.27	2.43	0.00	0.001	0.00	1.00
Mobile Combustion: Aircraft	CO2	0.07	3.15	0.00	0.001	0.00	1.00
Emissions from the Iron and Steel Industry	CO2	12.83	8.67	0.00	0.001	0.00	1.00
Mobile Combustion: Road Vehicles	CH4	20.62	6.70	0.00	0.000	0.00	1.00
Mobile Combustion: Railways	N2O	64.96	29.98	0.00	0.000	0.00	1.00
Emissions from Compost production	N2O	0.00	0.86	0.00	0.000	0.00	1.00
Emissions from Compost production	CH4	0.00	0.78	0.00	0.000	0.00	1.00
Mobile Combustion: Waterborne Navigation	N2O	0.10	0.65	0.00	0.000	0.00	1.00
Emissions from Waste Incineration	CO2	0.00	0.50	0.00	0.000	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	N2O	3.05	1.72	0.00	0.000	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	CH4	6.24	3.08	0.00	0.000	0.00	1.00
Mobile Combustion: Aircraft	N2O	0.00	0.04	0.00	0.000	0.00	1.00
Emissions from the Iron and Steel Industry	CH4	0.06	0.06	0.00	0.000	0.00	1.00
Emissions from Asphalt Roofing	CO2	0.01	0.02	0.00	0.000	0.00	1.00
Mobile Combustion: Railways	CH4	0.64	0.29	0.00	0.000	0.00	1.00
Mobile Combustion: Waterborne Navigation	CH4	0.00	0.01	0.00	0.000	0.00	1.00

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	Base year 1990	2008	Level Assessment	E Trend Assessment	F % Contribution to Trend	G Cumulative Total of Column F
Manufacturing Industries and Construction (Other fuels)	CO2	0.00	17.85	0.00	0.00	0.00	1.00
Solvent and Other Product Use	N2O	0	4.34	0.00	0.00	0.00	1.00
Mobile combustion (Other 1A5b)	CO2	0	3.39	0.00	0.00	0.00	1.00
Manufacturing Industries and Construction (Other fuels)	N2O	0	0.26	0.00	0.00	0.00	1.00
Manufacturing Industries and Construction (Other fuels)	CH4	0	0.13	0.00	0.00	0.00	1.00
Mobile combustion (Other 1A5b)	N2O	0	0.02	0.00	0.00	0.00	1.00
Mobile combustion (Other 1A5b)	CH4	0	0.00	0.00	0.00	0.00	1.00
Mobile Combustion: Aircraft	CH4	0.00	0.00	0.00	0.00	0.00	1.00
Total of categories included in Latvia's KCA		**26786.43**	**11901.61**	**1.00**	**1.48**	**1.00**	**51.44**
Total without LULUCF (from CRF Table Summary 2)		26 786.43	11 901.61				
Difference (= total of missing categories)		0.00	0.00				

Trend assessment year 2008, with LULUCF

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	1990	2008	Base year 1990, absolute value	2008, absolute value	Level Assessment	Trend Assessment	Contribution to trend	Cumulative
Removals from Forest Land	CO2	-19377.24	-29386.55	19377.24	29386.55	0.697	-1.962	0.49	0.49
CO2 Emissions from Stationary Combustion-oil	CO2	7421.27	834.44	7421.27	834.44	0.020	-0.460	0.12	0.61
CO2 Emissions from Stationary Combustion-gas	CO2	5681.39	3215.92	5681.39	3215.92	0.076	-0.424	0.11	0.72
Mobile Combustion: Road Vehicles	CO2	2351.55	3268.75	2351.55	3268.75	0.078	-0.230	0.06	0.78
CO2 Emissions from Stationary Combustion-coal	CO2	2651.11	406.34	2651.11	406.34	0.010	-0.168	0.04	0.82
Emissions from Enteric fermentation in Domestic Livestock	CH4	2147.55	672.65	2147.55	672.65	0.016	-0.145	0.04	0.85
Emissions from Agricultural Soils	direct-N2O	1601.56	739.71	1601.56	739.71	0.018	-0.115	0.03	0.88
Emissions from Wastewater Handling	CH4	370.40	241.57	614.96	637.60	0.015	-0.075	0.02	0.90
Emissions from Nitrogen Used in Agriculture	indirect-N2O	1033.87	336.82	1033.87	336.82	0.008	-0.070	0.02	0.92
Emissions from Solid Waste Disposal Sites	CH4	393.10	607.20	393.10	607.20	0.014	-0.040	0.01	0.93
Mobile Combustion: Railways	CO2	525.35	242.47	525.35	242.47	0.006	-0.038	0.01	0.94
Emissions from Manure Management	N2O	551.63	154.92	551.63	154.92	0.004	-0.037	0.01	0.95
Emissions from Cropland	CO2	440.07	304.70	440.07	304.70	0.007	-0.034	0.01	0.96
Emissions from Cement Production	CO2	366.12	168.69	366.12	168.69	0.004	-0.026	0.01	0.96
Pasture, Range and Paddock Manure	N2O	358.39	101.06	358.39	101.06	0.002	-0.024	0.01	0.97
Fugitive Emissions from Oil and Gas Operations	CH4	274.05	111.34	274.05	111.34	0.003	-0.019	0.00	0.98
Emissions from Manure Management	CH4	279.52	79.58	279.52	79.58	0.002	-0.019	0.00	0.98
Non-CO2 Emissions from Stationary Combustion-biomass	CH4	167.29	242.27	167.29	242.27	0.006	-0.017	0.00	0.98
Emissions from Forest Land	N2O	151.36	145.59	97.05	93.71	0.002	-0.008	0.00	0.99
Emissions from Limestone and Dolomite use	CO2	118.97	20.76	118.97	20.76	0.000	-0.008	0.00	0.99
Emissions from Wastewater Handling	N2O	79.85	65.97	79.94	65.79	0.002	-0.007	0.00	0.99
Emissions from other mineral products	CO2	69.18	22.70	69.18	22.70	0.001	-0.005	0.00	0.99
Mobile Combustion: Railways	N2O	64.96	29.98	64.96	29.98	0.001	-0.005	0.00	0.99
Emissions from Solvent and other product use	CO2	55.70	49.06	55.70	49.06	0.001	-0.005	0.00	0.99
Non-CO2 Emissions from Stationary Combustion-coal	CH4	59.639	6.311	59.64	6.31	0.000	-0.004	0.00	0.99
Non-CO2 Emissions from Stationary Combustion-biomass	N2O	34.10	59.85	34.10	59.85	0.001	-0.004	0.00	1.00
Mobile Combustion: Road Vehicles	N2O	26.36	35.58	26.36	35.58	0.001	-0.003	0.00	1.00
Emissions from Consumption of HFCs	HFC	0.00	80.10	0.00	80.10	0.002	-0.002	0.00	1.00
Emissions from Forest Land	CH4	19.28	28.00	19.28	28.00	0.001	-0.002	0.00	1.00
Wetlands remaining Wetlands	CO2	19.80	19.80	19.80	19.80	0.000	-0.002	0.00	1.00
Mobile Combustion: Road Vehicles	CH4	20.62	6.70	20.62	6.70	0.000	-0.001	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	N2O	19.50	2.29	19.50	2.29	0.000	-0.001	0.00	1.00
Emissions from Road Paving with Asphalt	CO2	9.603	21.177	9.60	21.18	0.001	-0.001	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-coal	N2O	16.478	1.956	16.48	1.96	0.000	-0.001	0.00	1.00
Emissions from the Iron and Steel Industry	CO2	12.83	8.67	12.83	8.67	0.000	-0.001	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	CH4	13.27	2.43	13.27	2.43	0.000	-0.001	0.00	1.00
Emissions from Grassland	CO2	10.074	8.676	10.07	8.68	0.000	-0.001	0.00	1.00
Manufacturing Industries and Construction (Other fuels)	CO2	0	17.85	0	17.85	0.000	0.000	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	CH4	6.245	3.084	6.24	3.08	0.000	0.000	0.00	1.00
Emissions from Lime Production	CO2	0.000	11.651	0.00	11.65	0.000	0.000	0.00	1.00
Emissions from Electrical equipment	SF6	0.00	10.076	0.00	10.08	0.000	0.000	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	N2O	3.049	1.721	3.05	1.72	0.000	0.000	0.00	1.00
Mobile Combustion: Waterborne Navigation	CO2	1.014	5.470	1.01	5.47	0.000	0.000	0.00	1.00

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	1990	2008	Base year 1990, absolute value	2008, absolute value	Level Assessment	Trend Assessment	Contribution to trend	Cumulative
Solvent and Other Product Use	N2O	0	4.34	0	4.34	0.000	0.000	0.00	1.00
Wetlands remaining Wetlands	N2O	1.32	1.32	1.32	1.32	0.000	0.000	0.00	1.00
Mobile combustion (Other 1A5b)	CO2	0	3.39	0	3.39	0.000	0.000	0.00	1.00
Mobile Combustion: Aircraft	CO2	0.066	3.148	0.07	3.15	0.000	0.000	0.00	1.00
Mobile Combustion: Railways	CH4	0.639	0.295	0.64	0.29	0.000	0.000	0.00	1.00
Mobile Combustion: Waterborne Navigation	N2O	0.105	0.647	0.10	0.65	0.000	0.000	0.00	1.00
Emissions from Compost production	N2O	0.00	0.86	0.00	0.86	0.000	0.000	0.00	1.00
Emissions from Compost production	CH4	0.00	0.780	0.00	0.78	0.000	0.000	0.00	1.00
Emissions from Waste Incineration	CO2	0.00	0.50	0.00	0.50	0.000	0.000	0.00	1.00
Manufacturing Industries and Construction (Other fuels)	N2O	0	0.26	0	0.26	0.000	0.000	0.00	1.00
Emissions from the Iron and Steel Industry	CH4	0.058	0.056	0.06	0.06	0.000	0.000	0.00	1.00
Manufacturing Industries and Construction (Other fuels)	CH4	0	0.13	0	0.13	0.000	0.000	0.00	1.00
Grassland remaining Grassland	CH4	0	0.06	0	0.06	0.000	0.000	0.00	1.00
Mobile Combustion: Aircraft	N2O	0.00	0.04	0.00056887	0.04	0.000	0.000	0.00	1.00
Emissions from Asphalt Roofing	CO2	0.01	0.02	0.008049	0.02	0.000	0.000	0.00	1.00
Grassland remaining Grassland	N2O	0	0.03	0	0.03	0.000	0.000	0.00	1.00
Mobile combustion (Other 1A5b)	N2O	0	0.02	0	0.02	0.000	0.000	0.00	1.00
Mobile Combustion: Waterborne Navigation	CH4	0.00	0.01	0.00	0.01	0.000	0.000	0.00	1.00
Mobile combustion (Other 1A5b)	CH4	0	0.00	0	0.00	0.000	0.000	0.00	1.00
Mobile Combustion: Aircraft	CH4	0.00	0.00	0.000010	0.00	0.000	0.000	0.00	1.00
Total of categories included in Latvia's KCA		**8051.09**	**-16976.775**	**46995.910**	**42140.302**	**1.000**	**-3.967**	**1.00**	
Total with LULUCF (from CRF Table Summary 2)		8 051.09	-16 976.78						
Difference (= total of missing categories)		0.00	0.000						

Level Assessment year 1990, with LULUCF

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	1990	1990, absolute values	Level Assessment	Cumulative
Removals from Forest Land	CO2	-19377.24	19377.24	0.41	0.41
CO2 Emissions from Stationary Combustion-oil	CO2	7421.27	7421.27	0.16	0.57
CO2 Emissions from Stationary Combustion-gas	CO2	5681.39	5681.39	0.12	0.69
CO2 Emissions from Stationary Combustion-coal	CO2	2651.11	2651.11	0.06	0.75
Mobile Combustion: Road Vehicles	CO2	2351.55	2351.55	0.05	0.80
Emissions from Enteric fermentation in Domestic Livestock’s	CH4	2147.55	2147.55	0.05	0.85
Emissions from Agricultural Soils	direct-N2O	1601.56	1601.56	0.03	0.88
Emissions from Nitrogen Used in Agriculture	indirect-N2O	1033.87	1033.87	0.02	0.90
Emissions from Manure Management	N2O	551.63	551.63	0.01	0.91
Mobile Combustion: Railways	CO2	525.35	525.35	0.01	0.93
Emissions from Cropland	CO2	440.07	440.07	0.01	0.94
Emissions from Solid Waste Disposal Sites	CH4	393.10	393.10	0.01	0.94
Emissions from Wastewater Handling	CH4	370.40	370.40	0.01	0.95
Emissions from Cement Production	CO2	366.12	366.12	0.01	0.96
Pasture, Range and Paddock Manure	N2O	358.39	358.39	0.01	0.97
Emissions from Manure Management	CH4	279.52	279.52	0.01	0.97
Fugitive Emissions from Oil and Gas Operations	CH4	274.05	274.05	0.01	0.98
Non-CO2 Emissions from Stationary Combustion-biomass	CH4	167.29	167.29	0.00	0.98
Emissions from Forest Land	N2O	151.36	151.36	0.00	0.99
Emissions from Limestone and Dolomite use	CO2	118.97	118.97	0.00	0.99
Emissions from Wastewater Handling	N2O	79.85	79.85	0.00	0.99
Emissions from other mineral products	CO2	69.18	69.18	0.00	0.99
Mobile Combustion: Railways	N2O	64.96	64.96	0.00	0.99
Non-CO2 Emissions from Stationary Combustion-coal	CH4	59.64	59.64	0.00	0.99
Emissions from Solvent and other product use	CO2	55.70	55.70	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-biomass	N2O	34.10	34.10	0.00	1.00
Mobile Combustion: Road Vehicles	N2O	26.36	26.36	0.00	1.00
Mobile Combustion: Road Vehicles	CH4	20.62	20.62	0.00	1.00
Wetlands remaining Wetlands	CO2	19.80	19.80	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	N2O	19.50	19.50	0.00	1.00
Emissions from Forest Land	CH4	19.28	19.28	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-coal	N2O	16.48	16.48	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	CH4	13.27	13.27	0.00	1.00
Emissions from the Iron and Steel Industry	CO2	12.83	12.83	0.00	1.00
Removals from Grassland	CO2	10.07	10.07	0.00	1.00
Emissions from Road Paving with Asphalt	CO2	9.60	9.60	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	CH4	6.24	6.24	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	N2O	3.05	3.05	0.00	1.00
Wetlands remaining Wetlands	N2O	1.32	1.32	0.00	1.00
Mobile Combustion: Waterborne Navigation	CO2	1.01	1.01	0.00	1.00
Mobile Combustion: Railways	CH4	0.64	0.64	0.00	1.00
Mobile Combustion: Waterborne Navigation	N2O	0.10	0.10	0.00	1.00
Mobile Combustion: Aircraft	CO2	0.07	0.07	0.00	1.00
Emissions from the Iron and Steel Industry	CH4	0.06	0.06	0.00	1.00
Emissions from Asphalt Roofing	CO2	0.01	0.01	0.00	1.00
Mobile Combustion: Waterborne Navigation	CH4	0.00	0.00	0.00	1.00
Mobile Combustion: Aircraft	N2O	0.00	0.00	0.00	1.00
Mobile Combustion: Aircraft	CH4	0.00	0.00	0.00	1.00
Emissions from Electrical equipment	SF6	0.00	0.00	0.00	1.00
Solvent and Other Product Use	N2O	0.00	0.00	0.00	1.00
Emissions from Compost production	N2O	0.00	0.00	0.00	1.00

IPCC GHG Source and Sink Categories	Direct Greenhouse Gas	1990	1990, absolute values	Level Assessment	Cumulative
Emissions from Compost production	CH4	0.00	0.00	0.00	1.00
Emissions from Waste Incineration	CO2	0.00	0.00	0.00	1.00
Grassland remaining Grassland	CH4	0.00	0.00	0.00	1.00
Grassland remaining Grassland	N2O	0.00	0.00	0.00	1.00
Sum		8051.09	**46805.57**		52.31
Total of categories included in Latvia's KCA		**8051.09**			
Total with LULUCF (from CRF Table Summary 2)		8 051.09			
Difference (= total of missing categories)		0.00			

Level Assessment year 1990, without LULUCF

IPCC GHG Source and Sink Categories (LULUCF not included)	Direct Greenhouse Gas	2008 Estimate, Gg CO2-eq	% Level Assessment	% Cumulative Total of Level Assessment
CO2 Emissions from Stationary Combustion-oil	CO2	7421.269	0.28	0.28
CO2 Emissions from Stationary Combustion-gas	CO2	5681.392	0.21	0.49
CO2 Emissions from Stationary Combustion-coal	CO2	2651.113	0.10	0.59
Mobile Combustion: Road Vehicles	CO2	2351.551	0.09	0.68
Emissions from Enteric fermentation in Domestic Livestocks	CH4	2147.550	0.08	0.76
Emissions from Agricultural Soils	direct-N2O	1601.562	0.06	0.82
Emissions from Nitrogen Used in Agriculture	indirect-N2O	1033.873	0.04	0.85
Emissions from Manure Management	N2O	551.629	0.02	0.88
Mobile Combustion: Railways	CO2	525.353	0.02	0.89
Emissions from Solid Waste Disposal Sites	CH4	393.097	0.01	0.91
Emissions from Wastewater Handling	CH4	370.402	0.01	0.92
Emissions from Cement Production	CO2	366.123	0.01	0.94
Pasture, Range and Paddock Manure	N2O	358.395	0.01	0.95
Emissions from Manure Management	CH4	279.52	0.01	0.96
Fugitive Emissions from Oil and Gas Operations	CH4	274.050	0.01	0.97
Non-CO2 Emissions from Stationary Combustion-biomass	CH4	167.286	0.01	0.98
Emissions from Limestone and Dolomite use	CO2	118.97	0.00	0.98
Emissions from Wastewater Handling	N2O	79.85	0.00	0.98
Emissions from other mineral products	CO2	69.18	0.00	0.99
Mobile Combustion: Railways	N2O	64.96	0.00	0.99
Non-CO2 Emissions from Stationary Combustion-coal	CH4	59.64	0.00	0.99
Emissions from Solvent and other product use	CO2	55.70	0.00	0.99
Non-CO2 Emissions from Stationary Combustion-biomass	N2O	34.10	0.00	1.00
Mobile Combustion: Road Vehicles	N2O	26.36	0.00	1.00
Mobile Combustion: Road Vehicles	CH4	20.62	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	N2O	19.50	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-coal	N2O	16.48	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-oil	CH4	13.27	0.00	1.00
Emissions from the Iron and Steel Industry	CO2	12.83	0.00	1.00
Emissions from Road Paving with Asphalt	CO2	9.60	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	CH4	6.24	0.00	1.00
Non-CO2 Emissions from Stationary Combustion-gas	N2O	3.05	0.00	1.00
Mobile Combustion: Waterborne Navigation	CO2	1.01	0.00	1.00
Mobile Combustion: Railways	CH4	0.64	0.00	1.00
Mobile Combustion: Waterborne Navigation	N2O	0.10	0.00	1.00
Mobile Combustion: Aircraft	CO2	0.07	0.00	1.00
Emissions from the Iron and Steel Industry	CH4	0.06	0.00	1.00
Emissions from Asphalt Roofing	CO2	0.01	0.00	1.00
Mobile Combustion: Waterborne Navigation	CH4	0.00	0.00	1.00
Mobile Combustion: Aircraft	N2O	0.00	0.00	1.00
Mobile Combustion: Aircraft	CH4	0.00	0.00	1.00
Emissions from Electrical equipment	SF6	0.00	0.00	1.00
Solvent and Other Product Use	N2O	0.00	0.00	1.00
Emissions from Compost production	N2O	0.00	0.00	1.00
Emissions from Compost production	CH4	0.00	0.00	1.00
Emissions from Waste Incineration	CO2	0.00	0.00	1.00
Total of categories included in Latvia's KCA		**26786.43**		
Total without LULUCF (from CRF Table Summary 2)		26 786.43		
Difference (= total of missing categories)		0.00		

Annex 2: Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion

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 CO_2 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:

- combusted type of fuel;
- amount of combusted fuel B_n;
- carbon content (C^d %) in working mass of fuel;
- 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 □ 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:

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

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.

4. Explanation and suggestions

1. In IPCC methodology [L1, Chapter 1.Energy 1.1 and 2.Energy 2.1.1.2] it is determined that in each country all available data have to be used in estimation of CO_2 emission factors for different fuel types and only when these data aren't available data from methodology could be used. It was taken into account when CO_2 emission factors for fuels used in Latvia were estimated.

2. Country's average CO_2 emission factors are estimated using actual data of fuel consumption and types [L1 chapter 1.2.1]. These data are obtained by Central Statistical Bureau of Latvia. Also in L1 it is stated that only part of fuel consumption used for acquisition of Energy has to be taken into account instead of the part that is used in technological processes. In the same chapter it is stated that amount of all combusted fuel types has to be estimated by using the same output measures. In the energy balance prepared by Central Statistical Bureau fuel consumption is estimated by using net calorific value of working volume of each particular type of fuel Q_z^d, but for natural gas – gross calorific value Q_a (it is recommendation of EUROSTAT). It has to be taken into account in estimation of total country's CO_2 emissions.

3. In total amount of CO_2 emissions leakage of gas (ventilation and technological losses) in the extraction fields of coal-gas aren't taken into account. It is referable to the exploitation of natural gas utilization equipment. Oxidation coefficient for the gaseous fuels is used in the estimation of CO_2 emissions. Leakage of gas is accounted as fugitive CH_4 emissions.

4. Oxidation coefficient for coal p = 0.98 is determined as global average. Oxidation factor is depending on type of coal and type of combustion installation. That's why in national account it could descend to p = 0.91, it means q_4 = 9% [L1].

5. In cases if net calorific values of fuels Q_z^d aren't available but only Q_a data it is possible to use average values in the estimation [L1]:

for liquid and solid fuels $Q_z^d \sim 0,95\ Q_a$

for gaseous fuels $Q_z^d \sim 0,9\ Q_a^d$

6. If installed capacity introduced with fuel marked in heat measures N_{th} is used in the estimations, oxidation coefficient isn't used because it is implicitly taken into account as losses of mechanically incomplete combustion and included in coefficient of efficiency of combustion installation $\square_{ka}$.

Annex 3: Other Detailed methodological descriptions for individual source or sink categories, including for KP-LULUCF activities

A.3.1. Energy (excluding Transport sector)

Type of fuel	Sulphur content (%)														EF (Gg/PJ)													
	1990-1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	1990-1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
diesel	0.3	0.3	0.2645	0.333	0.226	0.298	0.284	0.333	0.209	0.188	0.136	0.12	0.184	0.157	0.141	0.141	0.125	0.157	0.106	0.140	0.133	0.157	0.098	0.088	0.064	0.059	0.087	0.074
RFO	2	2	2.1221	2.097	2.005	2.078	1.983	1.922	1.972	1.452	1.292	1.03	1.184	0.888	0.966	0.966	1.024	1.012	0.968	1.003	0.957	0.928	0.952	0.701	0.624	0.497	0.572	0.429
gasoline	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.02	0.015	0.015	0.007	0.007	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	0.05	0.05	0.023	0.023	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 (for off-roads)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
other liquids	0.551	0.551	0.5514	0.564	0.523	0.428	0.417	0.3	0.253	0.215	0.211	0.23	0.268	0.183	0.263	0.263	0.263	0.269	0.250	0.205	0.199	0.143	0.121	0.103	0.101	0.109	0.128	0.087
LPG	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.014	0.013	0.014	0.013	0.01	0.02	0.02	0.088	0.088	0.088	0.088	0.066	0.066	0.066	0.006	0.006	0.006	0.006	0.005	0.009	0.009
shale oil	1	1	1	1	0.8	0.735	0.834	0.545	0.616	0.647	0.628	0.8	0.817	0.84	0.508	0.508	0.508	0.508	0.407	0.374	0.424	0.277	0.313	0.329	0.319	0.407	0.415	0.427
coal	1.8	1.8	1.4674	1.368	1.064	0.896	0.871	0.831	0.666	0.667	0.726	0.64	0.438	0.412	1.236	1.236	1.007	0.939	0.730	0.615	0.598	0.570	0.457	0.458	0.498	0.442	0.301	0.283
coke	1.8	1.2	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.209	0.806	0.403	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269
oil shale	1	1				0.05	0.7	1	1	0.86	0	0			1.957	1.957	0.000	0.000	0.000	0.098	1.370	1.957	1.957	1.683	0.000	0.000	0.000	0.000
peat	0.3	0.3	0.2803	0.219	0.205	0.237	0.215	0.273	0.265	0.254	0.271	0.24	0.217	0.116	0.507	0.507	0.474	0.370	0.347	0.400	0.364	0.462	0.448	0.429	0.458	0.414	0.367	0.196

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

A.3.2. Transport

Distribution of road transport fleet by sub-classes and layers, year 2008.

Subsector	Technology	Population	Mileage
Passenger Cars			
Gasoline <1,4 l	ECE 15/00-01	1394	1000
Gasoline <1,4 l	ECE 15/02	1045	1000
Gasoline <1,4 l	ECE 15/03	1394	2000
Gasoline <1,4 l	ECE 15/04	7415	3000
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	8029	5000
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	7236	14000
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	7675	25000
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	12420	27000
Gasoline 1,4 - 2,0 l	ECE 15/00-01	7061	1000
Gasoline 1,4 - 2,0 l	ECE 15/02	5296	1000
Gasoline 1,4 - 2,0 l	ECE 15/03	7061	2000
Gasoline 1,4 - 2,0 l	ECE 15/04	45984	5000
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	51898	7000
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	45823	14000
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	34453	27000
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	33848	30000
Gasoline >2,0 l	ECE 15/00-01	2023	1000
Gasoline >2,0 l	ECE 15/02	1517	1500
Gasoline >2,0 l	ECE 15/03	2023	2000
Gasoline >2,0 l	ECE 15/04	9419	6000
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	9861	9000
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	11005	16000
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	17350	28000
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	11152	30000
Diesel <2,0 l	Conventional	19726	12000
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	18628	16000
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	18958	23000
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	24289	24000
Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	20113	29000
Diesel >2,0 l	Conventional	11154	14000
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	12078	19000
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	13707	24000
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	22040	26000
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	14048	29000
LPG	Conventional	6544	11700
LPG	PC Euro 1 - 91/441/EEC	4686	15000
LPG	PC Euro 2 - 94/12/EEC	3977	19000
LPG	PC Euro 3 - 98/69/EC Stage2000	1936	28000
LPG	PC Euro 4 - 98/69/EC Stage2005	226	30000
Light Duty Vehicles			

Subsector	**Technology**	**Population**	**Mileage**
LPG	Conventional	137	13000
LPG	LD Euro 1 - 93/59/EEC	107	18000
LPG	LD Euro 2 - 96/69/EEC	119	20000
LPG	LD Euro 3 - 98/69/EC Stage2000	157	21000
LPG	LD Euro 4 - 98/69/EC Stage2005	7	25000
Gasoline <3,5t	Conventional	646	13000
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	466	18000
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	477	20000
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	692	21000
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	768	25000
Diesel <3,5 t	Conventional	3636	16000
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	3700	20000
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	4421	24000
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	8410	28000
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	8513	30000
Heavy Duty Trucks			
LPG	Conventional	426	19000
LPG	HD Euro I - 91/542/EEC Stage I	236	30000
LPG	HD Euro II - 91/542/EEC Stage II	97	35000
LPG	HD Euro III - 2000 Standards	38	40000
Gasoline >3,5 t	Conventional	1522	24000
Gasoline >3,5 t	HD Euro I - 91/542/EEC Stage I	356	28000
Gasoline >3,5 t	HD Euro II - 91/542/EEC Stage II	293	30000
Gasoline >3,5 t	HD Euro III - 2000 Standards	110	35000
Gasoline >3,5 t	HD Euro IV - 2005 Standards	10	40000
Rigid <=7,5 t	Conventional	1238	30000
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	732	40000
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	725	45000
Rigid <=7,5 t	HD Euro III - 2000 Standards	839	50000
Rigid <=7,5 t	HD Euro IV - 2005 Standards	600	55000
Rigid 7,5 - 12 t	Conventional	582	45000
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	297	55000
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	295	60000
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	353	65000
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	270	70000
Rigid 12 - 14 t	Conventional	230	45000
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	132	55000
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	106	60000
Rigid 12 - 14 t	HD Euro III - 2000 Standards	37	65000
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	41	70000
Rigid 14 - 20 t	Conventional	1862	50000
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	1308	60000
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	1428	65000
Rigid 14 - 20 t	HD Euro III - 2000 Standards	2519	70000
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	2897	75000

Subsector	Technology	Population	Mileage
Rigid 20 - 26 t	Conventional	690	55000
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	487	65000
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	486	70000
Rigid 20 - 26 t	HD Euro III - 2000 Standards	637	75000
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	1148	75000
Rigid 26 - 28 t	Conventional	52	55000
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	51	65000
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	37	70000
Rigid 26 - 28 t	HD Euro III - 2000 Standards	28	75000
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	23	80000
Rigid 28 - 32 t	Conventional	11	55000
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	9	65000
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	9	70000
Rigid 28 - 32 t	HD Euro III - 2000 Standards	13	75000
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	11	80000
Rigid >32 t	Conventional	8	55000
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	6	65000
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	6	70000
Rigid >32 t	HD Euro III - 2000 Standards	10	70000
Rigid >32 t	HD Euro IV - 2005 Standards	19	75000
Articulated 14 - 20 t	Conventional	437	50000
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	325	60000
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	451	65000
Articulated 14 - 20 t	HD Euro III - 2000 Standards	796	70000
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	1002	75000
Articulated 20 - 28 t	Conventional	328	55000
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	297	65000
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	301	70000
Articulated 20 - 28 t	HD Euro III - 2000 Standards	448	75000
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	926	75000
Articulated 28 - 34 t	Conventional	120	55000
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	124	65000
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	143	70000
Articulated 28 - 34 t	HD Euro III - 2000 Standards	238	75000
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	381	75000
Buses			
LPG	Conventional	9	30000
LPG	HD Euro I - 91/542/EEC Stage I	4	40000
LPG	HD Euro II - 91/542/EEC Stage II	6	40000
LPG	HD Euro III - 2000 Standards	10	40000
Urban Buses	Conventional	26	30000
Urban Buses	HD Euro I - 91/542/EEC Stage I	12	40000
Urban Buses	HD Euro II - 91/542/EEC Stage II	15	40000
Urban Buses	HD Euro III - 2000 Standards	23	40000
Urban Buses Midi <=15 t	Conventional	484	40000

Subsector	**Technology**	**Population**	**Mileage**
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	187	50000
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	218	58000
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	419	60000
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	502	60000
Coaches Standard <=18 t	Conventional	540	41000
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	280	54000
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	250	60000
Coaches Standard <=18 t	HD Euro III - 2000 Standards	190	60000
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	124	60000
Coaches Articulated >18 t	Conventional	105	42000
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	116	54000
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	128	60000
Coaches Articulated >18 t	HD Euro III - 2000 Standards	198	60000
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	83	60000
Mopeds			
<50 cm^3	Conventional	386	1500
<50 cm^3	Mop - Euro I	1018	1500
<50 cm^3	Mop - Euro II	7422	1500
Motorcycles			
2-stroke >50 cm^3	Conventional	796	1500
2-stroke >50 cm^3	Mot - Euro I	1157	2000
2-stroke >50 cm^3	Mot - Euro II	426	2000
2-stroke >50 cm^3	Mot - Euro III	817	2000
4-stroke 250 - 750 cm^3	Conventional	613	2000
4-stroke 250 - 750 cm^3	Mot - Euro I	1266	2500
4-stroke 250 - 750 cm^3	Mot - Euro II	509	2500
4-stroke 250 - 750 cm^3	Mot - Euro III	1056	3000
4-stroke >750 cm^3	Conventional	386	2500
4-stroke >750 cm^3	Mot - Euro I	740	2500
4-stroke >750 cm^3	Mot - Euro II	291	2500
4-stroke >750 cm^3	Mot - Euro III	760	3000

A.3.3. Industrial Processes Sector

Table 1 HFC–134a estimation from domestic refrigeration

	1995.	1996.	1997.	1998.	1999.	2000.	2001.	2002.	2003.	2004	2005	2006	2007	2008
amount of inhabitants	2469531	2444912	2420789	2399248	2381715	2377383	2364254	2345768	2331480	2319203	2306434	2294590	2281305	2270894
Amount of households (units)	1009791	999724	989860	981052	973883	972111	975785	958402	967065	986557	997821	1018096	1035713	1042168
Amount of households (%)	40.89	40.89	40.89	40.89	40.89	40.89	41.3	40.9	41.5	42.5	43.3	44.4	45.4	45.9
Amount of refrigerators in households (units)	897704	888755	879986	872156	865782	864207	867514	852019	859721	877049	887063	905087	920749	926487
Amount of refrigerators in households (%)	86.6	86.6	87.1	87.5	88.0	88.4	88.9	90.4	91.9	93.4	94.9	96.4	97.9	99.4
Amount of freezers in households (units)	33323	32991	32665	32375	32138	32080	32271	31627	31913	32556	32928	33597	34179	34392
Amount of freezers in households (%)	2.2	2.2	2.4	2.6	2.9	3.1	3.3	4.5	5.7	6.8	8.0	9.2	10.4	11.6
Refrigerators and freezers containing HFC-134a (%)	5.0	7.0	8.0	9.0	11.0	13.0	15.0	18.0	22.0	27.0	31.3	35.0	38.4	42.9
Amount of refrigerators containing HFC-134a (units)	44885	62213	70399	78494	95236	112347	130127	153363	189139	236803	277946	316781	353831	397570
Amount of freezers containing HFC-134a (units)	1666	2309	2613	2914	3535	4170	4841	5693	7021	8790	10317	11759	13134	14758
HFC-134a in refrigerators (140 g) (kg)	6283.93	8709.80	9855.84	10989.16	13333.05	15728.58	18217.79	21470.89	26479.40	33152.46	38912.49	44349.28	49536.29	55659.83
HFC-134a in freezers (140 g) (kg)	233.26	323.31	365.85	407.92	494.93	583.85	677.69	797.01	982.92	1230.63	1444.45	1646.26	1838.80	2066.11
HFC-134a in stocks (t)	6.52	9.03	10.22	11.40	13.83	16.31	18.90	22.27	27.46	34.38	40.36	46.00	51.38	57.73
HFC-134a charging one in a lifetime for refrigerators – (176.25 g) (kg)	3.82	5.29	5.99	6.68	8.11	9.56	8.86	10.44	12.88	16.12	18.92	21.57	24.09	27.07
HFC-134a charging one in a lifetime for freezers – (176.25 g) (kg)	0.14	0.20	0.22	0.25	0.30	0.35	0.33	0.39	0.48	0.60	0.70	0.80	0.89	1.00
HFC-134a charged	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
HFC-134a leakage during charging of refrigerators (2%) (kg)	0.08	0.11	0.12	0.13	0.16	0.19	0.18	0.21	0.26	0.32	0.38	0.43	0.48	0.54
HFC-134a leakage during charging of freezers (2%) (kg)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
HFC-134a from charging (t)	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0004	0.0005	0.0006
HFC-134a leakage from stocks in refrigerators containing HFC-134a (1%) (kg)	62.84	87.10	98.56	109.89	133.33	157.29	182.18	214.71	264.79	331.52	389.12	443.49	495.36	556.60
HFC-134a leakage from stocks in freezers containing HFC-134a (1%) (kg)	2.33	3.23	3.66	4.08	4.95	5.84	6.78	7.97	9.83	12.31	14.44	16.46	18.39	20.66
HFC-134a from stock (t)	0.0652	0.0903	0.1022	0.1140	0.1383	0.1631	0.1890	0.2227	0.2746	0.3438	0.4036	0.4600	0.5138	0.5773
HFC-134a leakage after disposal (80%60%) (kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
HFC-134a leakage after disposal (80%60%) (kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO

Table 2 HFC–134a emission estimation from commercial and industrial refrigeration

	1998.	1999.	2000.	2001.	2002.	2003.	2004.	2005	2006	2007	2008
Amount of HFC-134a used in installation of new equipment (t)	0.0800	0.0211	0.1118	0.2330	0.3532	0.5850	0.6639	0.3765	6.3143	4.8303	6.6466
Amount of HFC-134a used for charging (t)	0.0108	0.1420	0.1810	0.2233	0.5878	0.6982	0.3738	0.7360	IE	IE	IE
Amount of gas is manufactured equipment (t)		0.0300			0.0202	0.0136					
Total amount of HFC-134a charged (t)	0.0908	0.1931	0.2928	0.4563	0.9612	1.2968	1.0377	1.1125	6.3143	4.8303	6.6466
Leakage from charging (%)	15%	15%	15%	15%	15%	15%	15%	15%	8%	8%	8%
HFC-134a held in stocks (t)	0.0908	0.2231	0.3128	0.7748	1.0352	1.4044	2.1133	2.4695	25.6190	23.9031	30.1314
Leakage from stocks (%)	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	1.5%	1.5%	1.5%
HFC-134a emissions from charging (t)	0.0032	0.0068	0.0102	0.0160	0.0336	0.0454	0.0363	0.0389	0.0947	0.0725	0.0997
HFC-134a emissions from stocks (t)	0.0136	0.0335	0.0469	0.1162	0.1553	0.2107	0.3170	0.3704	2.0495	1.9122	2.4105
HFC-134a from disposal								NO	NO	NO	NO

Table 3 HFC–32 emission estimation from commercial and industrial refrigeration

	2004	2005	2006	2007	2008
Amount of HFC-32 used in installation of new equipment (t)			0.4882	1.5818	1.3011
Amount of HFC-32 used for charging (t)	0.0460		IE	IE	IE
Total amount of HFC-32 charged (t)	0.0460		0.4882	1.5818	1.3011
Leakage from charging (%)	15%	15%	8%	8%	8%
HFC-32 held in stocks (t)	0.4837	0.0184	1.3589	1.9340	2.9580
Leakage from stocks (%)	3.5%	3.5%	1.5%	1.5%	1.5%
HFC-32 emissions from charging (t)	0.0016		0.0073	0.0237	0.0195
HFC-32 emissions from stocks (t)	0.0726	0.0028	0.1087	0.1547	0.2366
HFC-32 from disposal		NO	NO	NO	NO

Table 4 HFC–125 emission estimation from commercial and industrial refrigeration

	2004	2005	2006	2007	2008
Amount of HFC-125 used in installation of new equipment (t)		0.0660	7.8982	6.4119	12.1509
Amount of HFC-125 used for charging (t)	0.0931		IE	IE	IE
Total amount of HFC-125 charged (t)	0.0931	0.0660	7.8982	6.4119	12.1509
Leakage from charging (%)	15%	15%	8%	8%	8%
HFC-125 held in stocks (t)	0.6247	0.0861	9.9471	14.4878	16.7096
Leakage from stocks (%)	3.5%	3.5%	1.5%	1.5%	1.5%
HFC-125 emissions from charging (t)	0.0033	0.0023	0.1185	0.0962	0.1823
HFC-125 emissions from stocks (t)	0.0937	0.0129	0.7958	1.1590	1.3368
HFC-125 from disposal		NO	NO	NO	NO

Table 5 HFC–143 emission estimation from commercial and industrial refrigeration

	2004	2005	2006	2007	2008
Amount of HFC-143 used in installation of new equipment (t)		0.0780	8.6815	5.6805	12.5648
Amount of HFC-143 used for charging (t)	0.0510		IE		IE
Total amount of HFC-143 charged (t)	0.0510	0.0780	8.6815	5.6805	12.5648
Leakage from charging (%)	15%	15%	8%	8%	8%
HFC-143 held in stocks (t)	0.0874	0.0780	9.9580	15.5377	16.0556
Leakage from stocks (%)	3.5%	3.5%	1.5%	1.5%	1.5%
HFC-143 emissions from charging (t)	0.0018	0.0027	0.1302	0.0852	0.1885
HFC-143 emissions from stocks (t)	0.0131	0.0117	0.7966	1.2430	1.2845
HFC-143 from disposal		NO	NO	NO	NO

Table 6 HFC–152 emission estimation from commercial and industrial refrigeration

	2006	2007	2008
Amount of HFC-152 used in installation of new equipment (t)	0.000627		
Amount of HFC-152 used for charging (t)	IE		
Leakage from charging (%)	8%	8%	8%
HFC-152 held in stocks (t)	0.0305047	0.0336763	0.0368479
Leakage from stocks (%)	1.5%	1.5%	1.5%
HFC-152 emissions from charging (t)	0.0000		
HFC-152 emissions from stocks (t)	0.0024	0.0027	0.0029
HFC-152 from disposal	0.0016	0.0018	0.0020

Table 7 HFC– 23 emission estimation from commercial and industrial refrigeration

	2008
Amount of HFC-23 used in installation of new equipment (t)	0.0012
Leakage from charging (%)	8%
HFC-23 held in stocks (t)	0.011
Leakage from stocks (%)	1.5%
HFC-23 emissions from charging (t)	0.0000
HFC-23 emissions from stocks (t)	0.0009
HFC-23 from disposal	NO

Table 8 HFC–134a emission estimation from transport refrigeration

	1999	2000	2001	2002	2003	2004	2005	2006
Amount of HFC-134a held in stocks (t)	0.0308	0.0913	0.2898	0.2598	0.3093	0.4580	0.5622	0.5440
Leakage from stocks (%)	15%	15%	15%	15%	15%	15%	15%	8%
Emissions from stocks (t)	0.0046	0.0137	0.0435	0.0390	0.0464	0.0687	0.0843	0.0435

Table 9 HFC–23 emission estimation from transport refrigeration

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Amount of HFC-23 held in stocks (t)	0.1	0.024	0.05	0.18	0.09	0.01	0.01	0.02	0.12
Leakage from stocks (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%
Emissions from stocks (t)	0.015	0.0036	0.0075	0.027	0.0135	0.0015	0.0015	0.003	0.018

Table 10 HFC–125 emission estimation from transport refrigeration

	2004	2005	2006
Amount of HFC-125 held in stocks (t)	0.0133	0.1704	0.3274
Leakage from stocks (%)			
Emissions from stocks (t)	0.0020	0.0256	0.0262

Table 11 HFC – 134a emission estimation from mobile air conditioning equipment

	1995.	1996.	1997.	1998.	1999.	2000.	2001.	2002.	2003.	2004.	2005	2006	2007	2008
Passenger cars with manufacturing year >1995	384	5137	9512	16061	23091	30730	41049	55166	73510	103917	151705	230926	324774	371591
Trucks with manufacturing year >1995	35	716	1292	3774	5783	8654	11659	12955.75	13927.33	16832	27258	37850.3	44713	44569
Passenger cars equipped with MACs (%)	20%	20%	20%	20%	20%	20%	25%	30%	35%	40%	45%	50%	55%	60%
Trucks equipped with MACs (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	52.5%	55.0%	57.5%	60.0%	62.5%	65.0%	67.5%	70.0%
Passenger cars equipped with MACs (pieces)	77	1027	1902	3212	4618	6146	10262	16550	25729	41567	68267	115463	178626	222955
Trucks equipped with MACs (pieces)	18	358	646	1887	2892	4327	6121	7126	8008	10099	17036	24603	30181	31198
Amount of HFC-134a in passenger cars (kg)	61	822	1522	2570	3695	4917	8210	13240	20583	33253	54614	92370	142901	178364
Amount of HFC-134a in trucks (kg)	21	430	775	2264	3470	5192	7345	8551	9610	12119	20444	29523	36218	37438
Total amount of HFC-134a in cars (t)	0.082	1.252	2.297	4.834	7.164	10.109	15.555	21.791	30.193	45.372	75.057	121.894	179.118	215.802
Leakage from stocks (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
HFC-134a emission from stocks (t)	0.012	0.188	0.345	0.725	1.075	1.516	2.333	3.269	4.529	6.806	11.259	18.284	26.868	32.370
Disposed MACs from passenger cars in year (piece)	6	82	152	257	369	492	821	1324	2058	3325	5461	9237	14290	17836
Disposed MACs from trucks in year (piece)	1	29	52	151	231	346	490	570	641	808	1363	1968	2415	2496
F-gases remained in one MAC (5)	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Remained f-gases in annually disposed MACs (kg)	4.946	75.091	137.827	290.050	429.862	606.552	933.298	1307.438	1811.560	2722.349	4503.438	7313.618	10747.085	12948.098
Leakage from disposal (%)	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
HFC-134a disposal emissions (t)	0.004	0.068	0.124	0.261	0.387	0.546	0.840	1.177	1.630	2.450	4.053	6.582	9.672	11.653

Table 12 Potential f-gases emissions estimation from Refrigerating and Air Conditioning Equipment

Chemicals / GWP	2004	2005	2006	2007	2008
HFC-32 (kg)	2.153	1.357	3.095	**5.94**	5.375
(Gg CO_2 eqv.) GWP 650	**1.39945**	**0.88205**	**2.01175**	**3.861**	**3.49375**
HFC-125 (kg)	11.737	11.461	18.36422	**16.45**	22.695
(Gg CO_2 eqv.) GWP 2800	**32.8636**	**32.0908**	**51.419816**	**46.06**	**63.546**
HFC-134a (kg)	3.964	3.944	6.8373	**7.83065**	8.824
(Gg CO_2 eqv.) GWP 1300	**5.1532**	**5.1272**	**8.88849**	**10.179845**	**11.4712**
HFC-143a (kg)	11.046	11.738	17.576	**18.858**	20.14
(Gg CO_2 eqv.) GWP 3800	**41.9748**	**44.6044**	**66.7888**	**71.6604**	**76.532**
HFC-152 (kg)	0.065	0.221	0.0351	**0.2055**	NO
(Gg CO_2 eqv.) GWP 140	**0.0091**	**0.03094**	**0.004914**	**0.02877**	**NO**
TOTAL (Gg CO_2 eqv.)	**81.40015**	**82.73539**	**129.11377**	**131.79002**	**155.04295**

Table 13 Potential f-gases emissions estimation from Foam Blowing

Chemicals. products	average % amount of f-gases in imported product	**2004**	**2005**	**2006**	**2007**	**2008**	**2004**	**2005**	**2006**	**2007**	**2008**
		Imported products (t)					Emission from products (t)				
HFC-134a (GWP-1300)											
DBS 9802 PUR B1	**6.25%**	NO	NO	NO	0.139	0.14	NO	NO	NO	0.00869	0.00875
FIXER MEGAPRO	**13.00%**	NO	NO	NO	1.425	1.5	NO	NO	NO	0.18525	0.195
FIXER	**13.00%**	NO	NO	NO	1.076	1.0	NO	NO	NO	0.13988	0.13
DBS 9802 PUR B1	**6.25%**	NO	NO	NO	0.239	0.5	NO	NO	NO	0.01494	0.03125
FIXER MEGAPRO	**13.00%**	NO	NO	NO	8.548	9.0	NO	NO	NO	1.11124	1.17
FIXER	**13.00%**	NO	NO	NO	1.972	2.0	NO	NO	NO	0.25636	0.26
HFC-152 (GWP-140)											
FIXER	**10.50%**	NO	NO	NO	1.076	1.5	NO	NO	NO	0.11298	0.1575
FIXER	**10.50%**	NO	NO	NO	1.972	2.0	NO	NO	NO	0.20706	0.21
227ae											
TECFOAM SP-27-B5/365/245	**100.00%**	2.9	2.7	2.5	NO	NO	2.9	2.7	2.5	NO	NO
TOTAL EMISSIONS (CO_2 eqv.)		**8.410**	**7.830**	**7.250**	**17.845**	**18.872**	**8.410**	**7.830**	**7.250**	**2.276**	**2.385**

Table 14 HFC–227ea emission estimation from fire extinguishing equipment

	2001	2002	2003	2004	2005	2006	2007	2008
Amount of HFC-227ea in installed equipment (t)	0.2435	0.2435	0.6085	1.2320	0.7930	0.2775	0.2775	0.2775
Amount of HFC-227ea held in containers (t)	195.5	195.5	195.5	195.5	195.5	195.5	195.5	195.5
Leakage from installed equipment (%)	5%	5%	5%	5%	5%	5%	5%	5%
Emission from stocks (t)	0.0122	0.0122	0.0304	0.0616	0.0397	0.0139	0.0139	0.0139

Table 15 Potential HFC–227ea emissions estimation from fire extinguishing equipment

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Amount of HFC-227ea in installed equipment (t)	0.2435	0.2435	0.6085	1.232	0.793	0.2775	0.2775	0.2775
Amount of HFC-227ea held in containers (t)	195.5	195.5	195.5	195.5	195.5	195.5	195.5	195.5
Leakage from installed equipment (%)	5%	5%	5%	5%	5%	5%	5%	5%
Emission from stocks (t)	9.78718	9.78718	9.80543	9.83660	9.81465	9.78888	9.78888	9.78888
Total emission from stocks (Gg CO_2 eqv.)	28.38281	28.38281	28.43573	28.52614	28.46249	28.38774	28.38774	28.38774

Table 16 HFC-134a emission estimation from metered dose inhalers

Type of medicine	Amount of HFC-134a in particular inhaler[105]	Total amount of HFC-134a sold/imported in country (kg)											Amount of sold/imported particular type of metered dose inhalers (pieces)										
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Bioparox	11.3				410.13	368.24	396.42	423	411.98	362.39	546.74	528.94				36295	32588	35081	37434	36458	32070	48384	46809
Bioparox	15.37	53.49	258.26	360.58									3480	16803	23460								
Berotec	13.66				138.33	148.4	4.29									10127	10864	314					
Berotec	9.11				152.47	140.99	76.99	7.17	0.01							16737	15476	8451	787	1			
Berotec	7.051	82.46	106.49	22.48									11695	15103	3188								
Flixotide 50mkg	10.59					1.14	5.01	3.85	3.01	3.55	2.95	5.53					108	473	364	284	335	279	522
Flixotide 125mkg - 60 doses	7.99																						
Flixotide 125mkg - 120 doses	12					1.14	24.14	36.31	64.8	115.67	179.64	157.26					95	2012	3026	5400	9639	14970	13105
Flixotide 250mkg - 60 doses	7.99																						
Flixotide 250mkg - 120 doses	12					1.8	1.14	0.42	4.38	22.63	38.24	32.77					150	95	35	365	1886	3187	2731
Ecobec Easi-Breathe	17.95				0.25											14							
Ecobec Easi-Breathe	15				0.33	0.2				0.06	0.05					22	13				4	3	
Ecobe	14.3								0.01	3.79	3.4	3.56								1	265	238	249
Ecosal	7.5								0.01	8.51	13.35	18.11								1	1134	1780	2415
Flixotide inhaler	5.3	2.6	43.58	42.16									490	8222	7955								
Ventolin Inhaler	10.2				226.88	310.63	303.21	372.38	579.16	622.7	723.42	766.52				22243	30454	29726	36508	56780	61049	70924	75149
Berodual	20.52				219.77	234.79	105.7					29.04				10710	11442	5151					1415
Berodual	13.687				7.13	4.01	4.65	2.05								521	293	340	150				
Seretide – all doses	9						18.75	32.92	53.28	79.03	98.97	107.06						2083	3658	5920	8781	10997	11896
Berotec N	7				4.24	2.04	83.2	150.35	123.74	131.07	122.42	118.29				605	292	11886	21479	17677	18724	17489	16898

[105] Data of State Agency of Medicine of Latvia

Type of medicine	Amount of HFC-134a in particular inhaler[105]	Total amount of HFC-134a sold/imported in country (kg)											Amount of sold/imported particular type of metered dose inhalers (pieces)										
		1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Berodual N	7.8				4.91	3.09	48.38	139.51	118.72	179.99	183.85	183.5				630	396	6202	17886	15221	23075	23570	23526
Berodual N	10.158	28.83	46.44	25.6									2838	4572	2520								
Serevent inhaler - 60 doses	4.5				20.73	19.77	14.78	12.9	12.24	8.84		0.01				4606	4394	3285	2866	2719	1964		3
Serevent inhaler – 120 doses	9				22.63	17.9	18.9	12.44	14	14.33	23.39	20.21				2514	1989	2100	1382	1556	1592	2599	2245
Becotide inhaler	10.1				93.85	63.78	67.29	79.93	86.25	84.09	80.25					9292	6315	6662	7914	8540	8326	7946	
Becloforte inhaler	9.8				126.28	97.71	108.93	115.34	121.11	109.82	106.86	98.45				12886	9970	11115	11769	12358	11206	10904	10046
Seretide all doses	11.99		0.96											80									
Ventolin inhaler	17.98	72.69	278.17	544.51									4043	15471	30284								
Total		**240.07**	**733.90**	**995.32**	**1427.94**	**1415.64**	**1281.76**	**1388.58**	**1592.69**	**1746.45**	**2123.55**	**2069.25**	**22546**	**60251**	**67407**	**90907**	**92251**	**89895**	**107824**	**126823**	**147980**	**164886**	**160200**
Actual HFC-134a emission (t)		**0.12**	**0.487**	**0.8646**	**1.2116**	**1.4218**	**1.3487**	**1.3352**	**1.4906**	**1.6696**	**1.935**	**2.0964**											
Potential HFC-134a emission (t)		**0.240**	**0.734**	**0.995**	**1.428**	**1.416**	**1.282**	**1.389**	**1.593**	**1.746**	**2.124**	**2.069**											

Table 17 SF_6 emission estimation from electrical equipment

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Amount of SF_6 in installed equipment in particular year (t)	0.5255	0.0756	0.4619	0.4217	0.5597	0.6231	1.4681	2.9396	1.1580	2.0503	2.2200	2.1250	2.5984	3.6065
Amount of SF_6 in operational equipment (t)		0.5255	0.6011	1.0630	1.4847	2.0444	2.6675	4.1356	7.0751	8.2332	10.2835	12.5035	14.6286	17.2269
Amount of SF_6 stored in containers (t)	320	320	320	320	320	320	320	320	320	320	320	395	390	439
Leakage from charging and stocks (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
SF_6 emission from charging (t)	0.0105	0.0015	0.0092	0.0084	0.0112	0.0125	0.0294	0.0588	0.0232	0.0410	0.0444	0.0425	0.0520	0.0721
SF_6 emission from stocks (t)	0.0000	0.0105	0.0120	0.0213	0.0297	0.0409	0.0534	0.0827	0.1415	0.1647	0.2057	0.2501	0.2926	0.3445
Emergency leakage (t)									0.02	0.019	0.065	0.0055	0.0151	0.0049

Table 18 Potential SF_6 emission estimation from electrical equipment

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Amount of SF_6 in installed equipment in particular year (t)	0.5255	0.0756	0.4619	0.4217	0.5597	0.6231	1.4681	2.9396	1.1580	2.0503	2.2200	2.1250	2.5984	3.6065
Amount of SF_6 in operational equipment (t)		0.5255	0.6011	1.0630	1.4847	2.0444	2.6675	4.1356	7.0751	8.2332	10.2835	12.5035	14.6286	17.2269
Amount of SF_6 stored in containers (t)	320	320	320	320	320	320	320	320	320	320	320	394.5	389.5	439
Leakage from charging and stocks (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Leakage from containers (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
SF_6 emission from charging (t)	0.0265	0.0280	0.0373	0.0457	0.0569	0.0694	0.0987	0.1575	0.2007	0.2407	0.3311	0.3178	0.3792	0.4436
SF_6 emission from stocks (t)	0.6336	0.6697	0.8905	1.0921	1.3596	1.6575	2.3592	3.7643	4.7959	5.7520	7.9126	7.5953	9.0618	10.6010
Emergency leakage (t)									0.0200	0.0190	0.0650	0.0055	0.0151	0.0049
Leakage from containers (t)	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0197	0.0195	0.0220
TOTAL POTENTIAL EMISSION (Gg CO_2 eqv.)	16.1585	17.0588	22.5562	27.5756	34.2375	41.6533	59.1267	94.1139	120.2771	144.0616	198.9592	189.7266	226.4653	264.6085

Table 19 HFC-134a emission estimation from shoes (shoes soles)

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
amount of manufactured shoes (pieces)	2266666	2050667	1834667	1586000	1468000	1154000	1240000	751400	596400	548200	175400						
amount of imported shoed (pieces)	708000	1020000	1332000	1660000	1924000	2284000	3756000	3922000	5088000	7008000	8462000	9748000	12246000	14194000	13284000	15266000	13956000
amount of exported shoes (pieces)	2338000	2338000	2338000	2338000	3082000	1754000	1512000										
amount of shoes containing HFC-134a (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
average amount of HFC-134a in one shoe (kg)	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
HFC-134a in manufactured shoes (t)	0.9067	0.8203	0.7339	0.6344	0.5872	0.4616	0.4960	0.3006	0.2386	0.2193	0.0702						
HFC-134a in imported shoes (t)	0.2832	0.4080	0.5328	0.6640	0.7696	0.9136	1.5024	1.5688	2.0352	2.8032	3.3848	3.8992	4.8984	5.6776	5.3136	6.1064	5.5824
HFC-134a in exported shoes (t)	0.9352	0.9352	0.9352	0.9352	1.2328	0.7016	0.6048										
HFC-134a in stocks (t)	0.2547	0.2931	0.3315	0.3632	0.1240	0.6736	1.3936	1.8694	2.2738	3.0225	3.4550	3.8992	4.8984	5.6776	5.3136	6.1064	5.5824
Leakage from manufacturing (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
HFC-134a emission from manufacturing (t)				0.095	0.088	0.069	0.074	0.045	0.036	0.033	0.011						
Leakage from stocks (%)				1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
HFC-134a emission stocks (t)				0.005448	0.001860	0.010104	0.020904	0.028040	0.034106	0.045337	0.051824	0.058488	0.073476	0.085164	0.079704	0.091596	0.083736
Amount of HFC-134a remained in shoes after the lifetime (%)				98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%
HFC-134a left in shoes after the lifetime in year t^{-3}				0.2508	0.2887	0.3265	0.3578	0.1221	0.6635	1.3727	1.8413	2.2397	2.9771	3.4031	3.8407	4.8249	5.5924
Lifetime factor (years)				3	3	3	3	3	3	3	3	3	3	3	3	3	3
Leakage from disposal (%)				71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%	71.5%
HFC-134a emission of disposal (t)				0.179355	0.206400	0.233444	0.255793	0.087330	0.474400	0.981478	1.316544	1.601352	2.128657	2.433242	2.746109	3.449821	3.998592
HFC-134a emission total (t)				**0.2800**	**0.1049**	**0.0943**	**0.1103**	**0.0881**	**0.0849**	**0.0932**	**0.0773**	**0.0735**	**0.0885**	**0.1002**	**0.0947**	**0.1066**	**0.0987**

Table 20 Potential HFC-134a emission estimation from shoes (shoes soles)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
amount of manufactured shoes (pieces)	2266666	2050667	1834667	1586000	1468000	1154000	1240000	751400	596400	548200	175400						
amount of imported shoed (pieces)	708000	1020000	1332000	1660000	1924000	2284000	3756000	3922000	5088000	7008000	8462000	9748000	12246000	14194000	13284000	15266000	13956000
amount of exported shoes (pieces)	2338000	2338000	2338000	2338000	3082000	1754000	1512000										
amount of shoes containing HFC-134a (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
average amount of HFC-134a in one shoe (kg)	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
HFC-134a in manufactured shoes (t)	0.9067	0.8203	0.7339	0.6344	0.5872	0.4616	0.4960	0.3006	0.2386	0.2193	0.0702						
HFC-134a in imported shoes (t)	0.2832	0.4080	0.5328	0.6640	0.7696	0.9136	1.5024	1.5688	2.0352	2.8032	3.3848	3.8992	4.8984	5.6776	5.3136	6.1064	5.5824
HFC-134a in exported shoes (t)	0.9352	0.9352	0.9352	0.9352	1.2328	0.7016	0.6048										
HFC-134a in stocks (t)	0.2547	0.2931	0.3315	0.3632	0.1240	0.6736	1.3936	1.8694	2.2738	3.0225	3.4550	3.8992	4.8984	5.6776	5.3136	6.1064	5.5824
Leakage from manufacturing (%)				15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
HFC-134a emission from manufacturing (t)				0.095	0.088	0.069	0.074	0.045	0.036	0.033	0.011						
Leakage from stocks (%)				5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
HFC-134a emission stocks (t)				0.018160	0.006200	0.033680	0.069680	0.093468	0.113688	0.151124	0.172748	0.194960	0.244920	0.283880	0.265680	0.305320	0.279120
Amount of HFC-134a remained in shoes after the lifetime (%)				95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%
HFC-134a left in shoes after the lifetime in year t^{-3}				0.2508	0.2887	0.3265	0.3450	0.1178	0.6399	1.3239	1.7759	2.1601	2.8714	3.2822	3.7042	4.6535	5.3937
Lifetime factor (years)				3	3	3	3	3	3	3	3	3	3	3	3	3	3
Leakage from disposal (%)				100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
HFC-134a emission of disposal (t)				0.250846	0.288671	0.326495	0.345040	0.117800	0.639920	1.323920	1.775892	2.160072	2.871356	3.282212	3.704240	4.653480	5.393720
HFC-134a emission total (t)				**0.3642**	**0.3830**	**0.4294**	**0.4891**	**0.2564**	**0.7894**	**1.5079**	**1.9592**	**2.3550**	**3.1163**	**3.5661**	**3.9699**	**4.9588**	**5.6728**
HFC-134a emission total (Gg CO_2 eqv)				**0.4734**	**0.4978**	**0.5582**	**0.6359**	**0.3333**	**1.0262**	**1.9603**	**2.5469**	**3.0615**	**4.0512**	**4.6359**	**5.1609**	**6.4464**	**7.3747**

A.3.3. Agriculture

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

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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;

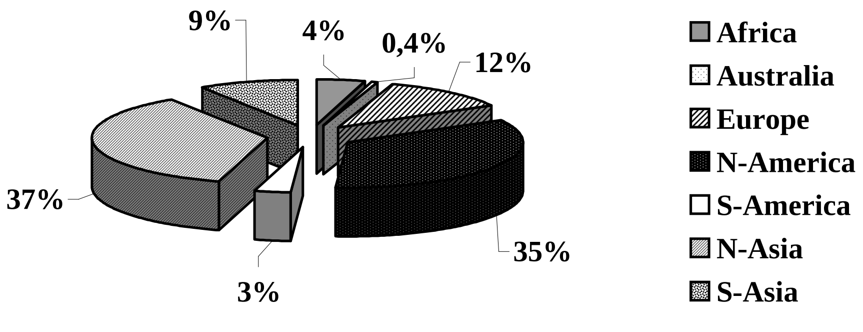
Second group histosols form in flat topography where annual precipitation exceed amount of vaporization. Highland swamps and peatlands are typical to this group;

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.

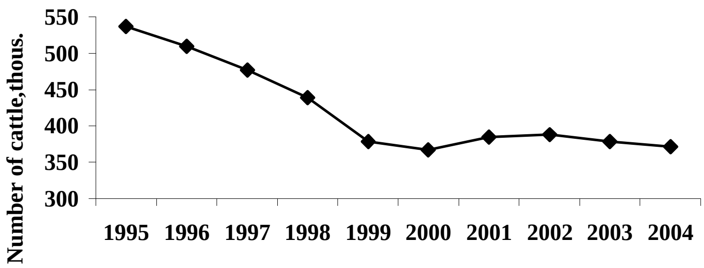
Comparing this proportion of histosols areas with the data of other countries we can agree with this assumption. In Denmark that is situated more to South from Latvia, areas occupied by histosols make 2377 km^2 or 5.5% from the state territory. In Denmark more than half of areas occupied by histosols 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)[106] 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.

Evaluation of manure management systems for the time period from 1990 - 2003

Pasture period

When estimating ammonium emissions from manure management system we assumed calculations in Table 1 regarding the length of the period livestock stays in the stall and outside of it.

When estimating pasture period in Latvia, the following considerations were taken into account:

- the length of pasture period has extended due to climate changes, as a result autumn season has been prolonged;
- besides due to various reasons and conditions (changes in keeping conditions – dairy cows are kept only in stall; disappearance of livestock from pastures, expansion of black flies etc.) livestock during the pasture season does not stay whole day and night in pastures or dry lots.

Connection can be observed in the method of calculation – when the length of pasture period is decreasing, ammonium emission coefficient is going up.
Manure management system evaluation done in the previous period (1990 – 2003) (LUA *(Latvia University of Agriculture)* Department of environment and water management, 2002) which was used in previous emission estimates (Appendix 2) should be adjusted according to the evaluation of present situation by experts and specialists (I.Grudulis - LLKC livestock farming specialist – consultant; I.Aizsilniece – representative of Milk producer association and others) taking into account climate changes in Latvia which imply longer autumn period.

Table 1 Adjusted period of livestock stay in pastures and its percentage in Latvia, 1990-2003

Livestock	Days in pastures	% percentage
Dairy cows	145	39,73
Other cattle	165	45,21
Horses	185	50,68
Sheep and goats	155	42,47

Source: author's estimates

Anaerobic lagoons

When evaluating manure management systems under the chapter "anaerobic lagoon" previous expert considered the research by R. Vizla (Vizla, 1987*)* where it was indicated that the following amounts of manure were collected with water flushing system: swine manure – 19%, dairy cow manure – 8%, meat cattle manure – 10%, poultry manure – 10%.

[106] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006

It is known that usually the system with water flashing consumes large amount of water and big amounts of liquid manure form which in previous period until 2003 were stored in field storages under aerobic conditions - “aerobic lagoon” and not under anaerobic conditions where through microbiological processes methane is emitted.
Through consultations with academician A.Jemeļjanovs, Dr. R.Kaugers, specialist H.Norberts and others we obtained information that liquid swine manure storage test in anaerobic storage - tank was done in the end of 1980s and it failed as the extraction of biogas failed in this test due to the fact that liquid manure did not contain enough dry matter.

Table 2 Adjusted period of livestock stay in pastures and stalls

Livestock	Days in a year	Days in pastures, 1990-2003.	% in pastures	% in stalls	Days in pastures, 2004. – 2012.	% in pastures	%, in stalls
Dairy cows	365	145	39.73	60.27	150	41.1	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: author’s estimates

We suppose that there was not and still there is not such manure management system in Latvia classified as “anaerobic lagoon” which includes only such manure management where manure is stored in closed tank or storage under anaerobic (without the access of air) conditions.

Liquids, bedding manure and other

In previous research (LUA Department of environment and water management, 2002) it was emphasized that it is hard to estimate amount of liquids. Authors indicate that in the category of solid manure there are included and as such are supposed to be manure in big livestock farms or complexes where peat is used as bedding material.
Having a good knowledge of that time period it is known that peat very often was used insufficiently and moisture content in the manure was high (in reality it was liquid manure). Considering this we suppose that in the previous report period percentage of liquids in total manure amount could be the following:

-) swine - 28%,

-) dairy cows - 24% (subtracting pasture period – 14,4%);

-) other cattle - 43% (subtracting pasture period - 21,5%);

-) poultry - 65 %.

It is very important to define manure management systems for dairy cows and other cattle as these categories produce the main part of emissions. In previous researches experts considered the following principles:

1) experts assumed (LUA Department of environment and water management, 2002) that pasture period for **dairy cows** was 145 days when all cows (40%) were let to graze. According to the data (rather approximate) in hand of the authors liquid system could be related to 5% of cows. Small farms with one and two cows (according to pasture period it would be approximately 23%) could be related to “other”. Results of inspection of previous years show that even though a small number but still there are some known farms in Riga, Dobele, Bauska and Jelgava regions which practice daily spread of manure. Assuming that also elsewhere in Latvia this system actually could

have been practiced and if pasture period is subtracted then in total emission estimates it should be indicated in the amount of 0,1%, but the other part – 31,9% could be related to bedding manure.

2) authors suppose (LUA Department of environment and water management, 2002) that pasture period for **other cattle** was 185 days, but there is no data what part of cattle had been let to graze as intense fattening of cattle was practiced. Theoretically authors assumed that cattle from small farms - up to 5 cattle - (number of cattle in such farms make approximately 32% - 35%) were let to graze, with this “pasture system” would make approximately 16,6% from the total manure management system. Remaining amount (16,8%) from these small farms was related to the group “other”. Liquids and daily spread could be assumed similar to dairy cows – 5% and 0,1% respectively, but residual part (61,5%) relates to bedding manure.

Authors suppose that in farms with smaller number of cows and cattle, manure is bedding manure and it is stored as solid manure. 3% and 2% respectively would be related to manure storage type “Other”.

In previous report, results of which LEGMC specialists used in emission estimates, data regarding meat cattle was used. Expert had indicated that pasture period given in Good agriculture practice terms for meat cattle is 185 days and for young stock 145 days.
We suppose that total of meat cattle and young stock average pasture period – 165 days should be used in calculations and assumed as appropriate for livestock category “Other cattle”. In relation to these changes also manure management system proportion changes regarding pasture period as it is shown in Table 3.

Table 3 Adjusted manure management systems, 1990 - 2003

Livestock	Anaerobic lagoon, %	Liquid system, %	Daily spread, %	Solid storage and dry lot, %	Pasture range and paddock, %	Other, %
Dairy cows		3,5		53,5	40	3
Other 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		

Source: author’s estimates

Table 4 Days in a year of livestock stay in pastures and percentage, 1990-2003

Livestock	Days in pastures	% percentage
Dairy cows	150	41,10
Other cattle	170	46,58
Horses	190	52,05
Sheep and goats	160	43,84

Source: author's estimates

Different livestock manure management systems by year are included in Appendix 2. Forecast is that in the future not only pasture period of livestock could become longer, but possibly also percentage of liquid manure in manure management systems could increase.

Evaluation of coefficients of available ammonium emissions

To estimate coefficient of ammonium emissions total amount of nitrogen from one animal should be known, as well as percentage between the period animal spends in stall and period in pasture. This issue is looked upon more detailed in chapter 1.

Until now LEGMC in estimates used in previous research defined nitrogen amounts from one animal which are included in Table 5. It should be taken into account that authors of previous research mention that projected error of estimate is 30%.

Table 5 Amount of nitrogen produced by one animal in a year, 1990 – 2003

Livestock	Nitrogen, kg/day			N in year, kg	nitrogen kg/t manure	N in year according "method" kg/year
	Min manures, kg/day	in urine, kg/day	total, kg/day			
Dairy cows	0,1161	0,078	0,1941	71	4,9	70,0
Other cattle	0,06	0,08	0,14	51	4,7	50,0
Sheep	0,0055	0,012	0,0175	6	9,7	16,0
Swine	0,012	0,0147	0,0267	10	7,4	20,0
Horses	0,0675	0,072	0,1395	51	6,6	25,0
Chickens	-	-	$2.55 \cdot 10^{-3}$	0.9	15,0	0,6
Goats	No data					25,0

Source: data from unpublished research, LUA Department of environment and waster management, 2002

Presently Institute of Agrarian Economics of Latvia has done a research on estimates and update of emission factors, coefficients for greenhouse gas emission estimates and forecast in agriculture sector and on the basis of detailed researches done by State Agrochemical centre (Timbare and co-authors, 2002) these coefficients were revised and such results acquired.

Table 6 Adjusted amount of nitrogen produced by one animal in a year, 1990 - 2003

Livestock	N, kg/year
Dairy cows	71,0
Other cattle	50,0
Sheep	6,0
Swine	10,0
Horses	46,0
Chickens	0,6

Source: author's estimates

As regards sheep in Latvia there is very low level of produced nitrogen in difference from recommended nitrogen amounts because:
-) dairy sheep are not bred in the country;

-) basis of sheep nutrition is not that rich as sheep usually are not fed additionally;

-) mainly local breed is used which is not very productive;

-) in general sheep farming as a branch in Latvia is relatively weakly developed.

Estimating amount of nitrogen from horses in a year indication by R.Timbare (Timbare and co-authors, 2002) was taken into account that more detailed researches are needed to estimate horse manure amount and nitrogen content in it. Because of that nitrogen amount produced by horse in a year was estimated as average from previous (51 N kg/year) and R. Timbare's research (41,6 N kg/year), which makes 46 N kg/year.

Table 7 Amount of nitrogen produced by one animal in a year, 2004 - 2020

Livestock	N, kg/year
Dairy cows	71,0
Other cattle	50,0
Sheep	6,0
Swine	7,3
Horses	6,0
Chickens	0,6

Source: author's estimates

When estimating nitrogen amount from swine it is assumed that starting from 2004 it reduces, as the average weight of swine continues to decrease. Weight decrease is related to changes in the genetic resource – crossbreeds of the bred swine. More and more such breeds and crossbreeds are used with higher content of lean meat in carcass, lower adipose tissue or bacon amount, and with this nutrition and fattening period changes.

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.

Latvian State Institute of Agrarian Economics for AWMS determination was done calculations to classify AWMS according IPCC Guidelines.

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.

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

Average N excretion per head of livestock was reassessed in the Research[107] 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[108] 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

[107] GHG Emissions from Agriculture. Latvian State Institute of Agrarian Economics. Working papers 2(16)/2006
[108] Research during the Project „CORINAIR – Institutional strengthening of National Air Emissions Inventories in Latvia", R. Sudārs. Nitrogen Separation

A.3.4. LULUCF

New methodology which 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

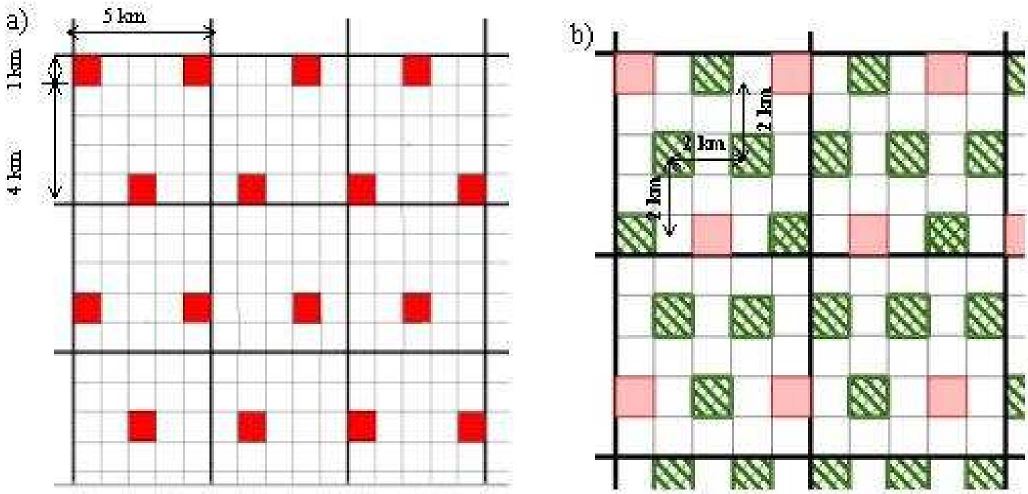
Forest statistical inventory is based on the method of continuous, combined, multistage sampling and GIS technology.

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:

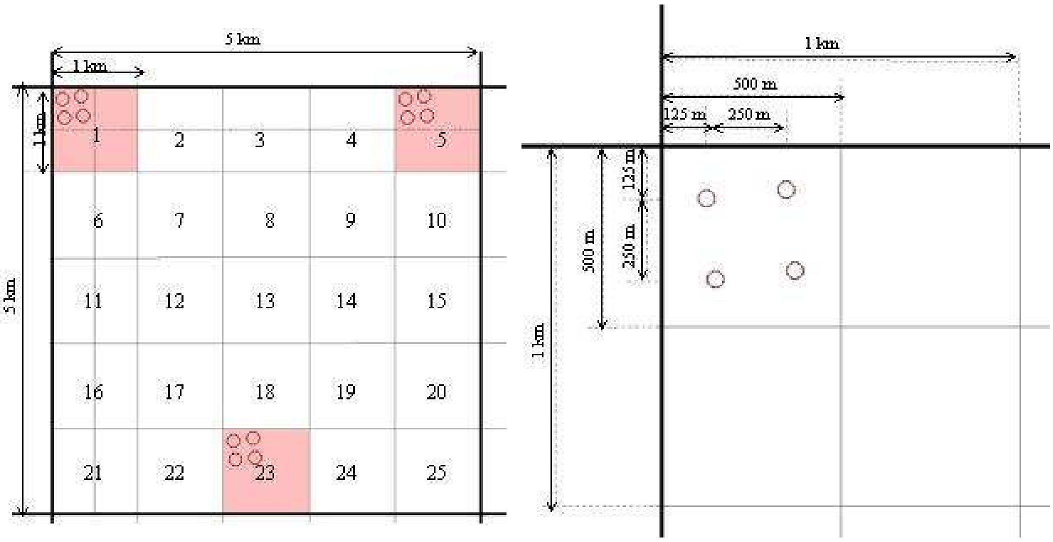
2.1. The net of permanent SP tracts is placed evenly in whole territory of country in distance 4*4 km from each other in a way that they are making equilateral triangles (picture 1.a.). Each year 1/5 from all permanent SP is measured.



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.

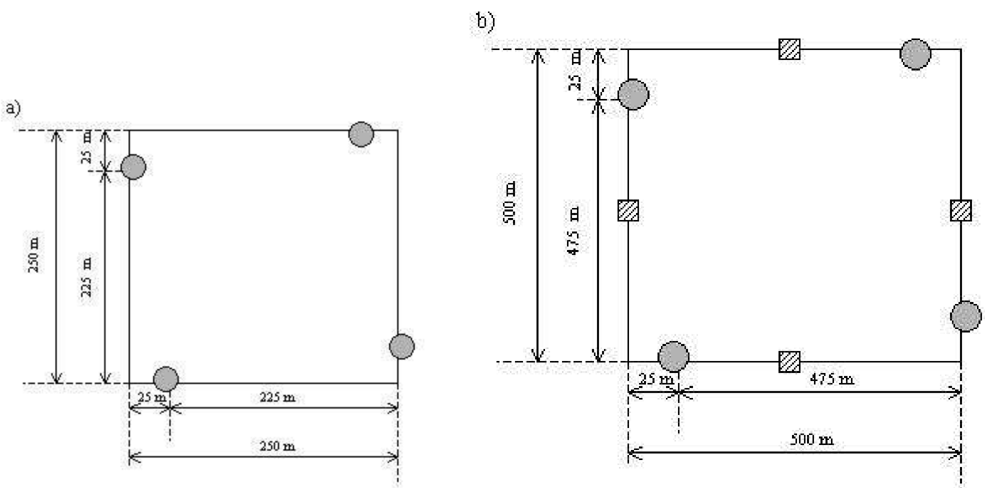
Each temporary plot after one year measurement represents territory of 6000 ha, but during 5 years – 1200 ha. Taking together permanent and temporary SPs, each plot during one year represents 1500ha, but during 5 years 300 ha. By making repeated measurements in permanent SPs changes in 5 years period 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)

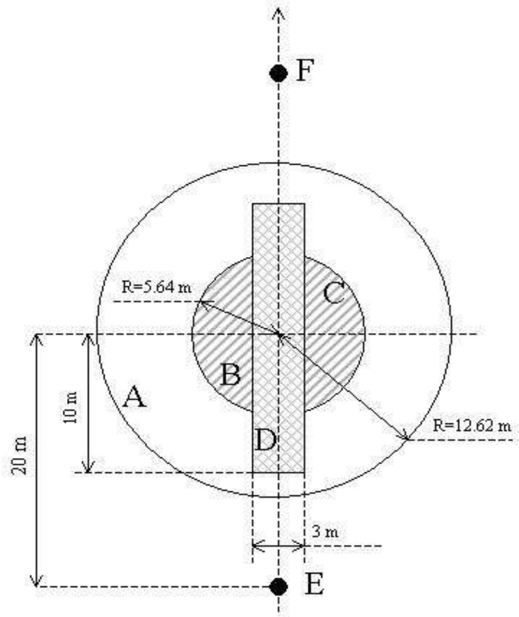
Temporary SPs are placed in quadrates of 500*500 m and they are divided in two parts - stump SPs, where only stumps are measured and SPs for accounting of trees which are measured like permanent SPs, but without fixation of placement of trees.

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)

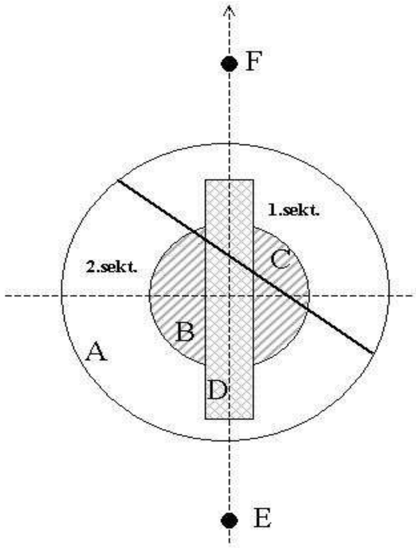
In the centre of SP another circular sample plot is singled out (B) - 100 m^2 (R=5.64 m), where all trees, stumps and deadwood with diameter >= 6.1 cm are measured. In the first ¼ of this SP (accounting from north direction) in 25 m2 (C) all naturally growing saplings and shoots with diameter >=2.1 cm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

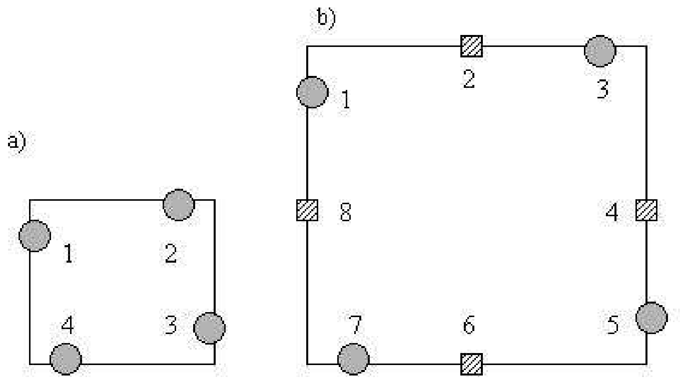
During identifying sectors of SP, azimuths and distances till centre of SP for those points, where sectors making line crossing border of SP, is fixed. (5.picture)



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).



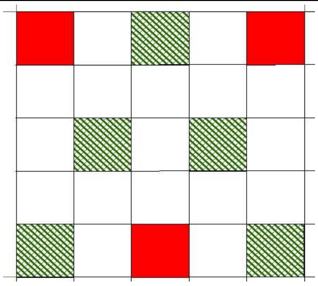
Picture 6 Schema of numbering permanent sample plots (a) and temporary sample plots (b)

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 which consists from 3 specialists.

During field work control is done regarding all those parameters which are re-measured repeatedly in next cycles (azimuth of trees, distance, diameter, and height). Random control is placed also on parameters which 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 - incase 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:

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

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 4: CO_2 reference approach and comparison with sectoral approach, Latvia's energy balance

Table 1 Reference approach estimations (Table 1.B)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV	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		17 588.00	1 143.22	NO	-219.85	16 664.63	1.00	NCV	16 664.63	18.91	315.06	NO	315.06	0.99	1 143.68
		Jet Kerosene	TJ		4 104.95	NO	4 061.74	NO	43.21	1.00	NCV	43.21	19.71	0.85	NO	0.85	0.99	3.09
		Other Kerosene	TJ		86.40	NO	NO	-129.60	216.00	1.00	NCV	216.00	19.71	4.26	NO	4.26	0.99	15.45
		Shale Oil	TJ		905.05	NO		NO	905.05	1.00	NCV	905.05	21.05	19.05	NO	19.05	0.99	69.15
		Gas / Diesel Oil	TJ		38 580.92	1 784.58	1 912.05	297.43	34 586.86	1.00	NCV	34 586.86	20.40	705.58	NO	705.58	0.99	2 561.24
		Residual Fuel Oil	TJ		6 780.20	NO	6 699.00	-121.80	203.00	1.00	NCV	203.00	21.11	4.29	NO	4.29	0.99	15.56
		Liquefied Petroleum Gas (LPG)	TJ		4 189.68	2 049.30		-45.54	2 185.92	1.00	NCV	2 185.92	17.13	37.44	NO	37.44	1.00	136.58
		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		3 599.96	NO		NO	3 599.96	1.00	NCV	3 599.96	22.00	79.20	79.20	0.00	0.99	0.00
		Lubricants	TJ		1 465.10	502.32	NO	-83.72	1 046.50	1.00	NCV	1 046.50	10.01	10.47	10.46	0.01	0.99	0.03
		Petroleum Coke	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Refinery Feedstocks	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other Oil	TJ		711.62	NO		NO	711.62	1.00	NCV	711.62	22.10	15.73	NO	15.73	0.99	57.10
Other Liquid Fossil												334,88		7,20	7,20			
Gasoline type jet fuel			TJ	NO	NO	NO	NO	NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
Paraffin Waxes			TJ	NO	251.16	NO	NO	NO	251.16	1.00	NCV	251.16	22.00	5.53	5.53	0.00	0.99	0.00
Used Oils			TJ	263.07	NO	NO	NO	NO	263.07	1.00	NCV	263.07	20.01	5.26	NO	5.26	0.99	19.11
White Spirit			TJ	NO	83.72	NO	NO	NO	83.72	1.00	NCV	83.72	20.00	1.67	1.67	0.00	0.99	0.00
Liquid Fossil Totals												60 760.70		1 204.38	96.86	1 107.52		4 020.98

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV	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	4 378.74	78.66	NO	52.44	4 247.64	1.00	NCV	4 247.64	25.68	109.06	NO	109.06	0.98	391.88
		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	110.55	NO	20.10		NO	90.45	1.00	NCV	90.45	28.93	2.62	NO	2.62	0.98	9.40
	Secondary Fuels	BKB[3] and Patent Fuel	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Coke Oven/Gas Coke	TJ		80.37	NO		-53.58	133.95	1.00	NCV	133.95	23.84	3.19	NO	3.19	0.98	11.48
Other Solid Fossil												NA		NA	NA	NA		NA
Solid Fossil Totals												4 472.04		114.87	NA,NO	114.87		412.76
Gaseous Fossil		Natural Gas (Dry)	NO	45 923.76	NO		-9 970.29	55 894.05	1.00	NCV	55 894.05	15.89	887.95	NO	887.95	1.00	3 255.82	3 164,48
Other Gaseous Fossil											NA		NA	NA	NA		NA	NA
Gaseous Fossil Totals											55 894.05		887.95	NA,NO	887.95		3 255.82	3 164,48
Total												121 126.79		2 207.20	96.86	2 110.34		7 689.56
Biomass total												48 339.61		1 444.65	NO	1 444.65		5 191.49
		Solid Biomass	TJ	61 733.00	460.00	15 188.00		-913.00	47 918.00	1.00	NCV	47 918.00	30.02	1 438.28	NO	1 438.28	0.98	5 168.20
		Liquid Biomass	TJ	1 357.24	NO	1 065.13		246.87	45.24	1.00	NCV	45.24	19.30	0.87	NO	0.87	1.00	3.20
		Gas Biomass	TJ	376.38	NO	NO		NO	376.38	1.00	NCV	376.38	14.62	5.50	NO	5.50	1.00	20.08

Table 2 Comparison of CO_2 emissions from fuel combustion (Table 1.C)

FUEL TYPES	REFERENCE APPROACH			SECTORAL APPROACH [1]		DIFFERENCE [2]	
	Apparent energy consumption (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
Liquid Fuels (excluding international bunkers)	60.76	55.82	4 020.98	60.32	4 355.60	-7.46	-7.68
Solid Fuels (excluding international bunkers)	4.47	4.47	412.76	4.41	406.34	1.40	1.58
Gaseous Fuels	55.89	55.89	3 255.82	55.56	3 217.98	0.60	1.18
Other [5]	0.21	0.21	17.85	0.21	17.85	0.00	0.00
Total	***121.34***	***116.40***	***7 707.41***	***120.50***	***7 997.77***	***-3.41***	***-3.63***

Table 3 Energobalance of Latvia in year 2008 (TJ)

	Total oil	Shale oil	LPG	Gasoline and aviation gasoline	Gasoline type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Bitumen	Paraffin wax	Other liquid	Used oils	Coal	Peat	Peat briquettes	Coke	Natural gas	Fuelwood	Used tires	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sludge gas	Straws	Thermal energy	Electricity	Total Energoresources
NCV		39.35	45.54	43.97	43.21	43.21	43.2	42.49	40.6	41.86	41.86	41.86	41.86	41.86	29.23	26.22	10.05	15.49	26.79	37.25	6.7	26.2	30	0.03	0.04	19.8	23.04	14.4	3.6	3.6	
production of energy resources																	110	1			61 449		270	312	1 046	277	92	14		11 405	74 976
primary product receipts	263														263							210									473
import	78 353	905	4 190	17 594		4 105	86	38 581	6 780	84	1 465	3 600	251	712		4 379			80	50 953	460		0							16 715	150 940
export	5 479		2 049	1 143				1 785			502					79	20	1			14 978		210	310	718					7 643	29 438
bunkering	8 611							1 912	6 699																						8 611
interproduct transfer	21	826					216	212	893					42																	21
stock changes	430		45	221			130	297	122		84			125		52		1	54	11 062	913		0	1	246						10 335
statistical differences	4 292							4 334					42																		4 292
gross energy - total	69 269	79	2 186	16 672		4 105		39 133	1 096	84	1 047	3 600	209	795	263	4 248	90	1	134	62 015	46 018	210	60	1	82	277	92	14		20 477	202 988
Transformation sector	652	0						43	609							472	40			37 432	6 969				0	198	92	0	26 402	7 582	79 839
public CHP	203								203							314				26 929	655						92		13 680	7 362	49 235
public heat plants																79	20			1 564	1 963							0	2 811		6 437
autoproducer CHP																				484	0					178			202	213	1 077
autoproducer heat plants	449	0						43	406							79	20			8 455	3 808				0				9 709		22 520
autoproducer electricity plants																										20				7	27
charcoal production plants																					543										543
Energy sector**	253							212	41							53	0			894	93								490	1 325	3 108
Losses																26	40			373									3 686	2 873	6 998
Final consumption:	68 364	79	2 186	16 672		4 105		38 878	446	84	1 047	3 600	209	795	263	3 697	10	1	134	23 316	38 956	210	60	1	82	79		14	22 226	23 861	181 011
Industry (including construction)	7 203	79	91	88				1 657	366	84		3 600	209	795	234	1 993			134	12 179	5 414	210	...		1			0	356	6 066	33 556
transport:	54 018		956	16 276		4 084		31 655			1 047									37				1	81					497	54 634
international air	4 052			1		4 051																									4 052

	Total oil	**Shale oil**	**LPG**	**Gasoline and aviation gasoline**	**Gasoline type jet fuel**	**Kerosene type jet fuel**	**Kerosene**	**Diesel oil**	**RFO**	**White spirit**	**Lubricants**	**Bitumen**	**Paraffin wax**	**Other liquid**	**Used oils**	**Coal**	**Peat**	**Peat briquettes**	**Coke**	**Natural gas**	**Fuelwood**	**Used tires**	**Charcoal**	**Bioethanol**	**Biodiesel**	**Landfill gas**	**Sludge gas**	**Straws**	**Thermal energy**	**Electricity**	**Total Energoresources**
domestic air	39			6		33																									39
road	46 528		956	16 269				28 256			1 047									37				1	81					274	46 921
railways	3 314							3 314																						155	3 469
domestic navigation	85							85																							85
pipelines																														68	68
Other sectors:	7 143		1 139	308		21		5 566	80						29	1 704	10	1		11 100	33 542		60		0	79		14	21 870	17 298	92 821
other consumers	1 625		91	44		21		1 360	80						29	839	10	1		5 364	3 130		0			79		14	5 404	9 486	25 952
residential	1 393		1 002	264				127								813				5 215	30 108		60						16 394	7 311	61 294
agriculture / forestry / hunting	3 700		46	0				3 654	0							52				521	297				0				72	472	5 114
fishery	425							425													7								0	29	461

* Electricity produced in hydroelectric power station and in wind power station

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

Annex 5: Assessment of completeness and (potential) sources and sink of GHG emissions and removals excluded for the annual inventory submission

Completeness of the Latvia's inventory submission 2009 is evaluated by sectors in the tables below. The completeness is estimated by the gases (CO2, CH4, N2O, F-gases, NMVOC) and emission categories according to the detailed CRF-classification.

Abbreviations used in tables:
X - included in the inventory
C - confidential business information
IE - included elsewhere
NA - not applicable
NE - not estimated
NO - not occurring in Latvia

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
Energy				
A. Fuel Combustion Activities				
1. Energy Industries				
a. Public Electricity and Heat Production	X	X	X	
b. Petroleum Refining	NO	NO	NO	
c. Manufacture of Solid Fuels and Other Energy Industries	X	X	X	
2. Manufacturing Industries and Construction				
a. Iron and Steel	X	X	X	
b. Non-Ferrous Metals	X	X	X	
c. Chemicals	X	X	X	
d. Pulp, Paper and Print	X	X	X	
e. Food Processing, Beverages and Tobacco	X	X	X	
f. Other *(as specified in table 1.A(a) sheet 2)*	X	X	X	
Other non-specified	X	X	X	
3. Transport				
a. Civil Aviation	X	X	X	
b. Road Transportation	X	X	X	
c. Railways	X	X	X	
d. Navigation	X	X	X	
e. Other Transportation *(as specified in table 1.A(a) sheet 3)*	NO	NO	NO	
Other non-specified	NO	NO	NO	
4. Other Sectors				
a. Commercial/Institutional	X	X	X	
b. Residential	X	X	X	
c. Agriculture/Forestry/Fisheries	X	X	X	
5. Other				
a. Stationary	NO	NO	NO	
Other non-specified	NO	NO	NO	
b. Mobile	X	X	X	
Other non-specified	X	X	X	
B. Fugitive Emissions from Fuels				
1. Solid Fuels				
a. Coal Mining and Handling	NO	NO	NO	
b. Solid Fuel Transformation	NO	NO	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
c. Other *(as specified in table 1.B.1)*	NO	NO	NO	
Other non-specified	NO	NO	NO	
2. Oil and Natural Gas				
a. Oil	NO	NO	NO	
b. Natural Gas	NO	X		
c. Venting and Flaring	NO	NO	NO	
Venting	NO	NO		
Flaring	NO	NO	NO	
d. Other *(as specified in table 1.B.2)*	NO	X	NO	
NOx and CO emissions from Natural Gas supply sytem	NO	IE	NO	Allocation per IPCC Guidelines: 1.B.2.B.4 Distribution. Allocation used by Parties: 1.B.2.B.4 Distribution. Comment: due to structure of CRF Reporter Software it is not possible to allocate NOx and CO emissions from Natural Gas distribution in sector its should be so these emissions are icluded here, but other emissions are included in right sector.
Underground storage	NO	X	NO	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
Total Industrial Processes				
A. Mineral Products				
1. Cement Production	X			
2. Lime Production	X			
3. Limestone and Dolomite Use	X			
4. Soda Ash Production and Use	NO			
5. Asphalt Roofing	X			
6. Road Paving with Asphalt	X			
7. Other *(as specified in table 2(I).A-G)*	X			
Glass Production	NA	NA	NA	
cement production (NOx and NMVOC)	IE	IE	IE	This subsector is seperate because sofware did not provide posibility to input NOx and NMVOC emissions from cement production processes to original 2.A.1 sub-sector
Production of Bricks	IE	IE	IE	
Production of Bricks (plant 1)	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.
Production of Bricks (plant 2)	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.
Production of Bricks (plant 3)	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.
Production of Bricks (plant 4)	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.
Production of Bricks (plant 5)	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.

Production of Glass (Use of fluorspar)	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.
Production of Glass (Use of potash)	NO	NO	NO	
Production of Glass Fibre	NO	NO	NO	
Production of Tiles	X	NE	NE	Emissions are not estimated whereby lack of information about methodology and emission factors.
B. Chemical Industry				
1. Ammonia Production	NO	NO	NO	
2. Nitric Acid Production			NO	
3. Adipic Acid Production	NO		NO	
4. Carbide Production	NO	NO		
5. Other *(as specified in table 2(I).A-G)*	NO	NO	NO	
Carbon Black		NO		
Ethylene	NO	NO	NO	
Dichloroethylene		NO		
Styrene		NO		
Methanol		NO		
C. Metal Production				
1. Iron and Steel Production	X	X		
2. Ferroalloys Production	NO	NO		
3. Aluminium Production	NO	NO		
4. SF_6 Used in Aluminium and Magnesium Foundries				
5. Other *(as specified in table 2(I).A-G)*	NO	NO	NO	
Other non-specified	NO	NO	NO	
D. Other Production				
1. Pulp and Paper				
2. Food and Drink(2)	NA			
E. Production of Halocarbons and SF_6				
1. By-product Emissions				
Production of HCFC-22				
Other				
2. Fugitive Emissions				
3. Other *(as specified in table 2(II))*				
Other non-specified				
F. Consumption of Halocarbons and SF_6				
1. Refrigeration and Air Conditioning Equipment				
2. Foam Blowing				
3. Fire Extinguishers				
4. Aerosols/ Metered Dose Inhalers				
5. Solvents				
6. Other applications using ODS(3) substitutes				
7. Semiconductor Manufacture				
8. Electrical Equipment				
9. Other *(as specified in table 2(II)*				
Production of shoes				
G. Other				
Other non-specified	NA	NA	NA	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	N_2O	NMVOC	Explanation, -if not estimated -if included elsewhere
Total Solvent and Other Product Use				
A. Paint Application				
B. Degreasing and Dry Cleaning	X	NO	X	
C. Chemical Products, Manufacture and Processing	NE		X	No data available
D. Other				
1. Use of N_2O for Anaesthesia		X		
2. N_2O from Fire Extinguishers		NE		no statistical data available
3. N_2O from Aerosol Cans		NE		no statistical data available
4. Other Use of N_2O		NE		no statistical data available
5. Other *(as specified in table 3.A-D)*				
Domestic solvent use	X	NO	X	
Glue manufacturing	X	NO	X	
Printing Industry	X	NO	X	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
Agriculture			
A. Enteric Fermentation			
1. Cattle (1)	X		
Option A:			
Dairy Cattle	X		
Non-Dairy Cattle	X		
2. Buffalo	NO		
3. Sheep	X		
4. Goats	X		
5. Camels and Llamas	NO		
6. Horses	X		
7. Mules and Asses	NO		
8. Swine	X		
9. Poultry	NE		Emissions are not estimated because lack of emission factor
10. Other *(as specified in table 4.A)*	NE		
Other non-specified	NE		Not estimated because of unsignificantly of this sector
B. Manure Management			
1. Cattle (1)	X		
Option A:			
Dairy Cattle	X		
Non-Dairy Cattle	X		
2. Buffalo	NO		
3. Sheep	X		
4. Goats	X		
5. Camels and Llamas	NO		
6. Horses	X		
7. Mules and Asses	NO		
8. Swine	X		
9. Poultry	X		
10. Other livestock	NE		
Other non-specified	NE		Not estimated because of unsignificantly of this sector

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
B. Manure Management (continued)			
11. Anaerobic Lagoons		NA	
12. Liquid Systems		X	
13. Solid Storage and Dry Lot		X	
14. Other AWMS		X	
C. Rice Cultivation	NO		
1. Irrigated	NO		
2. Rainfed	NO		
3. Deep Water	NO		
4. Other *(as specified in table 4.C)*	NO		
Other non-specified	NO		
D. Agricultural Soils			
1. Direct Soil Emissions	NA	X	
2. Pasture, Range and Paddock Manure (3)		X	
3. Indirect Emissions	NA	X	
4. Other *(as specified in table 4.D)*	NA	NA	
Other non-specified	NA	NA	
E. Prescribed Burning of Savannas	NA	NA	
F. Field Burning of Agricultural Residues			
1 . Cereals	NA	NA	
2. Pulses	NA,NO	NA,NO	
3 . Tubers and Roots	NA	NA	
4 . Sugar Cane	NA	NA	
5 . Other *(as specified in table 4.F)*	NA	NA	
Other non-specified	NA	NA	
G. Other			
Other non-specified	NA	NA	

	Net CO_2 emissions/removals	**CH_4**	**N_2O**	Explanation, -if not estimated -if included elsewhere
Total Land-Use Categories				
A. Forest Land				
1. Forest Land remaining Forest Land	X	X	X	
2. Land converted to Forest Land	X	NE,NO	NE,NO	
B. Cropland				
1. Cropland remaining Cropland	X	NE	NE	
2. Land converted to Cropland	NE	NE	NE	
C. Grassland				
1. Grassland remaining Grassland	X	X	X	
2. Land converted to Grassland	NE	NE	NE	
D. Wetlands				
1. Wetlands remaining Wetlands	X	NE	NE	
2. Land converted to Wetlands	NE	NE	NE	
E. Settlements				
1. Settlements remaining Settlements (3)	NE	NE	NE	No data
2. Land converted to Settlements	NE	NE	NE	No data
F. Other Land				
1. Other Land remaining Other Land (4)				
2. Land converted to Other Land	NE	NE	NE	No data

G. Other				
Harvested Wood Products	NE	NE	NE	No data
Other (please specify)	NA	NA	NA	
Information items				
Forest Land converted to other Land-Use Categories	NE	NE	NE	No data
Grassland converted to other Land-Use Categories	NE	NE	NE	No data

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2**	**CH_4**	**N_2O**	Explanation, -if not estimated -if included elsewhere
Waste				
A. Solid Waste Disposal on Land				
1. Managed Waste Disposal on Land	NE	X		
2. Unmanaged Waste Disposal Sites	NO	NO		
3. Other	NO	NO		
Other non-specified	NO	NO		
B. Waste Water Handling				
1. Industrial Wastewater		X	X	
2. Domestic and Commercial Waste Water		X	X	
3. Other *(as specified in table 6.B)*		NE,NO	NO	
Other non-specified		NE,NO	NO	
C. Waste Incineration	X	**NE,NO**	**NE,NO**	
D. Other *(please specify)*				
Compost production	NE	X	X	No methodology

Annex 6: The annual inventory submission and the supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol or other useful reference information

A.6.1: Annual inventory submission

Information on the QA/QC plan:

General Schedule for Implementation of QC/QA Activities for submission 2010

No.	Action	Month											
		05	06	07	08	09	10	11	12	01	02	03	04
Preparation of inventory													
1.	Annual meeting of the experts involved in the inventory in order to discuss and evaluate problems, methods, the QA/QC plan and the necessary activities		X										
1.1.	Additional meetings: Agriculture LULUCF Transport							X		X	X		
2.	Preparation of emission calculations (inventory)		X	X	X	X	X	X	X				
3.	Preparation of the initial National Inventory Report to the European Commission							X	X	X			
4.	Preparation of the National Inventory Report to the European Commission and the Convention									X	X	X	
5.	Amending of the prepared National Inventory Report of the European Commission and the Convention if necessary											X	X
6.	Documentation of all materials used in the inventory		X	X	X	X	X	X	X				
7.	Archiving of all documents of the inventory with the aggregator of inventory												X
8.	Quality control (all involved institutions according to Tier 1 GPG)		X	X	X	X	X	X	X	X	X	X	
9.	Report on review of the Convention						X	X					
10.	Quality assurance (third party for Energy and Transport Sectors)										X	X	
11.	Sending of the inventory (final version) to the Convention Secretariat and the European Environment Agency												X
12.	Amending the inventory pursuant to evaluations/reports of the Convention Secretariat and the European Commission							X	X		X	X	X
Inventory													
13.	Data collection				X	X	X	X	X				
14.	Calculation of emissions				X	X	X	X	X	X	X		
15.	Recalculation of emissions if errors or uncertainties have been detected							X	X	X	X	X	

No.	Action	Month											
		05	06	07	08	09	10	11	12	01	02	03	04
16.	Entering of emissions in the common standardised reporting format software						X	X	X	X			
17.	Entering of emissions in the common standardised reporting format software if there are changes										X	X	
18.	Analysis and entering of the main sources in the common standardised reporting format software									X		X	
19.	Generation (creation) of the common standardised reporting format and *XML* format for sending of the inventory									X		X	X
20.	Analysis of uncertainties							X	X	X	X		

IMPROVEMENT PLAN TO DEVELOP AND VERIFY METHODOLOGIES OF CALCULATIONS OF GHG EMISSIONS AND CO_2 REMOVALS IN LULUCF SECTOR

By Latvian State Forestry Research Institute "Silava" (LSFRI Silava)

BACKGROUND INFORMATION

The improvement plan to develop and to scientifically verify methodologies and implied emission factors for the National GHG inventory in the LULUCF sector was elaborated in 2009-2010 by the LSFRI Silava in cooperation with invited experts from Latvia University of Agriculture, Ministry of Agriculture of Republic of Latvia and Tartu University of Life Sciences as a project application "National greenhouse gas inventory supporting studies" for the European Regional Development Fund supported research and development program[109] managed by the Ministry of Education and Science of Republic of Latvia.

The application was submitted to the Ministry of Education and Science of Republic of Latvia in 9th of March, 2010. Evaluation of the project applications will be completed latest in September, 2010. In case in the application will receive funding from the European Regional Development fund, practical work will be started in October, 2010 and continued until the end of November, 2013 when all methodologies should be verified, published in scientific articles, presented in the greenhouse gas (GHG) inventory in Land Use, Land Use Change and Forestry (LULUCF) sector dedicated international conference and incorporated into the National GHG inventory.

PROJECT SUMMARY

The overall target of the project is to fulfil Latvia's international obligations within the frame of the United Nations Framework Convention on Climate Change and to create preconditions for the inclusion of CO_2 removals through forestry practices and wood processing in the emission trading scheme.

The specific target of the project is to develop a methodological basis for the preparation of national greenhouse gas emission and removals inventory report. This methodological basis should fit to requirements of the Good Practice Guidelines in the sector of Land Use, Land Use Change and Forestry by the Intergovernmental Panel on Climate Change.

The project corresponds to the priority field of science – sustainable use of local resources (earth entrails, forest, food and transport) – new products and technologies.

According to the paragraph 3.1 of the regulation Nr. 752 (07.07.2009) of the Cabinet of Ministers, the project complies with the following criteria:

1. project is implemented by a scientific institution which, accordingly to its statute, performs scientific activities and dissemination of the results of scientific activities transferring knowledge and technologies; the payments obtained while implementing basic activities are repeatedly invested in the basic activities;

[109] http://translate.google.com/translate?js=y&prev=_t&hl=en&ie=UTF-8&layout=1&eotf=1&u=http%3A%2F%2Fesfondi.izm.gov.lv%2F1060.html&sl=lv&tl=en (original in Latvian - http://esfondi.izm.gov.lv/1060.html)

2. businessmen who can influence the scientific institution , have no privilege on the capacity of the research or results of the research;
3. public accessibility of the results of research will be ensured in the frames of the project.

To achieve the goals following activities are planned in the project:

1. Research & development;
   - 1.1. Definitions and other normative regulations,
   - 1.2. Land use balance,
   - 1.3. Biomass and carbon removals of trees;
   - 1.4. Emissions related to deadwood,
   - 1.5. Emissions related to soil and litter,
   - 1.6. Emissions related to forest damage,
   - 1.7. The integration of the methodology for greenhouse gas inventory in the National forest inventory.
2. Ensuring of the public accessibility of research results.

Place of implementation of the project – LSFRI Silava.

Planned total length of project implementation – 36 months.

JUSTIFICATION OF THE PROBLEMS ADDRESSED IN PROJECT

Latvia has undertaken the fulfilment of international obligations in the prevention of climate change by signing the United Nations Framework Convention on Climate Change in 1992 and ratifying it in 1995. The aim of the Convention is to decrease the concentration of greenhouse gases (GHG) in the atmosphere down to the level that would prevent dangerous anthropogenic interference to the climatic system. According to the Kyoto protocol of the Convention, in the period from 2008 to 2012 Latvia together with other countries must decrease anthropogenic GHG emissions by 8% compared to 1990. According to the Convention, the member states every year submit annual GHG inventory report, as well as prepare national reports that reflect the relevance of accomplished and planned tasks. According to the regulation No. 157 (17.02.2009) of the Cabinet of Ministers, the preparation of GHG inventory report in the LULUCF sector is carried out by LSFRI Silava.

One of the mechanisms mentioned in the Kyoto protocol to reduce GHG emissions is international emission trade. Starting from 2008, also sector of land use, land use change and forestry is included in this scheme, and at the end of the reference period (2012) Latvia will be able to apply for additional 6,23 mill. tons of CO_2 quotas. However, to be able to use these quotas, the national system of GHG inventory must correspond with the quality requirements stated in the Good Practice Guidelines in the sector of Land Use, Land Use Change and Forestry by the Intergovernmental Panel on Climate Change (IPCC GPG LULUCF) and must be scientifically verified. In case the requirements of IPCC are not met, Latvia can be excluded from the emission trading scheme and lose potential income connected with the reduction of GHG emissions in the industry and other sectors.

The main problems connected with GHG emission and removals inventory in the LULUCF sector are incomplete methodological basis for the inventory of alive and dead biomass, soil and litter CO_2 removals and GHG emissions, as well as incomplete land use balance inventory system that lacks accurate geographical information on the historical dynamics of different land use types.

These problems have to be solved by the end of 2012 when Latvia must submit a final report in the frames of Kyoto protocol. If Latvia fails to put into practice appropriate inventory and calculations of GHG emissions and CO_2 removals in the LULUCF sector, the state can lose emission quotas in this sector (6,23 mill. tons of CO_2 equivalent in the time period from 2008 to 2012) but in the worst case the country can be excluded from the emission trading scheme until methodological issues are solved.

The cause for shortcomings in the LULUCF sector inventory system are the changes in the policy of climate change and forestry, creating new mechanisms for the development of these sectors but also setting new tasks to verify the effectiveness of the use of these mechanisms. Similar problems of the LULUCF sector are presently solved in all developed countries of the world.

There are no viable alternatives for the implementation of the goals stated in the project because, according to the guidelines (IPCC GPG LULUCF), every developed country is obliged to produce an individual methodology for the inventory of most important sources of emissions and removals in the LULUCF sector. Alternative solution is the secession from the Kyoto protocol, however, in this case the gain, giving up science development, cannot be compared to the losses that would be created by exclusion from the emission trading scheme. Only in the LULUCF sector the losses during the next 5 years would be around 124 mill. EUR, recalculating to the present prices of emission quotas.

References:

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- Latvian Environment, Geology & Meteorology Agency, *Latvia's national inventory report Submitted under United Nations Convention on Climate Change*, 2009;
- United Nations, *15/CMP.1 Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol*, 2006;
- United Nations, Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998.

Description of solutions proposed in the project

Within the scope of the project in collaboration with the leading experts of the LULUCF sector in the Nordic countries and the Baltic states the methodology of GHG emissions and removals inventory will be developed and integrated in the existing inventory systems, including:

1. The matrix of land use balance analysis, as well as the model for the calculation of CO_2 removals in alive and dead biomass (*dieback of living trees and logging residues*) will be integrated in the National forest inventory (NFI) program;
2. The calculations of GHG emissions and CO_2 removals in soils with the organic horizon not thicker than 80 cm and in forest litter will be linked with Level I forest monitoring program;
3. The inventory of GHG emissions created by forest felling and CO_2 removals in wood products will be linked with Forest fund data base maintained by State Forest service;
4. The assessment of damages, as well as analysis of GHG emissions and CO_2 removals in organic soils with the organic horizon above 80 cm will be carried out based on the data from long-term research.

According to the regulation No 590 (28.08.2007) and No 313 (07.04.2009) of the Cabinet of Ministers, NFI and Level I forest monitoring in the frames of international project FutMon are carried out by LSFRI "Silava".

Taking into account the structure of GHG inventory and specific character of problems to be solved, following research activities are outlined in the project:

1. Development of definitions and other normative regulations to ensure the integrity of land use balance and emission data.
2. Updating of the land use balance starting from year 1990 and defining territories corresponding with points 3.3 and 3.4 of the Kyoto protocol, as well as lands where no economic activities are carried out.
3. Analysis of the biomass and carbon removals of trees, including development of species- and land use type-specific equations for above- and below-ground biomass, as well as coefficients for the recalculation of carbon content.
4. Emissions related to deadwood, including deadwood in the growing forest, wood products, logging residues and their use (including burning), and analysis of the decomposition of tree root system.
5. Emissions and removals related to soil and litter, including the development of method for the inventory of soil and litter emissions and removals and integration of this method in the existing modelling instruments (*Yasso*) for the prognosis of the impact of different activities (melioration, logging, land use change).
6. Emissions related to forest damage, including forest fires, animal damage and wind damage.
7. The integration of GHG inventory methodology in the NFI and forest management planning models for the preparation of short and long term prognoses and forest policy planning.

The main result of all project activities will be articles in the international peer reviewed journals, serving as the instrument for scientific verification of the GHG inventory methodology. Altogether it is planned to prepare 9 scientific articles.

In addition, during the project implementation, public accessibility of scientific results will be ensured via project home page and regular (twice a year) press releases. In the final stage of the project an international scientific conference will be organized, where the developed methodology will be presented and discussed. The conference materials will be summarized in proceedings with international editorial board. The language of the proceedings will be English.

DESCRIPTION OF PLANNED ACTIVITIES

Within the scope of the project it is planned to carry out an industrial research in forest science that includes evaluation and broadening of available knowledge related to the GHG inventory in the LULUCF sector, in order to develop a methodology necessary for the preparation of national GHG inventory report and sustainability analysis of land use and timber industry. The implementation of the project will ensure the return of financial resources gained by emission trade to the forest sector through activities promoting sustainable forestry and use of wood products. The project is directed towards significant improvement of existing technologies (inventory methodology). There will be following research activities in the project:

1. Development of definitions and other normative regulations to ensure integrity of land use balance and removals data. The main task of the activity is to use unified nomenclature of land use types in the territory of Latvia, that would include classification principles used in several, also international data bases. It is planned to finish this activity within 3 months from the start of the project.

2. Update of land use balance starting from 1990 and defining territories that correspond to the points 3.3 and 3.4 of the Kyoto protocol, as well as lands where no economic activity is carried out. The main task of the activity is, based on the definitions developed in the 1st scientific activity, to identify the change of land use type in all NFI sample plots including those outside forest land starting from 1990. The change of land use type will be identified analysing series of LANDSAT satellite images and identifying the year of transformation for every sample plot.

3. Analysis of tree biomass and carbon removals is the most extensive scientific activity including development of species- and land use type-specific tree above- and below-ground biomass equations and carbon concentration recalculation coefficients. Original biomass and carbon recalculation equations will be developed for the main tree species (pine (*Pinus sylvestris* L.), spruce (*Picea abies* (L.) H.Karst.), birch (*Betula pendula* Roth and *Betula pubescens* Ehrh.), aspen (*Populus tremula* L.), black alder (*Alnus glutinosa* L.), grey alder (*Alnus incana* (L.) Moench), ash (*Fraxinus excelsior* L.) and oak (*Quercus robur* L.)) using tree height and breast height diameter as factorial features. To simplify the task the development of equations for conifers and birch will be based on equations used in the GHG inventory in Finland. For less common tree and shrub species contributing only to a small part of GHG balance in the forest lands unified recalculation equations will be developed, based on experimental and literature data. For each tree species several sets of equations will be developed, according to the definitions of 1st scientific activity.

4. Emissions related to deadwood include the dieback of living trees in growing forest and wood products originating from forest felling (timber, biofuel, logging residues and tree below-ground biomass). A significant part of GHG emissions is formed burning the logging residues immediately after logging, therefore a method to estimate an actual amount of this part of emissions will be developed, expanding NFI observations in the forest stands felled in the current year. Within the frames of this activity also a monitoring method for the amount of biofuel production will be developed, based on the NFI grid and additional observations in stands to be felled. In the analysis of removals and emissions from wood products SCAD (*Stock Change Approach on Domestically produced and consumed wood*) method will be used. The amount of dieback of volume increment will be determined using research results obtained in Tartu, Estonian University of Life Sciences. In this task expert from Estonian University of Life Sciences, Ph.D. Kajar Köster will take part.

5. The activity related to emissions and removals in the soil and litter includes the development of method for inventory of CO_2 removals and GHG emissions from soil and litter, as well as integration of this method in the existing modelling instruments (*Yasso*) for the prognosis of the impact of economic activities (melioration, forest felling, land use type change). The activity is divided into two parts according to the thickness of peat layer – (1) mineral soils and shallow organic soils (thickness of organic layer less than 80 cm) and (2) organic soils with thick organic layer. In the first group the methodology of GHG emissions and CO_2 inventory will be based on the grid of long-term monitoring sample plots including forest lands, arable lands and grasslands. For the second group of soils recalculation equations will be developed based on long-term observations in forest and non-forest land.

6. Emissions related to forest damage, including forest fires, animal and wind damage. In this activity data from NFI, State forest service, scientific research, and other sources of information and GIS technologies will be integrated in order to develop a calculation model for the biomass burned in the forest fires. The calculation model of other damage (wind and animals) will be based on NFI data. To prevent double record of emissions researchers of this activity will closely collaborate with researchers from 5th activity.

7. Integration of GHG inventory methodology in the NFI and forest management planning models will be carried out gradually during all project progress. The activity can be finished only after work with biomass and carbon recalculation equations will be over. This activity includes also development of instructions for field work and calculations and methodology of data validation. The integration of new models in the NFI data base will be carried out so, that also processing of previously obtained data will be possible.

QUANTITATIVE INDICATORS OF THE PROJECT'S RESULTS

The main outputs of the project will be set of scientific publications targeted to be a basis for the GHG inventory in LULUCF sector. The proposed methodologies will be verified and applied practically in the future inventories during the implementation of the project. The methodologies will be introduced into the inventory as soon as they will be elaborated and verified, therefore future inventories will be considerably updated. All methodologies should be ready for use before completion of the National inventory report in 2014.

Quantitative indicators of the project are provided in Table 1, comparison with currently utilized methodologies – in Table 2, the project time schedule – in Table 3.

Table 1 Quantitative indicators

No. of activity	Title of activity	Result	Results in measurable units	
			Count	Measurement unit
1.	Research			
1.1	Definitions and other normative regulations	Instruction for the identification of land use and management types	1	instruction
1.2	Land use balance	Methodology for the calculation of land use balance	1	methodology
		Land use change matrix since 1990 with geographically identifiable territorial units	1	report, integrated in the GHG inventory report
1.3	Biomass and carbon removals of trees	Methodology for the calculation of tree biomass and carbon removals	1	methodology
		Recalculation of CO_2 removals in live biomass since 1990	1	report, integrated in the GHG inventory report
1.4	Emissions related to deadwood	Methodology for the calculation of the increase of dead biomass	1	methodology
		Methodology for the emission calculations related to forest felling and wood products	1	methodology
		Methodology for monitoring of burning logging residues and calculation of emissions	1	methodology
		Recalculation of GHG emissions related to deadwood since 1990	1	report, integrated in the GHG inventory report

No. of activity	Title of activity	Result	Results in measurable units	
			Count	Measurement unit
1.5	Emissions and removals related to soil and litter	Methodology for CO_2 removals and GHG emission calculations in forest litter, mineral soils and shallow organic soils	1	methodology
		Methodology for GHG emission calculations in drained organic soils with thick organic layer	1	methodology
		Recalculation of GHG emissions and CO_2 removals related to soil and litter since 1990	1	report, integrated in the GHG inventory report
1.6	Emissions related to forest damages	Methodology for the evaluation of GHG emissions due to the forest fires	1	methodology
		Methodology for the evaluation of GHG emissions due to last year's grass fires	1	methodology
		Recalculation of GHG emissions related to forest fires and last year's grass fires since 1990	1	report, integrated in the GHG inventory report
1.7	The integration of the methodology for GHG inventory in the NFI	Methodologies developed during the research activities and necessary additional information integrated and verified in the NFI system	1	calculation model
		Instruction for the fieldwork and calculations in NFI	1	instruction
2	Ensuring of the public accessibility of research results	The results of the research activities published in international peer-reviewed journals	9	Internationally acknowledged publications
		An international conference related to questions of GHG inventory in the LULUCF sector is organized	1	scientific conference
		Chapters in the doctoral degree works	3	doctoral degree studies

Table 2 Comparison of currently applied and proposed approaches in GHG inventory of the LULUCF sector

Project activity	Solutions used currently	Solutions proposed by the project
Definitions and other normative regulations	Land use definitions are only partly compatible with definitions given in the IPCC GPG LULUCF. Economic activities in the forest lands are not stated, as well as prerequisites for the land use change.	Land use definitions given by IPCC GPG LULUCF will be improved according to the local conditions and integrated in the NFI methodology. Economic activities on forest land and non-forest land corresponding to the points 3.3 and 3.4 of the Kyoto protocol will be identified.
Land use balance	Data provided by State Land service about the area of agricultural lands, forest lands, wetlands, infrastructure and other lands corrected by the NFI data about forest lands. The system does not ensure that land use change is geographically identifiable outside forest lands.	Land use balance will be included in the NFI, recalculating the land use every year, according to the data of exact measurements. Land use change will be geographically identifiable. Land use balance calculation will also allow identifying the area of organic agriculture lands in Latvia.

Project activity	Solutions used currently	Solutions proposed by the project
Biomass and carbon removals in living trees	To recalculate removals in the tree biomass coefficients corresponding to the lowest quality level (*Tier1*) are used (coefficient to recalculate stem volume into above-ground biomass – 1.3, coefficient to recalculate above-ground biomass into below-ground biomass – 1.32, wood density – 0.5, carbon concentration in biomass – 50%.)	Species- and land use type-specific equations for the recalculation of carbon removals will be developed, using measured tree height and diameter data. These equations will be scientifically verified and suitable for local conditions.
Stock change of dead biomass	Is not considered at all due to the lack of appropriate method.	Will be evaluated, using data from NFI and former research, recalculation starting from 1990 will be performed, based on changes in stand age structure and species composition.
Emissions related to forest felling	To calculate CO_2 emissions from the felled volume, coefficients corresponding to *Tier1* are used. Emissions are calculated using the method of "direct oxidation", assuming that all biomass (stem, logging residues, and roots) turns to emissions immediately after felling.	GHG emissions will be calculated using equations for the increment of live tree biomass. The decomposition rate of logging residues and tree root systems, as well as life length of wood materials will be taken into account, giving up the method of "direct oxidation".
Burning of logging residues	It is assumed that 30% of the logging residues are left for burning, thus significantly overestimating actual GHG emissions that are related to the forest felling.	For the inventory of further use (including burning) of logging residues a new monitoring system based on the NFI data and remote sensing, will be used. The results will be statistically credible and geographically identifiable.
Emissions and removals related to the soil and litter	CO_2 emission calculations are carried out only for drained organic soils using *Tier1* coefficients corresponding to the temperate zone. Thus emissions related to soil are significantly overestimated.	CO_2 removals and GHG emissions from the mineral soils and shallow organic soils will be evaluated using Level I forest monitoring sample plots. GHG emissions from organic soils with organic layer thicker than 80 cm will be calculated using data from long-term scientific research.
Emissions related to forest damage	Only emissions related to forest fires are evaluated, using equations that are not verified in the local conditions.	GHG emissions from forest and last year's grass fires will be calculated using data about types and areas of fires provided by State Fire and Rescue service and State Forest service, as well as scientifically verified equations. GHG emissions related to wind and other damage will be calculated using NFI data.
Integration of inventory of GHG emissions and CO_2 removal methodology into the NFI	Calculations are not connected to NFI observations.	In the frames of the project the methodology will be integrated in the NFI field work and calculation system, securing transparency of data gathering and calculations, as well as continuity of the process.

Table 3 Time schedule of the project

No. and title of research activity	**Schedule of implementation of the project's activities**																			
	2009				**2010**				**2011**				**2012**				**2013**			
	1.	**2.**	**3.**	**4.**	**1.**	**2.**	**3.**	**4.**	**1.**	**2.**	**3.**	**4.**	**1.**	**2.**	**3.**	**4.**	**1.**	**2.**	**3.**	**4.**
1.1. Definitions and other normative regulations								X												
1.2 Land use balance									X	X	X	X								
1.3 Biomass and carbon removals in living trees									X	X	X	X	X	X	X	X				
1.4 Carbon stock change of dead biomass									X	X	X	X	X	X	X	X				
1.5 Emissions and removals related to soil and litter								X	X	X	X	X	X	X	X	X	X	X	X	
1.6 Emissions related to forest damage												X	X	X						
1.7 The integration of the methodology for GHG inventory in the NFI													X	X	X	X	X	X	X	
2. Dissemination								X	X	X	X	X	X	X	X	X	X	X	X	

A.6.2: Emission trends

CO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)																			%
1. Energy	**18 631.76**	**17 115.31**	**13 828.58**	**11 676.27**	**10 101.13**	**8 925.39**	**8 991.51**	**8 481.33**	**8 089.05**	**7 472.83**	**6 892.16**	**7 297.74**	**7 291.15**	**7 425.54**	**7 432.22**	**7 604.42**	**8 047.61**	**8 406.93**	**7 997.77**	**-57.07**
A. Fuel Combustion (Sectoral Approach)	18 631.76	17 115.31	13 828.58	11 676.27	10 101.13	8 925.39	8 991.51	8 481.33	8 089.05	7 472.83	6 892.16	7 297.74	7 291.15	7 425.54	7 432.22	7 604.42	8 047.61	8 406.93	7 997.77	-57.07
1. Energy Industries	6 386.17	5 869.19	5 002.60	4 009.66	3 766.34	3 472.32	3 596.87	3 380.27	3 418.24	2 993.93	2 543.37	2 498.63	2 396.40	2 333.60	2 143.82	2 137.75	2 167.78	2 034.14	2 005.59	-68.59
2. Manufacturing Industries and Construction	3 804.95	2 856.38	2 406.27	2 118.32	1 919.68	1 888.98	1 851.68	1 806.02	1 584.54	1 437.01	1 190.01	1 098.70	1 140.46	1 085.14	1 085.83	1 159.67	1 191.11	1 253.43	1 155.29	-69.64
3. Transport	2 877.98	2 695.53	2 403.28	2 216.11	2 102.57	2 002.49	1 965.76	1 955.86	1 930.36	1 897.37	2 106.95	2 496.90	2 574.42	2 718.25	2 856.85	2 982.88	3 290.75	3 726.94	3 519.84	22.30
4. Other Sectors	5 562.64	5 694.20	4 016.43	3 332.18	2 312.54	1 555.48	1 573.95	1 326.83	1 152.65	1 135.18	1 051.70	1 203.34	1 173.01	1 282.21	1 336.11	1 316.52	1 390.49	1 389.57	1 313.66	-76.38
5. Other	NO	NO	NO	NO	NO	6.12	3.25	12.34	3.25	9.33	0.14	0.17	6.87	6.33	9.61	7.60	7.49	2.86	3.39	100.00
B. Fugitive Emissions from Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial Processes	**576.72**	**508.52**	**226.79**	**51.05**	**134.82**	**149.39**	**148.99**	**155.55**	**160.32**	**191.19**	**145.72**	**161.78**	**175.01**	**187.90**	**194.52**	**210.76**	**215.62**	**259.49**	**253.68**	**-56.01**
A. Mineral Products	563.89	499.80	221.06	44.05	128.26	144.96	145.50	147.55	151.81	183.48	137.29	153.74	167.41	175.74	181.60	198.40	203.04	244.91	245.00	-56.55
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal Production	12.83	8.71	5.73	7.01	6.55	4.43	3.49	8.00	8.50	7.71	8.43	8.04	7.60	12.16	12.92	12.36	12.57	14.57	8.67	-32.38
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
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	51.10	52.26	51.03	49.06	-11.91
5. Land Use, Land-Use Change and Forestry(2)	**-18 907.29**	**-20 258.07**	**-21 349.57**	**-21 415.66**	**-21 273.61**	**-21 465.67**	**-22 444.30**	**-21 041.33**	**-20 659.21**	**-20 697.60**	**-21 684.28**	**-23 199.82**	**-23 035.20**	**-23 437.49**	**-25 304.56**	**-25 466.98**	**-29 760.42**	**-28 993.82**	**-29 053.37**	**53.66**
A. Forest Land	-19 377.24	-20 728.63	-21 819.51	-21 886.88	-21 749.04	-21 760.56	-22 755.48	-21 352.31	-20 966.24	-20 988.20	-21 971.77	-23 484.89	-23 350.34	-23 761.51	-25 604.63	-25 782.43	-30 147.65	-29 339.62	-29 386.55	51.65
B. Cropland	440.07	440.70	440.29	441.80	445.87	264.59	279.65	282.04	276.88	258.60	256.39	249.35	267.29	272.24	263.02	284.96	314.01	312.23	304.70	-30.76
C. Grassland	10.07	10.07	9.85	9.63	9.76	10.50	11.72	9.13	10.35	12.20	11.30	15.93	28.05	31.98	17.25	10.69	53.42	13.78	8.68	-13.88
D. Wetlands	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	0.00
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
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	NA,NE	NA,NE	0.00
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**	**1.18**	**0.50**	**100.00**
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	NE,NO	NE,NO	0.00
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	1.18	0.50	100.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)																			%
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	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**	**NO**	**NO**	**0.00**
Total CO2 emissions including net CO2 from LULUCF	**356.88**	**-2 582.78**	**-7 245.06**	**-9 642.15**	**-10 992.40**	**-12 349.25**	**-13 260.65**	**-12 360.92**	**-12 365.44**	**-12 987.67**	**-14 599.31**	**-15 691.23**	**-15 521.28**	**-15 775.56**	**-17 628.26**	**-17 600.26**	**-21 443.43**	**-20 275.19**	**-20 752.36**	**-5 914.91**
Total CO2 emissions excluding net CO2 from LULUCF	**19 264.18**	**17 675.29**	**14 104.51**	**11 773.51**	**10 281.21**	**9 116.42**	**9 183.66**	**8 680.42**	**8 293.77**	**7 709.94**	**7 084.98**	**7 508.59**	**7 513.92**	**7 661.93**	**7 676.29**	**7 866.72**	**8 316.99**	**8 718.62**	**8 301.02**	**-56.91**
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**	**788.19**	**1 003.69**	**825.81**	**810.74**	**950.79**	**-44.76**
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	148.08	179.57	201.59	245.82	296.15	33.92
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	564.93	654.64	-56.36
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO2 Emissions from Biomass	2 964.03	3 476.19	3 466.38	3 860.64	4 002.69	4 537.71	4 742.49	4 754.34	4 692.58	4 606.58	4 278.39	4 746.04	4 716.65	5 071.20	5 347.32	5 352.46	5 386.85	5 273.79	5 227.46	76.36

CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)																			%
1. Energy	25.80	26.67	24.27	24.39	23.98	24.14	24.12	22.73	21.46	20.75	19.44	20.36	20.39	19.19	19.46	20.16	17.88	17.92	17.74	-31.23
A. Fuel Combustion (Sectoral Approach)	12.75	14.10	12.81	13.43	13.27	13.71	14.07	13.35	12.46	12.17	11.50	12.66	12.36	12.91	13.24	13.21	12.85	12.76	12.44	-2.42
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	0.19	0.19	-30.86
2. Manufacturing Industries and Construction	0.26	0.19	0.17	0.18	0.17	0.17	0.18	0.17	0.18	0.17	0.16	0.20	0.19	0.19	0.23	0.26	0.29	0.27	0.27	3.46
3. Transport	1.01	0.93	0.89	0.87	0.83	0.76	0.72	0.68	0.64	0.61	0.65	0.72	0.66	0.63	0.59	0.52	0.47	0.41	0.33	-67.03
4. Other Sectors	11.20	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	11.89	11.64	3.98
5. Other	NO	NO	NO	NO	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	0.00	100.00
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	5.16	5.30	-59.37
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
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	5.16	5.30	-59.37
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**	**0.00**	**0.00**	**-3.55**
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.55
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
4. Agriculture	**115.57**	**110.25**	**89.98**	**55.88**	**47.72**	**46.81**	**44.30**	**43.39**	**40.11**	**34.91**	**34.60**	**36.48**	**36.37**	**35.46**	**35.04**	**36.06**	**35.65**	**37.21**	**35.82**	**-69.01**
A. Enteric Fermentation	102.26	97.78	80.48	50.16	42.54	41.49	39.53	38.92	35.92	31.08	30.87	32.49	32.26	31.45	31.09	32.09	31.73	33.20	32.03	-68.68
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	4.01	3.79	-71.53
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Agricultural Soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.92**	**1.07**	**1.67**	**1.20**	**1.39**	**1.71**	**1.72**	**2.20**	**2.45**	**2.74**	**2.78**	**1.56**	**1.86**	**1.79**	**1.62**	**1.66**	**1.77**	**1.49**	**1.34**	**45.54**
A. Forest Land	0.92	1.07	1.67	1.20	1.39	1.71	1.72	2.20	2.45	2.73	2.77	1.55	1.84	1.75	1.60	1.65	1.70	1.48	1.33	45.23
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
C. Grassland	NE,NO	NE,NO	NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.03	0.03	0.02	0.01	0.06	0.01	0.00	100.00
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
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	NA,NE	NA,NE	0.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)																			%
6. Waste	**36.36**	**36.60**	**33.48**	**31.09**	**30.44**	**30.85**	**31.46**	**32.46**	**33.79**	**34.54**	**37.66**	**38.80**	**38.83**	**37.41**	**37.98**	**38.38**	**36.14**	**36.64**	**40.45**	**11.27**
A. Solid Waste Disposal on Land	18.72	19.79	20.83	21.82	22.86	23.56	24.31	25.08	25.88	26.71	27.56	28.44	28.48	26.86	26.22	26.77	27.43	28.18	28.91	54.47
B. Waste-water Handling	17.64	16.80	12.66	9.27	7.58	7.29	7.15	7.38	7.90	7.83	10.10	10.36	10.35	10.54	11.73	11.59	8.67	8.42	11.50	-34.78
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	NE,NO	NE,NO	0.00
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.03	0.03	0.05	0.04	0.04	100.00
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**	**NO**	**NO**	**0.00**
Total CH4 emissions including CH4 from LULUCF	**178.65**	**174.59**	**149.40**	**112.57**	**103.53**	**103.52**	**101.59**	**100.79**	**97.81**	**92.94**	**94.48**	**97.21**	**97.46**	**93.85**	**94.09**	**96.26**	**91.45**	**93.27**	**95.36**	**-46.62**
Total CH4 emissions excluding CH4 from LULUCF	**177.73**	**173.52**	**147.74**	**111.37**	**102.14**	**101.80**	**99.87**	**98.59**	**95.36**	**90.20**	**91.70**	**95.65**	**95.59**	**92.06**	**92.47**	**94.60**	**89.68**	**91.78**	**94.02**	**-47.10**
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	0.04	0.04	-53.94
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	0.00	0.00	78.53
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	0.03	0.04	-56.11
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

N_2O

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)																			%
1. Energy	**0.53**	**0.52**	**0.47**	**0.41**	**0.39**	**0.40**	**0.41**	**0.41**	**0.39**	**0.37**	**0.36**	**0.39**	**0.40**	**0.43**	**0.44**	**0.44**	**0.44**	**0.45**	**0.43**	**-19.59**
A. Fuel Combustion (Sectoral Approach)	0.53	0.52	0.47	0.41	0.39	0.40	0.41	0.41	0.39	0.37	0.36	0.39	0.40	0.43	0.44	0.44	0.44	0.45	0.43	-19.59
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	0.03	0.02	-45.75
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	0.03	0.03	17.21
3. Transport	0.29	0.28	0.24	0.18	0.17	0.17	0.17	0.18	0.17	0.16	0.17	0.19	0.20	0.22	0.23	0.23	0.22	0.23	0.21	-27.55
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	0.16	0.16	-3.79
5. Other	NO	NO	NO	NO	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	0.00	100.00
B. Fugitive Emissions from Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
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	0.01	0.01	100.00
4. Agriculture	**11.44**	**10.59**	**8.05**	**5.61**	**4.87**	**3.66**	**3.67**	**3.69**	**3.52**	**3.21**	**3.28**	**3.62**	**3.54**	**3.77**	**3.72**	**4.05**	**4.17**	**4.36**	**4.30**	**-62.42**
B. Manure Management	1.78	1.71	1.37	0.85	0.73	0.72	0.67	0.63	0.58	0.51	0.50	0.53	0.54	0.52	0.51	0.51	0.51	0.53	0.50	-71.92
D. Agricultural Soils	9.66	8.88	6.68	4.76	4.14	2.94	3.00	3.06	2.94	2.69	2.78	3.09	3.01	3.25	3.22	3.53	3.66	3.83	3.80	-60.67
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.49**	**0.49**	**0.50**	**0.49**	**0.50**	**0.50**	**0.50**	**0.50**	**0.51**	**0.51**	**0.51**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.51**	**0.50**	**0.47**	**-3.76**
A. Forest Land	0.49	0.49	0.50	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.47	-3.82
B. Cropland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
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	0.00	0.00	0.00	100.00
D. Wetlands	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	0.00	0.00	0.00
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
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	NA,NE	NA,NE	0.00
6. Waste	**0.26**	**0.26**	**0.25**	**0.25**	**0.24**	**0.24**	**0.23**	**0.23**	**0.23**	**0.23**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**-16.30**
B. Waste-water Handling	0.26	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	-17.39
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	NE,NO	NE,NO	0.00
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00	0.00	0.00	0.00	0.00	0.00	100.00
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**	**NO**	**NO**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
	(Gg)																			%
Total N2O emissions including N2O from LULUCF	**12.72**	**11.87**	**9.27**	**6.77**	**6.00**	**4.81**	**4.83**	**4.85**	**4.65**	**4.32**	**4.39**	**4.76**	**4.69**	**4.94**	**4.91**	**5.22**	**5.37**	**5.53**	**5.43**	**-57.31**
Total N2O emissions excluding N2O from LULUCF	**12.23**	**11.37**	**8.77**	**6.27**	**5.50**	**4.31**	**4.33**	**4.35**	**4.15**	**3.82**	**3.88**	**4.26**	**4.18**	**4.44**	**4.41**	**4.72**	**4.86**	**5.03**	**4.95**	**-59.47**
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**	**0.09**	**0.08**	**-56.65**
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	0.01	0.01	0.01	0.01	61.05
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	0.09	0.07	-60.67
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

HFCs and SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Change from base to latest reported year
Emissions of HFCs(3) - (Gg CO2 equivalent)	**0.65**	**0.88**	**1.24**	**2.38**	**3.14**	**4.83**	**7.60**	**10.08**	**12.97**	**18.19**	**27.09**	**48.62**	**67.26**	**80.10**	**100.00**
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA,NE,NO	NA,NE,NO	NA,NE,NO	IE,NA,NE,NO	0.00	100.00
HFC-32	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.00	0.00	0.00	0.00	0.00	100.00
HFC-41	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	0.00
HFC-43-10mee	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	0.00
HFC-125	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.00	0.00	0.00	0.00	0.00	100.00
HFC-134	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	0.00
HFC-134a	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.05	0.05	100.00
HFC-152a	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	0.00	0.00	0.00	100.00
HFC-143	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	0.00
HFC-143a	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.00	0.00	0.00	0.00	0.00	100.00
HFC-227ea	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-236fa	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	0.00
HFC-245ca	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	0.00
Unspecified mix of listed HFCs(4) - (Gg CO2 equivalent)	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	0.00
Emissions of PFCs(3) - (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**	**NA,NO**	**NA,NO**	**0.00**
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
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	NA,NO	NA,NO	0.00
Emissions of SF6(3) - (Gg CO2 equivalent)	**0.25**	**0.29**	**0.51**	**0.71**	**0.98**	**1.28**	**1.98**	**3.38**	**4.41**	**5.37**	**7.53**	**7.12**	**8.60**	**10.08**	**100.00**
SF6	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	100.00

A.6.3: Supplementary information under Article 7.1

Legal entities authorised to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol

Legal entity authorised to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol	Role
A/S "Olaines udens un siltums"	Latvia's ETS operator (obligatory participation)
Ventspils pilsetas pašvaldibas SIA "Ventspils siltums"	Latvia's ETS operator (obligatory participation)
Ventspils pilsetas pašvaldibas SIA "Parventas siltums"	Latvia's ETS operator (obligatory participation)
A/S "Jelgavas cukurfabrika"	Latvia's ETS operator (obligatory participation)
AS "Latvenergo" TEC-1	Latvia's ETS operator (obligatory participation)
AS "Latvenergo" TEC-2	Latvia's ETS operator (obligatory participation)
SIA "Fortum Jelgava"	Latvia's ETS operator (obligatory participation)
SIA "Fortum Jelgava"	Latvia's ETS operator (obligatory participation)
SIA "Livanu siltums"	Latvia's ETS operator (obligatory participation)
SIA "Aizkraukles siltums"	Latvia's ETS operator (obligatory participation)
A/S "Rigas siltums" katlu maja Gobas iela 33a	Latvia's ETS operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale "Daugavgriva"	Latvia's ETS operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale "Vecmilgravis"	Latvia's ETS operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale "Ziepniekkalns"	Latvia's ETS operator (obligatory participation)
A/S "Rigas siltums" iecirknis "Zasulauks"	Latvia's ETS operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale "Imanta"	Latvia's ETS operator (obligatory participation)
SIA "Dobeles energija"	Latvia's ETS operator (obligatory participation)
Ogres novada PA "Malkalne"	Latvia's ETS operator (obligatory participation)
SIA "Wesemann "“Sigulda"	Latvia's ETS operator (obligatory participation)
SIA "Jurmalas siltums" Dubulti	Latvia's ETS operator (obligatory participation)
SIA "Jurmalas siltums" Kauguri	Latvia's ETS operator (obligatory participation)
A/S "Cesvaines piens"	Latvia's ETS operator (obligatory participation)
SIA "Rigas laku un krasu rupnica"	Latvia's ETS operator (obligatory participation)
A/s "Putnu fabrika Kekava""	Latvia's ETS operator (obligatory participation)
A/S "Rigas kugu buvetava"	Latvia's ETS operator (obligatory participation)
A/S "BLB Baltijas Terminals"	Latvia's ETS operator (obligatory participation)
SIA "Kraslavas nami"	Latvia's ETS operator (obligatory participation)
SIA "Cesu siltumtikli"	Latvia's ETS operator (obligatory participation)
SIA "Tukuma siltums"	Latvia's ETS operator (obligatory participation)
PAS "Daugavpils siltumtikli" SC3	Latvia's ETS operator (obligatory participation)
PAS "Daugavpils siltumtikli" SC1	Latvia's ETS operator (obligatory participation)
PAS "Daugavpils siltumtikli" SC2	Latvia's ETS operator (obligatory participation)
A/S "Ligija teks"	Latvia's ETS operator (obligatory participation)
SIA "Jekabpils siltums"	Latvia's ETS operator (obligatory participation)
SIA "Latgales Energija"	Latvia's ETS operator (obligatory participation)
SIA "Latgales Energija"	Latvia's ETS operator (obligatory participation)
A/S "Valmieras piens"	Latvia's ETS operator (obligatory participation)
SIA "Lauma Fabrics"	Latvia's ETS operator (obligatory participation)
SIA "Liepajas energija"	Latvia's ETS operator (obligatory participation)
SIA "Liepajas energija"	Latvia's ETS operator (obligatory participation)
A/S "Preilu siers"	Latvia's ETS operator (obligatory participation)
SIA "KP Tehnologijas"	Latvia's ETS operator (obligatory participation)
SIA "Salaspils siltums"	Latvia's ETS operator (obligatory participation)
A/S "Latvijas finieris" rupnica "Furniers"	Latvia's ETS operator (obligatory participation)
A/S "Latvijas Finieris" rupnica "Lignums"	Latvia's ETS operator (obligatory participation)
SIA "Sabiedriba Marupe"	Latvia's ETS operator (obligatory participation)
A/S "Balticovo"	Latvia's ETS operator (obligatory participation)

Legal entity authorised to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol	Role
A/S "Ventbunkers"	Latvia's ETS operator (obligatory participation)
SIA "Papirfabrika Ligatne"	Latvia's ETS operator (obligatory participation)
SIA "Saulkalne S"	Latvia's ETS operator (obligatory participation)
SIA "Brocenu keramika"	Latvia's ETS operator (obligatory participation)
A/S "Valmieras stikla šķiedra"	Latvia's ETS operator (obligatory participation)
SIA "Kalnciema kiegelis Kalnciema ražotne"	Latvia's ETS operator (obligatory participation)
SIA "Lodes kiegelis"	Latvia's ETS operator (obligatory participation)
SIA "CEMEX"	Latvia's ETS operator (obligatory participation)
A/S "Liepajas metalurgs"	Latvia's ETS operator (obligatory participation)
SIA "Livanu kiegelis"	Latvia's ETS operator (obligatory participation)
MSIA "AKD Logistik"	Latvia's ETS operator (obligatory participation)
SIA "Ceplis"	Latvia's ETS operator (obligatory participation)
SIA "Kalnciema kiegelis Anes ražotne"	Latvia's ETS operator (obligatory participation)
SIA "Jurmalas siltums" Pliekšana 80	Latvia's ETS operator (obligatory participation)
SIA "Jurmalas siltums" Aizputes 1d	Latvia's ETS operator (obligatory participation)
SIA "Latgales Energija"	Latvia's ETS operator (obligatory participation)
SIA "Ludzas Bio-Energija"	Latvia's ETS operator (obligatory participation)
SIA "Latelektro Gulbene"	Latvia's ETS operator (obligatory participation)
SIA "Olaines kimiska rupnica "BIOLARS""	Latvia's ETS operator (obligatory participation)
SIA "Livberzes Energija"	Latvia's ETS operator (obligatory participation)
A/S "Grizinkalns"	Latvia's ETS operator (obligatory participation)
SIA "Bolderaja Ltd"	Latvia's ETS operator (obligatory participation)
SIA "Talsu BIO-energija"	Latvia's ETS operator (obligatory participation)
SIA "Port Milgravis"	Latvia's ETS operator (obligatory participation)
SIA "Juglas jauda"	Latvia's ETS operator (obligatory participation)
SIA "JELD-WEN Latvija"	Latvia's ETS operator (obligatory participation)
A/S "Valmieras Energija" Rigas iela 25	Latvia's ETS operator (obligatory participation)
A/S "Valmieras Energija" Dzelzcela iela 7	Latvia's ETS operator (obligatory participation)
A/S "Latvijas Gaze"	Latvia's ETS operator (obligatory participation)
SIA "Buvmateriali AN"	Latvia's ETS operator (obligatory participation)
SIA "Fortum Jelgava"	Latvia's ETS operator (obligatory participation)
SIA "Jaunpagasts Plus" Iecavas spirta rupnica	Latvia's ETS operator (obligatory participation)
SIA "Rigens"	Latvia's ETS operator (obligatory participation)
SIA "Tennere"	Latvia's ETS operator (obligatory participation)
SIA "Jaunpagasts Plus" Jaunpagasta spirta rupnica	Latvia's ETS operator (obligatory participation)
A/S "Rezeknes Siltumtikli" Atbrivošanas aleja 155a	Latvia's ETS operator (obligatory participation)
A/S "Rezeknes Siltumtikli" N.Rancana iela 5	Latvia's ETS operator (obligatory participation)
A/S "Rezeknes Siltumtikli" Meža iela 1	Latvia's ETS operator (obligatory participation)
SIA "Gamma - A"	Latvia's ETS operator (obligatory participation)
SIA "CEMEX"	Latvia's ETS operator (obligatory participation)

Annex 7: Tables 6.1 and 6.2 of the IPCC Good Practice Guidance

Table 1 The uncertainties in total (with LULUCF)

IPCC Source Categories (LULUCF is included)	Direct Greenhouse Gas	Base Year (1990) Estimate	Current Year (2008) 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	Emission Factor quality indicator	Activity data quality indicator
		Gg CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%		
CO2 Emissions from Stationary Combustion-oil	CO2	7421.27	834.44	2%	10%	10%	-1%	203%	10%	20%	0%	20%	D	D
CO2 Emissions from Stationary Combustion-coal	CO2	2651.11	406.34	2%	15%	15%	0%	74%	5%	11%	0%	11%	D	D
CO2 Emissions from Stationary Combustion-gas	CO2	5681.39	3215.92	2%	5%	5%	-1%	187%	40%	9%	1%	9%	D	D
Non-CO2 Emissions from Stationary Combustion-oil	CH4	13.27	2.43	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-coal	CH4	59.64	6.31	2%	50%	50%	0%	2%	0%	1%	0%	1%	D	D
Non-CO2 Emissions from Stationary Combustion-gas	CH4	6.24	3.08	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-biomass	CH4	167.29	242.27	15%	50%	52%	-1%	7%	3%	4%	1%	4%	D	D
Non-CO2 Emissions from Stationary Combustion-oil	N2O	19.50	2.29	2%	50%	50%	0%	1%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-coal	N2O	16.48	1.96	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-gas	N2O	3.05	1.72	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-biomass	N2O	34.10	59.85	15%	50%	52%	0%	2%	1%	1%	0%	1%	D	D
Mobile Combustion: Road Vehicles	CO2	2351.55	3 268.75	5%	5%	7%	-1%	102%	41%	5%	3%	6%	D	D
Mobile Combustion: Road Vehicles	CH4	20.62	6.70	5%	40%	40%	0%	1%	0%	0%	0%	0%	D	D
Mobile Combustion: Road Vehicles	N2O	26.36	35.58	5%	50%	50%	0%	1%	0%	1%	0%	1%	D	D
Mobile Combustion: Waterborne Navigation	CO2	1.01	5.47	50%	5%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Waterborne Navigation	CH4	0.00	0.01	50%	10%	51%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Waterborne Navigation	N2O	0.10	0.65	50%	10%	51%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Aircraft	CO2	0.07	3.15	20%	5%	21%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Aircraft	CH4	0.00	0.00	20%	10%	22%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Aircraft	N2O	0.00	0.04	20%	10%	22%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Railways	CO2	525.35	242.47	2%	5%	5%	0%	17%	3%	1%	0%	1%	D	D

IPCC Source Categories (LULUCF is included)	Direct Greenhouse Gas	Base Year (1990) Estimate	Current Year (2008) 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	Emission Factor quality indicator	Activity data quality indicator
		Gg CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%		
Mobile Combustion: Railways	CH4	0.64	0.29	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Railways	N2O	64.96	29.98	2%	10%	10%	0%	2%	0%	0%	0%	0%	D	D
Manufacturing Industries and Construction (Other fuels)	CO2	0.00	17.85	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D
Manufacturing Industries and Construction (Other fuels)	CH4	0.00	0.13	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile combustion (Other 1A5b)	CO2	0	3.39	2%	5%	5%	0%	0%	0%	0%	0%	0%	D	D
Mobile combustion (Other 1A5b)	CH4	0	0.00	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile combustion (Other 1A5b)	N2O	0	0.02	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Manufacturing Industries and Construction (Other fuels)	N2O	0	0.26	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Fugitive Emissions from Oil and Gas Operations	CH4	274.05	111.34	5%	5%	7%	0%	9%	1%	0%	0%	0%	D	D
Emissions from Cement Production	CO2	366.12	168.69	10%	2%	10%	0%	12%	2%	0%	0%	0%	D	D
Emissions from Lime Production	CO2	0.00	11.65	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Limestone and Dolomite use	CO2	118.97	20.76	2%	30%	30%	0%	3%	0%	1%	0%	1%	D	D
Emissions from Asphalt Roofing	CO2	0.01	0.02	70%	70%	99%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Road Paving with Asphalt	CO2	9.60	21.18	70%	70%	99%	0%	1%	0%	0%	0%	0%	D	D
Emissions from other mineral products	CO2	69.18	22.70	10%	60%	61%	0%	2%	0%	1%	0%	1%	D	D
Emissions from the Iron and Steel Industry	CO2	12.83	8.67	25%	5%	25%	0%	0%	0%	0%	0%	0%	D	D
Emissions from the Iron and Steel Industry	CH4	0.06	0.06	25%	10%	27%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Solvent and other product use	CO2	55.70	49.06	25%	50%	56%	0%	2%	1%	1%	0%	1%	D	D
Solvent and Other Product Use	N2O	0.00	4.34	2%	2%	3%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Electrical equipment	SF6	0.00	10.08	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Consumption of HFCs	HFC	0.00	80.10	75%	75%	106%	-1%	1%	1%	1%	1%	1%	D	D
Emissions from Enteric fermentation in Domestic Livestocks	CH4	2147.55	672.65	2%	20%	20%	-1%	64%	8%	13%	0%	13%	D	D
Emissions from Manure Management	CH4	279.52	79.58	2%	30%	30%	0%	8%	1%	2%	0%	2%	D	D
Emissions from Manure Management	N2O	551.63	154.92	40%	30%	50%	0%	16%	2%	5%	1%	5%	D	D
Emissions from Agricultural Soils	direct	1601.56	739.71	40%	25%	47%	-2%	51%	9%	13%	5%	14%	D	D

IPCC Source Categories (LULUCF is included)	Direct Greenhouse Gas	Base Year (1990) Estimate	Current Year (2008) 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	Emission Factor quality indicator	Activity data quality indicator
		Gg CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%		
	N2O													
Emissions from Nitrogen Used in Agriculture	Indirect N2O	1033.87	336.82	30%	40%	50%	-1%	31%	4%	12%	2%	13%	D	D
Pasture, Range and Paddock Manure	N2O	358.39	101.06	40%	25%	47%	0%	11%	1%	3%	1%	3%	D	D
Forest Land remaining Forest Land	CO2	-19377.24	-29386.55	1%	30%	30%	52%	-894%	-365%	-268%	-4%	268%	D	D
Emissions from Forest Land	N2O	151.36	145.59	10%	70%	71%	-1%	6%	2%	4%	0%	4%	D	D
Emissions from Cropland	CO2	440.07	304.70	30%	90%	95%	-2%	15%	4%	14%	2%	14%	D	D
Emissions from Grassland	CO2	10.07	8.68	30%	90%	95%	0%	0%	0%	0%	0%	0%	D	D
Grassland remaining Grassland	CH4	0.00	0.06	30%	90%	95%	0%	0%	0%	0%	0%	0%	D	D
Grassland remaining Grassland	N2O	0.00	0.03	30%	90%	95%	0%	0%	0%	0%	0%	0%	D	D
Wetlands remaining Wetlands	CO2	19.80	19.80	56%	30%	63%	0%	1%	0%	0%	0%	0%	D	D
Wetlands remaining Wetlands	N2O	1.32	1.32	30%	90%	95%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Forest Land	CH4	19.28	28.00	10%	70%	71%	0%	1%	0%	1%	0%	1%	D	D
Emissions from Solid Waste Disposal Sites	CH4	393.10	607.20	20%	52%	56%	-2%	18%	8%	9%	2%	10%	D	D
Emissions from Domestic Wastewater Handling	CH4	63.28	77.74	10%	30%	32%	0%	3%	1%	1%	0%	1%	D	D
Emissions from Industrial Wastewater Handling	CH4	307.12	163.83	2%	30%	30%	0%	10%	2%	3%	0%	3%	D	D
Emissions from Wastewater Handling	N2O	79.85	65.97	2%	10%	10%	0%	3%	1%	0%	0%	0%	D	D
Emissions from Waste Incineration	CO2	0.00	0.50	20%	50%	54%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Compost production	CH4	0.00	0.78	20%	100%	102%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Compost production	N2O	0.00	0.86	20%	90%	92%	0%	0%	0%	0%	0%	0%	D	D
							0%	11%	1%	0%	0%	0%		
Total uncertainties	Overall uncertainty 2008 year (%):			52.1%	Trend uncertainty (%):			271.10%						

Table 2 The uncertainties in total (without LULUCF)

IPCC Source Categories (LUCF not included)	Direct Greenhouse Gas	Base Year (1990) Estimate	Current Year (2009) 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	Emission Factor quality indicator	Activity data quality indicator
		Gg CO2-eq	Gg CO2-eq	%	%	%	%	%	%	%	%	%		
CO2 Emissions from Stationary Combustion-oil	CO2	7421.27	834.44	2%	10%	10%	1%	-9%	3%	-1%	0%	1%		
CO2 Emissions from Stationary Combustion-coal	CO2	2651.11	406.34	2%	15%	15%	1%	-3%	2%	0%	0%	0%	D	D
CO2 Emissions from Stationary Combustion-gas	CO2	5681.39	3215.92	2%	5%	5%	1%	3%	12%	0%	0%	0%	D	D
Manufacturing Industries and Construction (Other fuels)	CO2	0.00	17.85	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D
Mobile combustion (Other 1A5b)	CO2	0.00	3.39	2%	5%	5%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-oil	CH4	13.27	2.43	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-coal	CH4	59.64	6.31	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-gas	CH4	6.24	3.08	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-biomass	CH4	167.29	242.27	15%	50%	52%	1%	1%	1%	0%	0%	0%	D	D
Manufacturing Industries and Construction (Other fuels)	CH4	0.00	0.13	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile combustion (Other 1A5b)	CH4	0.00	0.00	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-oil	N2O	19.50	2.29	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-coal	N2O	16.48	1.96	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-gas	N2O	3.05	1.72	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Non-CO2 Emissions from Stationary Combustion-biomass	N2O	34.10	59.85	15%	50%	52%	0%	0%	0%	0%	0%	0%	D	D
Manufacturing Industries and Construction (Other fuels)	N2O	0.00	0.26	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile combustion (Other 1A5b)	N2O	0.00	0.02	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D

IPCC Source Categories (LUCF not included)	Direct Greenhouse Gas	Base Year (1990) Estimate	Current Year (2009) 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	Emission Factor quality indicator	Activity data quality indicator
Mobile Combustion: Road Vehicles	CO2	2351.55	3268.75	5%	5%	7%	2%	8%	12%	0%	1%	1%	D	D
Mobile Combustion: Road Vehicles	CH4	20.62	6.70	5%	40%	40%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Road Vehicles	N2O	26.36	35.58	5%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Waterborne Navigation	CO2	1.01	5.47	50%	5%	50%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Waterborne Navigation	CH4	0.00	0.01	50%	10%	51%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Waterborne Navigation	N2O	0.10	0.65	50%	10%	51%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Aircraft	CO2	0.07	3.15	20%	5%	21%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Aircraft	CH4	0.00	0.00	20%	10%	22%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Aircraft	N2O	0.00	0.04	20%	10%	22%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Railways	CO2	525.35	242.47	2%	5%	5%	0%	0%	1%	0%	0%	0%	D	D
Mobile Combustion: Railways	CH4	0.64	0.29	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D
Mobile Combustion: Railways	N2O	64.96	29.98	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D
Fugitive Emissions from Oil and Gas Operations	CH4	274.05	111.34	5%	5%	7%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Cement Production	CO2	366.12	168.69	10%	5%	11%	0%	0%	1%	0%	0%	0%	D	D
Emissions from Lime Production	CO2	0.00	11.65	2%	50%	50%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Limestone and Dolomite use	CO2	118.97	20.76	2%	30%	30%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Asphalt Roofing	CO2	0.01	0.02	70%	70%	99%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Road Paving with Asphalt	CO2	9.60	21.18	70%	70%	99%	0%	0%	0%	0%	0%	0%	D	D
Emissions from other mineral products	CO2	69.18	22.70	10%	60%	61%	0%	0%	0%	0%	0%	0%	D	D
Emissions from the Iron and Steel Industry	CO2	12.83	8.67	25%	5%	25%	0%	0%	0%	0%	0%	0%	D	D
Emissions from the Iron and Steel Industry	CH4	0.06	0.06	25%	10%	27%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Solvent and other product use	CO2	55.70	49.06	25%	50%	56%	0%	0%	0%	0%	0%	0%	D	D
Solvent and Other Product Use	N2O	0.00	4.34	2%	2%	3%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Electrical equipment	SF6	0.00	10.08	2%	10%	10%	0%	0%	0%	0%	0%	0%	D	D

IPCC Source Categories (LUCF not included)	Direct Greenhouse Gas	Base Year (1990) Estimate	Current Year (2009) 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	Emission Factor quality indicator	Activity data quality indicator
Emissions from Consumption of HFCs	HFC	0.00	80.10	75%	75%	106%	1%	0%	0%	0%	0%	0%	D	D
Emissions from Enteric fermentation in Domestic Livestocks	CH4	2147.55	672.65	2%	20%	20%	1%	-1%	3%	0%	0%	0%	D	D
Emissions from Manure Management	CH4	279.52	79.58	2%	30%	30%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Manure Management	N2O	551.63	154.92	40%	30%	50%	1%	0%	1%	0%	0%	0%	D	D
Emissions from Agricultural Soils	Direct N2O	1601.56	739.71	40%	25%	47%	3%	0%	3%	0%	2%	2%	D	D
Emissions from Nitrogen Used in Agriculture	Indirect N2O	1033.87	336.82	30%	40%	50%	1%	0%	1%	0%	1%	1%	D	D
Pasture, Range and Paddock Manure	N2O	358.39	101.06	40%	25%	47%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Solid Waste Disposal Sites	CH4	393.10	607.20	20%	52%	56%	3%	2%	2%	1%	1%	1%	D	D
Emissions from Domestic Wastewater Handling	CH4	63.28	77.74	10%	30%	32%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Industrial Wastewater Handling	CH4	307.12	163.83	2%	30%	30%	0%	0%	1%	0%	0%	0%	D	D
Emissions from Wastewater Handling	N2O	79.85	65.97	10%	30%	32%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Waste Incineration	CO2	0.00	0.50	20%	50%	54%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Compost production	CH4	0.00	0.78	20%	100%	102%	0%	0%	0%	0%	0%	0%	D	D
Emissions from Compost production	N2O	0.00	0.86	20%	90%	92%	0%	0%	0%	0%	0%	0%	D	D
Total uncertainties	Overall uncertainty 2008 year (%):			5.4%		Trend uncertainty (%):		2.55%						