LATVIA'S
NATIONAL INVENTORY REPORT

Submission under UNFCCC and the Kyoto Protocol

Common Reporting Formats (CRF)
1990 – 2012

RIGA, 2014

PREFACE

Latvia's National Inventory Report (NIR) under the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 repealing Decision No 280/2004/EC contains following parts:

1. Latvia's National Inventory Report 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 1990-2012 including KP-LULUCF data tables. The CRF tables are compiled with the UNFCCC CRF Reporter software (version 3.6.2.).
3. SEF (Standard Electronic Tables) for reporting of Kyoto units (AAU, ERU, CER, t-CER. l-CER, RMU) in the registry 31.12.2013. and transfers of the units during the year 2013.

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The Latvia's inventory report as well as the CRF tables can be downloaded from addresses: http://www.varam.gov.lv.
http://www.meteo.lv/

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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
CLRTAP - Convention on Long-range Transboundary Air Pollution
CRF – Common Reporting Format
CSB – Central Statistical Bureau of Latvia
DES - Data Exchange Standard
EMEP/CORINAIR 2007 – 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/EEA - air pollutant emission inventory guidebook 2009
ETR – Emission trading registry
GHG – Greenhouse Gases
GDP – Grand domestic product
ICR – In-country review
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
IPE – Institute of Physical Energetic
LEGMC – Latvian Environment, Geology and Meteorology Centre
LSIAE – Latvian State Institute of Agrarian Economics
LULUCF – Land Use, Land Use Change and Forestry
MoA - Ministry of Agriculture
MEPRD - Ministry of Environmental Protection and Regional Development
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
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

ES.1.1 Background information on climate change

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.

The data compiled in this report shows that Latvia has reached the target of 8% emission reduction over the period from 2008-2012 for the first commitment period under the Kyoto Protocol. For the second commitment period of Kyoto Protocol until 2020 Latvia has committed together with other EU member states to achieve the joint target of emission reduction by 20% comparing to year 1990.

ES.1.2 Background information on greenhouse gas inventories

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 the Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC require to annualy report information regarding their anthropogenic GHG emissions.

Single national entity with overall responsibility for the Latvia's GHG inventory is the Ministry of Environmental Protection and Regional Development. The preparation of GHG inventory is collaborative work of different involved institutions.

This report contains the most 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 1990-2012.

The GHG inventory is prepared according to the UNFCCC reporting guidelines on annual inventories (UNFCCC 2006). For the preparation of the 2014 submission CRF Reporter v.3.6.2 software has been used. Greenhouse gas inventory is compiled according to the methodologies recommended by the IPCC.

ES.1.3 Background information on supplementary information required under article 7, paragraph 1 of the Kyoto Protocol

This report also includes supplementary information in accordance with Article 7, paragraph 1, of the Kyoto Protocol. The required information is specified in the Annex of Decision 15/CMP.1 and includes information on changes in the national system and national registry, information related to Article 3, paragraphs 3 and 4, and Article 3, paragraph 14. The summary of information on the accounting of Kyoto units is provided in Chapter 12.

ES.2 SUMMARY OF NATIONAL EMISSION AND REMOVAL RELATED TRENDS

ES.2.1 GHG inventory

In 2012, Latvia's greenhouse gas emissions totalled 10 978.48 Gg CO_2 eq. excluding LULUCF.

Latvia’s total GHG emissions without LULUCF in 2012 showed a decrease of 58% comparing to the base year.

The GHG emissions have considerably decreased during the time period from 1990–2000 by 61.9 % when the national economy of Latvia transformed from central planning economy to a market economy which affected all sectors of the national economy. From 2001 to 2007 the total GHG emissions have been fluctuating from 10 625.78 Gg CO2 eq (2001) to 11 978.93 Gg CO2 eq in 2007 which is equal to increment of total emissions by 11.3%. From 2007-2009 emissions have fallen by about 9.4%, but from 2009-2012 total emissions are fluctuating within 10 %.

Net aggregated emissions in LULUCF sector considerably increased since 1990 due to growth of economic activity in forest sector and due to conversion of forest lands to settlements and croplands. In spite increment of living biomass in forest land remaining forest and afforested lands is still bigger than natural mortality and commercial felling. The difference is decreasing causing reduction of net removals of CO_2 in forest lands in spite total growing stock of living biomass is constantly increasing in forest lands due to growing increment in ageing stands.

The major source of GHG in 2012, excluding LULUCF, was CO_2 (7 433.73 CO_2 eq (Gg)), accounting for 67.7% of the total emissions, accordingly CH_4 constituted 14.9%, N_2O – 16.5%, and fluorinated gases – 0.9% of total emissions. Energy sector caused 65.8% of total GHG emissions, agriculture – 22.0%, industrial processes – 6.3%, waste management – 5.5%, use of solvents and other products – 0.4%.

Under the Kyoto Protocol Latvia was obliged to reduce the GHG emissions from its territory by 8% as to compared with the base year level. 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. Results of GHG inventory shows that Latvia reach determined limit (Figure ES.1).

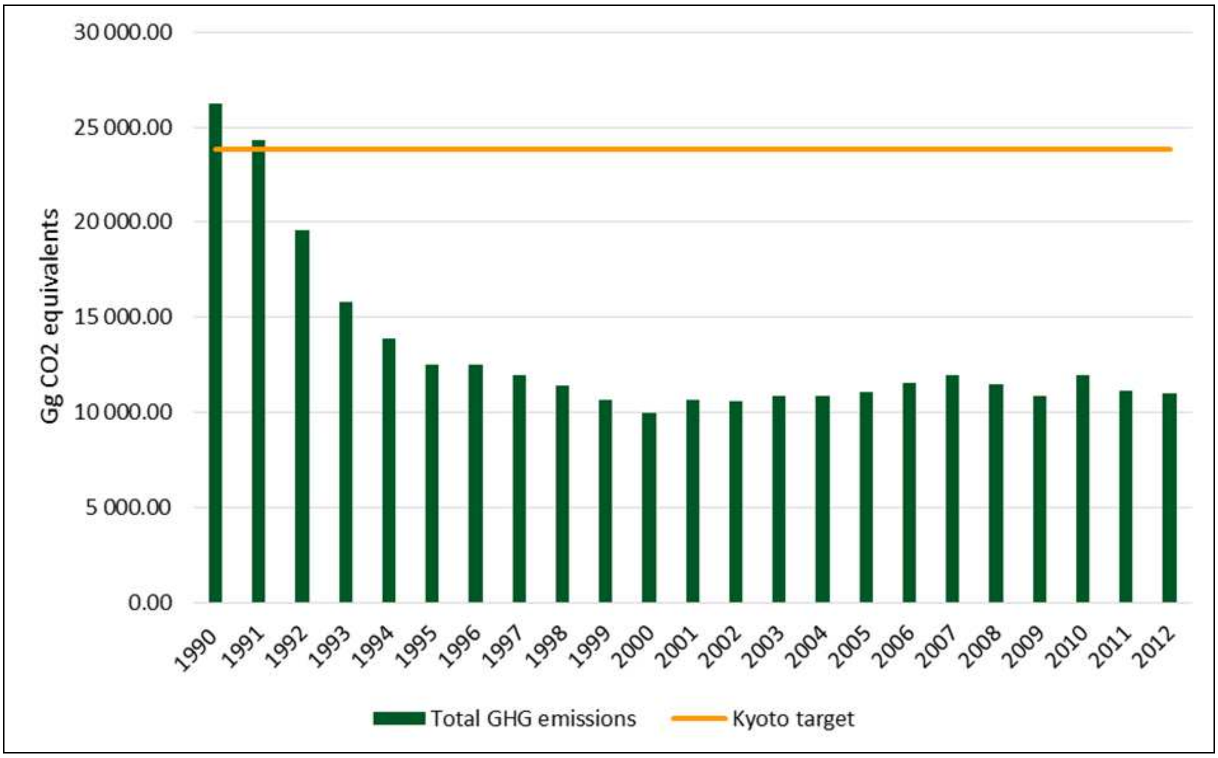


Figure ES.1. GHG emission time series for 1990–2012 and the target of the Kyoto Protocol (Gg CO_2 eq.)

Table ES.1 a Aggregated GHG emissions by gases (1990 - 2001), Gg CO_2 eq

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	CO_2 eq (Gg)											
CO_2 emissions including net CO_2 from LULUCF	-1 012.11	-3 674.03	-5 838.62	-7 907.72	-10 571.44	-9 811.68	-10 332.77	-8 051.22	-6 928.48	-7 216.08	-7 452.84	-6 938.09
CO_2 emissions excluding net CO_2 from LULUCF	19 052.32	17 478.42	14 003.22	11 737.21	10 227.59	9 035.36	9 123.75	8 595.22	8 210.89	7 611.22	6 968.13	7 394.85
CH_4 emissions including CH_4 from LULUCF	3 384.98	3 297.96	3 049.97	2 160.84	1 979.09	1 980.76	1 935.43	1 906.89	1 824.94	1 747.81	1 724.47	1 752.09
CH_4 emissions excluding CH_4 from LULUCF	3 344.39	3 266.12	2 806.40	2 113.13	1 939.47	1 919.08	1 863.41	1 833.59	1 750.60	1 629.97	1 609.02	1 696.67
N_2O emissions including N_2O from LULUCF	3 973.36	3 716.78	2 966.97	2 146.40	1 909.96	1 740.87	1 727.36	1 730.02	1 674.76	1 603.31	1 625.17	1 733.95
N_2O emissions excluding N_2O from LULUCF	3 816.20	3 554.14	2 759.18	1 967.67	1 726.43	1 547.25	1 529.01	1 529.76	1 472.03	1 390.25	1 410.04	1 524.70
HFCs	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	0.64	0.83	1.92	2.86	3.27	5.11	7.58
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
SF_6	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
Total (including LULUCF)	**6 346.23**	**3 340.70**	**178.32**	**-3 600.48**	**-6 682.39**	**-6 089.17**	**-6 668.85**	**-4 411.88**	**-3 425.21**	**-3 860.71**	**-4 096.81**	**-3 442.49**
Total (excluding LULUCF)	**26 212.92**	**24 298.68**	**19 568.81**	**15 818.01**	**13 893.49**	**12 502.58**	**12 517.29**	**11 961.00**	**11 437.09**	**10 635.69**	**9 993.58**	**10 625.78**

Table ES.1 b Aggregated GHG emissions by gases (2002 - 2012), Gg CO_2 eq

GREENHOUSE GAS EMISSIONS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from 1990 to latest reported year
	CO_2 eq (Gg)											(%)
CO_2 emissions including net CO_2 from LULUCF	-4 596.89	-5 707.14	-5 614.07	-5 920.11	-7 377.07	-6 489.71	-8 494.20	-7 244.92	-2 915.38	-4 339.21	-5 124.87	406.36
CO_2 emissions excluding net CO_2 from LULUCF	7 411.34	7 622.70	7 655.43	7 744.86	8 226.36	8 542.69	8 106.29	7 418.27	8 500.38	7 750.86	7 433.73	-60.98
CH_4 emissions including CH_4 from LULUCF	1 809.27	1 705.90	1 685.40	1 711.85	1 758.91	1 711.91	1 705.11	1 720.81	1 714.43	1 603.34	1 668.21	-50.72
CH_4 emissions excluding CH_4 from LULUCF	1 688.68	1 637.19	1 622.89	1 659.62	1 617.46	1 662.47	1 658.17	1 659.27	1 654.84	1 566.62	1 631.10	-51.23
N_2O emissions including N_2O from LULUCF	1 714.77	1 792.92	1 768.08	1 833.94	1 847.33	1 889.56	1 873.89	1 912.89	1 974.00	1 957.75	2 037.26	-48.73
N_2O emissions excluding N_2O from LULUCF	1 491.30	1 576.06	1 550.32	1 615.97	1 608.84	1 666.62	1 648.77	1 684.11	1 747.77	1 734.94	1 816.31	-52.41
HFCs	9.85	15.70	18.06	28.36	62.57	98.56	72.83	74.35	72.18	75.01	83.65	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	0.00
SF_6	3.38	4.41	5.37	7.53	7.12	8.60	10.08	13.53	12.25	12.45	13.69	100.00
Total (including LULUCF)	**-1 059.62**	**-2 188.21**	**-2 137.16**	**-2 338.42**	**-3 701.14**	**-2 781.08**	**-4 832.29**	**-3 523.34**	**857.49**	**-690.66**	**-1 322.06**	**-120.83**
Total (excluding LULUCF)	**10 604.55**	**10 856.07**	**10 852.07**	**11 056.34**	**11 522.35**	**11 978.93**	**11 496.15**	**10 849.53**	**11 987.43**	**11 139.89**	**10 978.48**	**-58.12**

Table ES.2 a Aggregated GHG emissions by sectors (1990 - 2000), Gg CO_2 eq

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. Energy	19 052.21	17 559.26	14 301.61	12 199.23	10 617.82	9 420.74	9 499.44	8 937.07	8 520.61	7 871.46	7 252.05
2. Industrial processes	597.41	535.60	256.57	81.47	142.02	155.83	168.23	174.70	176.42	210.23	161.54
3. Solvent and other products use	42.91	42.75	42.51	41.59	40.87	40.22	39.72	39.32	38.94	38.59	38.31
4. Agriculture	5 932.54	5 563.21	4 372.12	2 908.88	2 509.55	2 311.52	2 242.73	2 231.70	2 116.25	1 931.11	1 957.11
5. Land use, land use change and forestry	-19 866.69	-20 957.98	-19 390.49	-19 418.49	-20 575.88	-18 591.75	-19 186.14	-16 372.88	-14 862.30	-14 496.40	-14 090.39
6. Waste	587.85	597.86	596.00	586.85	583.23	574.28	567.17	578.20	584.87	584.31	584.58
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total emissions (including LULUCF)	**6 346.23**	**3 340.70**	**178.32**	**-3 600.48**	**-6 682.39**	**-6 089.17**	**-6 668.85**	**-4 411.88**	**-3 425.21**	**-3 860.71**	**-4 096.81**

Table ES.2 b Aggregated GHG emissions by sectors (2001 - 2012), Gg CO_2 eq

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year (%)
1. Energy	7 687.46	7 695.04	7 888.60	7 919.95	8 031.18	8 434.48	8 748.04	8 295.73	7 638.31	8 438.43	7 521.25	7 222.09	-62.09
2. Industrial processes	186.40	200.16	220.90	235.94	237.09	300.93	341.12	306.97	304.17	564.84	657.31	687.51	15.08
3. Solvent and other products use	37.85	37.72	37.12	36.62	36.56	41.48	43.08	43.93	39.42	41.69	45.44	48.51	13.05
4. Agriculture	2 101.43	2 065.56	2 136.88	2 083.59	2 175.88	2 170.06	2 261.47	2 225.32	2 257.11	2 327.37	2 321.21	2 420.30	-59.20
5. LULUCF	-14 068.27	-11 664.17	-13 044.29	-12 989.22	-13 394.76	-15 223.50	-14 760.01	-16 328.44	-14 372.87	-11 129.94	-11 830.54	-12 300.54	-38.08
6. Waste	612.65	606.07	572.57	575.97	575.63	575.41	585.21	624.20	610.52	615.09	594.67	600.07	2.08
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total emissions (including LULUCF)	**-3 442.49**	**-1 059.62**	**-2 188.21**	**-2 137.16**	**-2 338.42**	**-3 701.14**	**-2 781.08**	**-4 832.29**	**-3 523.34**	**857.49**	**-690.66**	**-1 322.06**	**-120.83**

ES.2.2 KP-LULUCF activities

For the LULUCF activities under Article 3 paragraphs 3 and 4, of Kyoto Protocol Latvia has chosen period accounting. Therefore the accounting quantity is 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 Gg CO_2 equivalents.

ES.3 OVERVIEW OF SOURCE AND SINK CATEGORY EMISSION ESTIMATES AND TRENDS

ES.3.1 GHG inventory

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 ES.2.

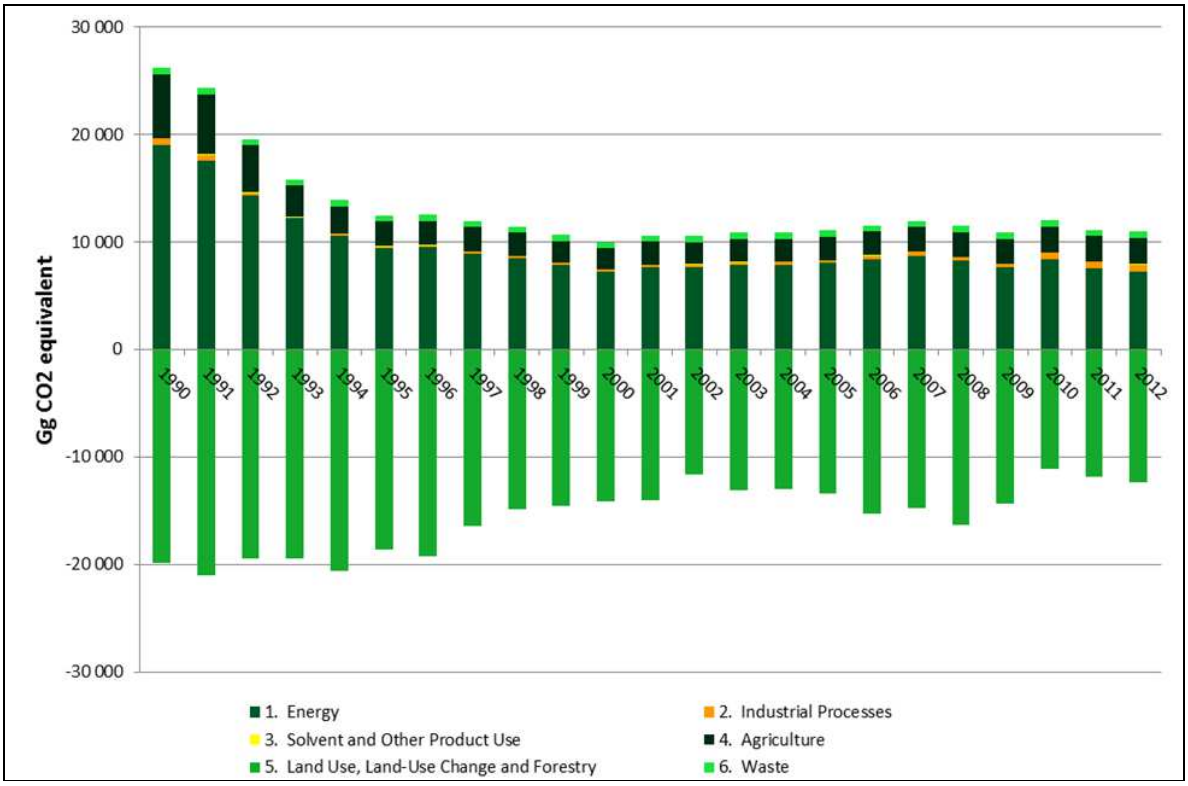


Figure ES.2. Latvian greenhouse gas emission trends by sector, Gg CO_2 eq.

The composition of Latvian greenhouse gas emissions by sector in 2012 is presented in Figure ES.3.

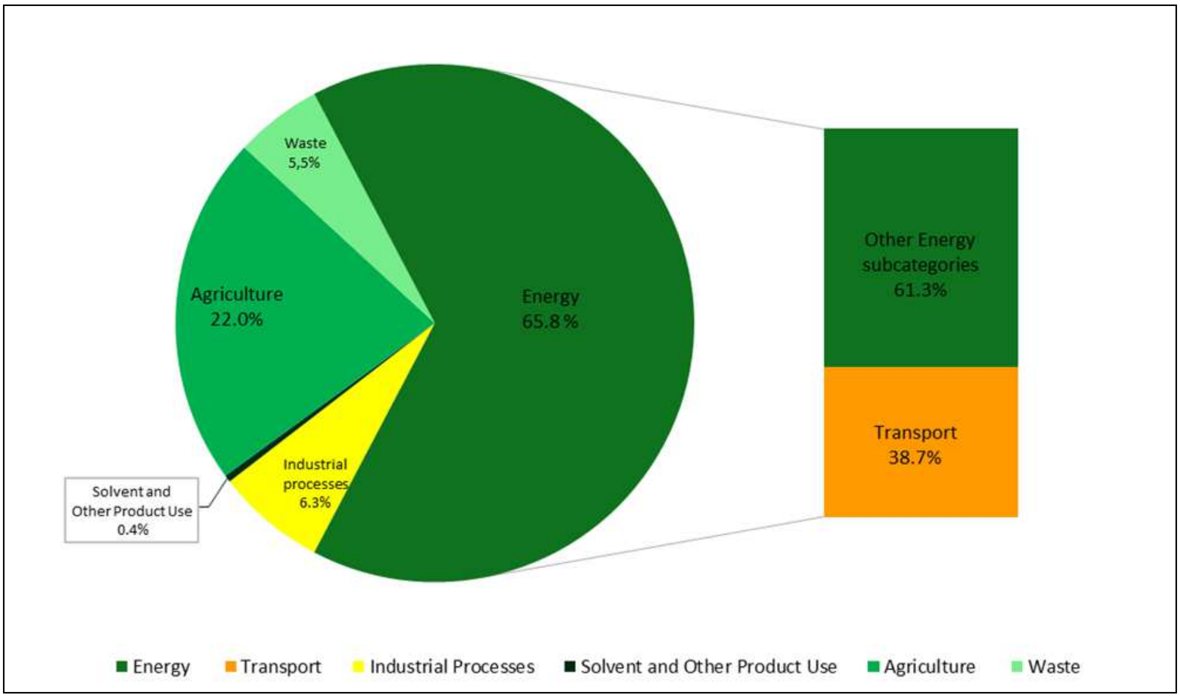


Figure ES.3. Latvian greenhouse gas emissions by sector in 2012 (without LULUCF), Gg CO_2 eq

The **Energy sector** is the most significant source of GHG emissions with 65.8% share of the total emissions in the 2012. GHG emissions fluctuate in the latest years mainly according to the economic trend, the energy supply structure and climate conditions. Total emissions in Energy sector in 2012 decreased by 62.1% if to compare with the base year. A large part of energy sector emissions comes from transport sector (38.7%). Transport emissions decreased by 3.6% comparing with year 2011. One of the critical factors influencing GHG emissions in transport sector is the amount of consumed fuel.

Agriculture is the second most significant source of GHG emissions, with approximately 22.0% of Latvia's total emissions. Emissions from agriculture include CH_4 and N_2O emissions. GHG emissions increased in 2012 by accordingly by 3.3% and 4.7% if to compare with 2011 due to increase of cattle and sheep numbers, synthetic N fertilizer consumption and crop production. The annual emissions have reduced approximately by 59.2% since 1990 due to decreases in the number of livestock, nitrogen fertilisation and etc. Given in CO_2 equivalents, the N_2O emission contributed with 67.6% of total GHG emission from the agricultural sector, but CH_4 contributed with the remaining 32.4% in 2012.

Emissions from the **Waste sector** consist of CH_4 and N_2O emissions and have been increased since 1990. In 2012, emissions were approximately 2.1% higher than in 1990, but compare to 2011 emissions increased by 0.9%. Trend could be explained with changes of economical situation in Latvia. In 2012, emissions from the Waste sector were 600.1 Gg CO_2 equivalents; it contributes 5.5% of total GHG emissions (excluding LULUCF).

The **Industrial Processes** category contributes approximately 6.3% of the total GHG emissions. The emissions from industrial processes (referred to as non-energy related ones), include CO_2, CH_4, N_2O and F-gases. The largest decrease in emissions occurred between years 1991 and 1993, when industry was going through a crisis.

In the latest years emissions increased significantly due to overall increasing of activity for industrial production processes. In 2012, emissions increased by 4.4%, compare to 2011 due to increase of activity data in sectors 2.A.1 Cement production (increase of activity data +3.3%), 2.A.5 Asphalt roofing (increase of activity data +7.0%) and 2.A.6 Road paving with asphalt (increase of activity data +7.0%), 2.C.1 Iron and Steel Production (increase of activity data +399.0%), 2.F. Consumption of Halocarbons and SF_6 (about 11.3% increase of actual emissions due to increase of purchased gas amount in Commercial refrigeration and increasing number of passenger cars and trucks which caused growth of emissions from Mobile Air-Conditioning).

Solvent and Other Product Use made only about 0.4% 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 13.1% since 1990. In 2012, emissions increased by 6.3% comparing with 2011.

Land use, Land use change and forestry (LULUCF) is a net sink in Latvia. In 2012, CO_2 removals were -12 300.54 Gg CO_2 eq compared to -19 866.69 Gg CO_2 eq in the base year that is approximately 38.1 % smaller than in 1990, because of increase of harvesting rate in forest. Most of the removals in the LULUCF sector come from forest growth.

ES.3.2 KP-LULUCF activities

Information table on accounting for activities under articles 3.3 and 3.4 of the Kyoto Protocol is shown in the Table ES.3.

Table ES.3 Accounting for activities under articles 3.3 and 3.4 of the Kyoto Protocol

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Net emissions/removals						Accounting Parameters	Accounting Quantity
	2008	2009	2010	2011	2012	Total		
A. Article 3.3 activities								
A.1. Afforestation and Reforestation								-1 385.16
A.1.1. Units of land not harvested since the beginning of the commitment period	-226.46	-253.00	-276.75	-301.56	-327.40	-1 385.16		-1 385.16
A.1.2. Units of land harvested since the beginning of the commitment period								NA,NO
Harvested lands	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO		NA,NO
A.2. Deforestation	1 317.70	1 271.80	1 228.89	1 215.93	1 190.10	6 224.42		6 224.42
B. Article 3.4 activities								
B.1. Forest Management	-17 106.35	-15 052.22	-10 908.71	-11 203.73	-12 447.61	-66 718.62		-11 072.59
3.3 offset							4 839.26	-4 839.26
FM cap							6 233.33	-6 233.33
B.2. Cropland Management (if elected)	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Net emissions/removals						Accounting Parameters	Accounting Quantity
	2008	2009	2010	2011	2012	Total		
B.3. Grazing Land Management (if elected)	NA	NA	NA	NA	NA	NA	NA	NA
B.4. Revegetation (if elected)	NA	NA	NA	NA	NA	NA	NA	NA

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 ES.4.

Table ES.4 Emissions of indirect GHG and SO_2, Gg

	NOx	CO	NMVOC	SO_2
1990	83.51	382.40	78.44	102.28
1991	76.99	349.15	75.05	85.88
1992	64.36	397.40	70.33	72.87
1993	58.03	333.88	69.58	67.40
1994	52.46	314.34	67.36	67.26
1995	48.63	290.74	65.43	49.05
1996	47.90	297.67	65.52	54.53
1997	46.39	265.95	62.19	42.46
1998	42.92	246.72	59.67	38.19
1999	41.70	244.78	57.88	30.06
2000	40.58	235.04	56.16	15.63
2001	43.32	236.17	58.94	12.30
2002	42.22	244.05	57.40	10.92
2003	43.38	226.74	56.79	8.83
2004	42.62	219.27	56.33	6.78
2005	41.18	208.06	54.77	6.60
2006	41.69	233.15	55.15	5.85
2007	41.45	191.44	53.28	5.68
2008	37.28	179.51	51.15	4.58
2009	33.81	196.98	51.69	4.19
2010	35.91	184.85	51.46	3.27
2011	31.07	156.51	49.67	2.94
2012	34.87	161.22	53.08	2.39

In the period from 1990 to 2000 indirect GHG emissions have decreased: NO_x by 51%, CO by 39%, NMVOC by 28%. But starting from 2001, a small increase in NO_x, NMVOC and CO emissions is observed as a reason of increasing firewood consumption in Residential sector as well as fuel consumption in Transport sector. SO_2 emissions have decreased significantly from 1990 to 2012 by almost 98% as a reason of fuel switch and approved legislation.

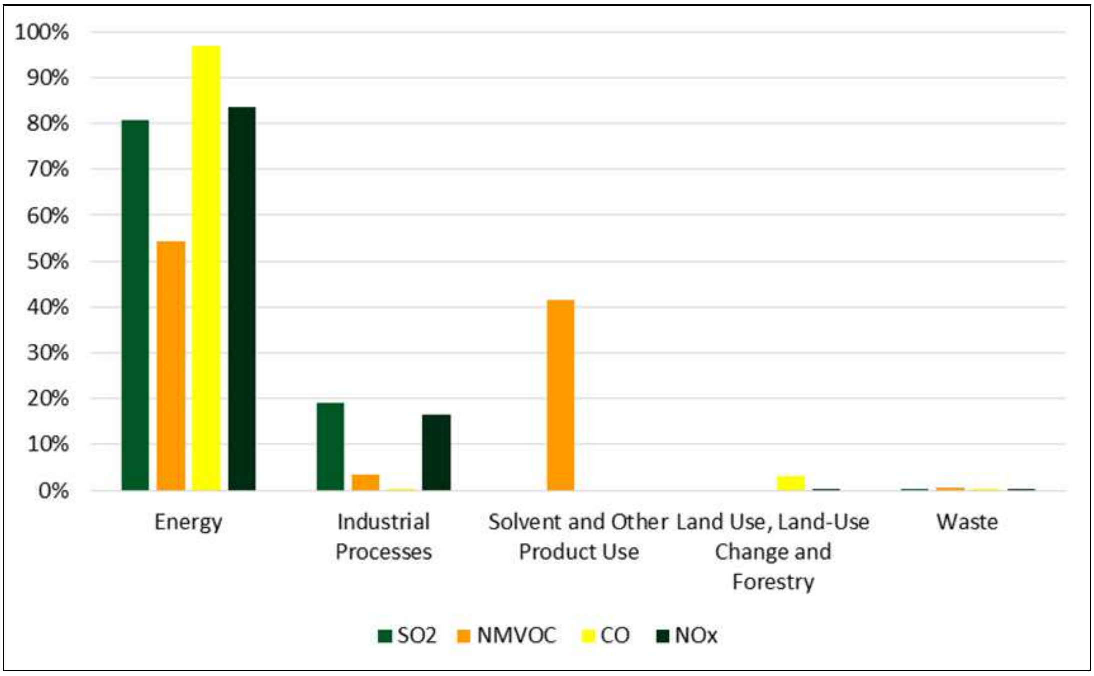


Figure ES.4. Indirect GHG emission trends by sector, % from total indirect GHG emissions in sector

The most important sector producing indirect GHG is Energy sector. Almost all CO emissions (97%) appear in Energy sector mainly from Fuel Combustion in Residental and Commercial/Institutional subsectors. The major part of SO_2 emissions comes form Energy sector (Fuel Combustion) but the other SO_2 emissions come from Industrial processes (Cement production and Iron and Steel production). Fuel combustion in Energy sector causes largest emissions of NO_x (more than 83% from total NO_x emissions in 2012) (Figure ES.4).

A notable part of indirect GHG (NMVOC, NO_x, SO_2) emissions occurs in Industrial processes sector from Road Paving with Asphalt, Cement and Metal production, but an important emission source for NMVOC is also Solvent and other Product Use.

Indirect emissions from LULUCF and Waste sectors are negligible, but in Agricuture sector emissions do not appear at all.

PART I: ANNUAL INVENTORY SUBMISSION

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 64 573 km^2 and there are 2044813 (2012) inhabitants[1]. Baltic coastline is approximately 498 km. Since the beginning of the previous century the forest area of Latvia has almost doubled by occupying 3,290,288 ha (51% from the total area of the country) in 2012 (according to Sixth National Communication (NC6)[2]). 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 rocks 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 found for summer and autumn seasons. Ice and snow cover period in Latvia became 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 have significant effect on natural and socio-economical systems in Latvia[3].

1.1.2 Background information on greenhouse gas inventories

The Parliament of the Republic of Latvia ratified the United Nations Framework 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

[1] http://www.csb.gov.lv/statistikas-temas/iedzivotaji-datubaze-30028.html

[2] https://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/lv_nc6_1br_2013_final%5B1%5D.pdf

[3] Kļaviņš, M. Climate change in Latvia. University of Latvia.

Kyoto Protocol to the UN Framework Convention on 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.

The legislation act – Regulation No. 217 of Cabinet of Ministers (27.03.2012.) determinates the institutions that are responsible for GHG inventory preparation.

Ministry of Environmental Protection and Regional Development, Climate and Environmental Policy Integration Department is responsible for the implementation and development of climate change mitigation and adaptation (and related) policies and measures. Ministry is responsible for the actions (coordination, implementation and development) to meet the international and EU emission reduction targets. Ministry also coordinates the monitoring and reporting of GHG emission data.

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 2012. The structure of this NIR follows the "Annotated outline of the national Inventory Report including elements under Kyoto Protocol" prepared by UNFCCC.

1.1.3 Overview of inventory preparation and management, including for supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

Latvia, as an Annex I Party that is also part of the Kyoto Protocol is required to report supplementary information in accordance with Article 7, paragraph 1, of the Kyoto Protocol. The required information is specified in the Annex of Decision 15/CMP.1.

1.2 DESCRIPTION OF THE INSTITUTIONAL ARRANGEMENT FOR INVENTORY PREPARATION

1.2.1 Overview of institutional, legal and procedural arrangements for compiling GHG inventory and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

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.

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

Ministry of Environmental Protection and Regional Development, Climate and Environmental Policy Integration Department is responsible for the implementation and development of climate change mitigation and adaptation (and related) policies and measures. Ministry is responsible for the actions (coordination, implementation and development) to meet the international and EU emission reduction targets. Ministry also coordinates the monitoring and reporting of GHG emission data. MEPRD is single national entity with overall responsibility for the Latvian GHG inventory.

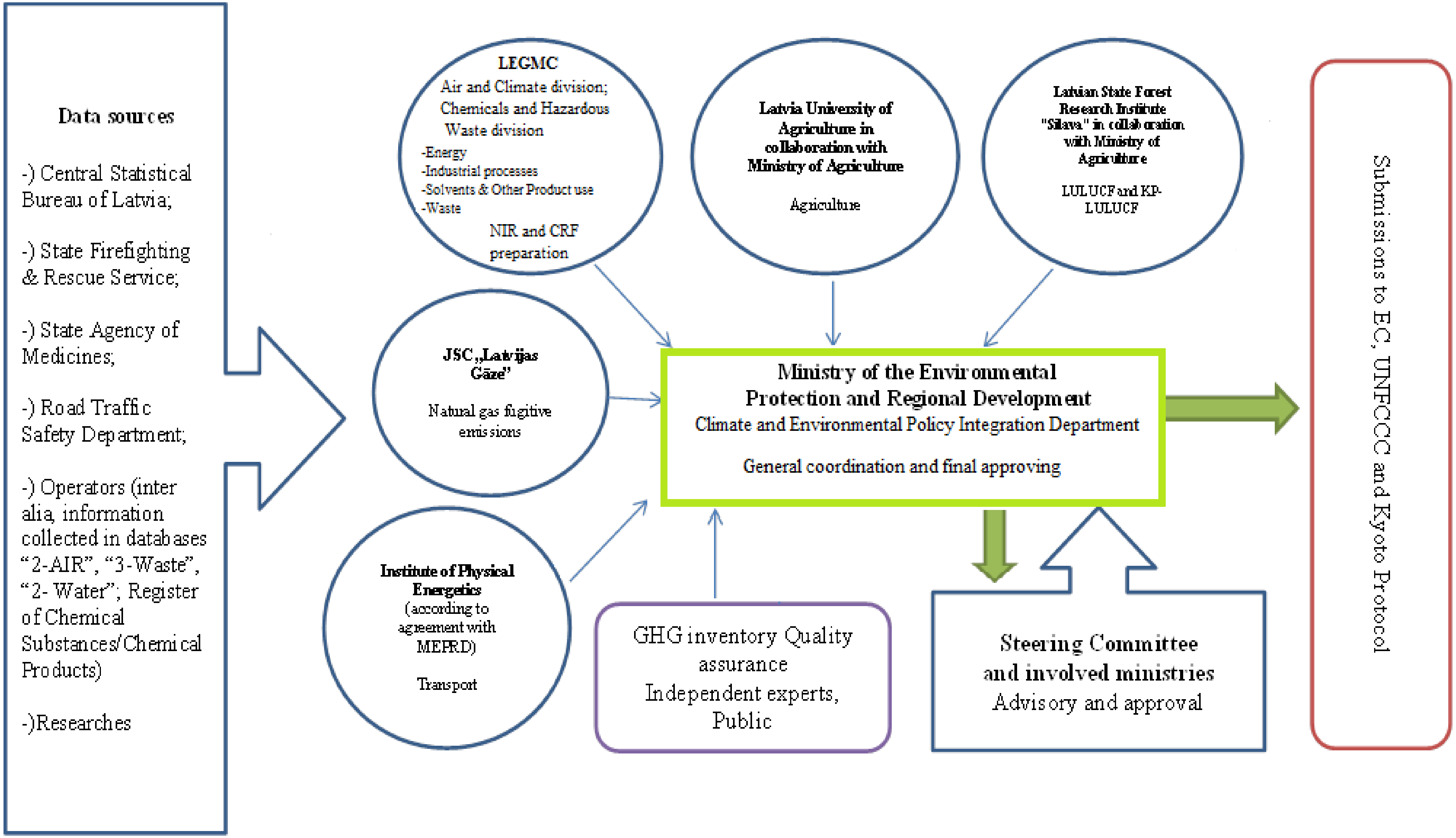


Figure 1.1 The structure of National Inventory System

The MEPRD (CEPID) is responsible for:

- Preparation of legal basis for maintaining the National System;
- Informing the inventory compilers about requirements of the national system;
- Overall coordination of GHG inventory process;
- Final checking and approving of the GHG inventory before official submission to the EC and UNFCCC;
- Timely submission of GHG inventory to the UNFCCC and European Commission;
- Formal agreements with inventory experts and for third part experts that evaluate quality assurance process;
- Coordinating the work between the involved institutions, experts, European Commission and UNFCCC (including coordination of the UNFCCC inventory reviews);
- Keeping of archive of official submissions to UNFCCC and European Commission (starting from 2012 submission).

Latvian Environment, Geology and Meteorology Centre (LEGMC) is a governmental limited liability company and is responsible for:

- collecting of activity data for Energy, Industrial Processes, Solvent and Other Product use and Waste sectors (activity data are mainly collected from other institutions and LEGMC (Air and Climate division, Chemicals and Hazardous Waste division, Inland Waters division) use them to calculate emissions);
- preparation of the emission estimates for the Energy, Industrial Processes, Solvent and Other Product use and Waste sectors;
- preparation of QC procedures for relevant categories and documentation and archiving of used materials for emission calculation;
- LEGMC Air and Climate Division compile the final NIR using information from all involved institutions as well as summarized emission data in CRF Reporter;
- for submission 2014 quality manager from LEGMC Air and Climate division perform the overall QC/QA procedures for all sectors according to the QA/QC plan.

Calculations of removals and emissions for the LULUCF sector were done by Latvian State Forest Research Institute "Silava" in collaboration with MoA. "Silava" is responsible for collecting of activity data, preparation of the removals/emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation.

Institute of Physical Energetic (IPE) calculates emissions for Transport sector according to agreement with MEPRD. IPE is responsible for collecting of activity data, preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation.

Emissions from Agriculture sector were done by Latvia University of Agriculture in collaboration with MoA. Latvia University of Agriculture is responsible for collecting of necessary activity data (cooperating with CSB), preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculation.

The main data supplier for the Latvian GHG inventory is the Central Statistical Bureau of Latvia (CSB). Mainly MEPRD, LEGMC, IPE, Latvia University of Agriculture contacted with five CSB experts.

Institutions involved in the preparation of the national inventory report, are determined in the CoM Regulations No. 217 (27.03.2012). For ensuring the continuity of the functions of the national system, the delegation contract is signed between the MEPRD and LEGMC. The delegation contract ensure the accomplishing of emission estimations and information preparation in the Energy, Industrial Processes, Solvent and Other Product use and Waste sectors for the inventory, as well as GHG inventory compilation and activities related to ETS.

Additionally there are agreements with "Silava", IPE and Latvia University of Agriculture for emission estimations and information preparation accordingly for LULUCF, Transport and Agriculture sectors.

Before final GHG inventory are submitted to European Commission and UNFCCC secretariat it is forwarded to the involved ministries for review and approving. Based on received coments inventory are corrected appropriate.

Several meetings (related Energy, LULUCF, Agriculture, Industrial Processes, Waste) were held before and during preparation of inventory 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.

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

1.2.2 Overview of inventory planning

Inventory planning is one of the main stages in national GHG inventory management system and all responsible institutions are involved in this process, wich consists of:

- establishing of national entity with owerall responsibility for the national inventory;
- assigning responsibilities for inventory preparation and management;
- developing time schedule;
- making arrangements to collect data from statistical agencies, companies, industry associations, etc;
- creating QA/QC plan;

- defining formal approval process within government;
- developing review processes;
- integrating continuous improvements.

Latvia's 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/CP.7) to ensure the transparency, consistency, comparability, completeness and accuracy of inventories.

The inventory preparation plan is a part of the Latvia's QA/QC plan and has to be followed by all institutions defined in CoM Regulations No. 217 (27.03.2012)[4]. The inventory preparation plan is presented in the Table 1.2.

After the end of the annual reporting cycle in April, the institutions involved in inventory preparation start to plan for producing of the next annual inventory following received improvements and recommendations from ERT. Planning includes the identification of improvements to be undertaken due to revised methodologies, updated activity data or emission factors and other relevant technical elements of inventory as well as addressing the issues and recommendations in the review of the previous inventory submission.

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 Environment and Energy Statistics Section, Road Traffic Safety Department (RTSD)
	Calculations	LEGMC Air and Climate division, Institute of Physical Energetics (IPE)
Table 1.A(b) – CO_2 from Fuel Combustion Activities – Reference Approach	Activity data	CSB Environment and Energy Statistics Section
	Calculations	LEGMC Air and Climate division
Table 1.A(d) – Feedstock's and Non-Energy Use of Fuels	Activity data	CSB Environment and Energy Statistics Section
	Calculations	LEGMC Air and Climate division
Table 1.B.2. – Fugitive Emissions from Oil and Natural Gas	Activity data	CSB Environment and Energy Statistics Section
	Calculations	LEGMC Air and Climate Division, JSC "LatvijasGāze"
Table 1.C – International Bunkers and Multilateral Operations	Activity data	CSB Environment and Energy Statistics Section
	Calculations	LEGMC Air and Climate division
Table 2(I).A-G – Industrial Processes	Activity data	CSB Industrial Statistics Section EU Emission Trading Scheme operators

[4] http://likumi.lv/doc.php?id=246033.

CRF sectors	Data	Responsible institutions
	Calculations	LEGMC Air and Climate division, EU Emission Trading Scheme operators
Table 2(II) F – Industrial Processes - HFCs, PFCs AND SF_6	Activity data	CSB Population Statistics Section, Environment and Energy Statistics Section Latvenergo AS; State Agency of Medicines; Enterprises operating with F-gases (reported to Chemicals Register of LEGMC)
	Calculations	LEGMC Air and Climate division
Table 3 – Solvent and Other Product Use	Activity data	CSB Population Statistics Section State Agency of Medicines; Research of experts; LEGMC "2-AIR" and "Chemical" databases
	Calculations	LEGMC Chemicals and Hazardous Waste Division
Table 4.A – Agriculture, Enteric Fermentation	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture
Table 4.B(a) - Agriculture, CH_4 Emissions from Manure Management	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture
Table 4.B(b) - Agriculture, N_2O Emissions from Manure Management	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture
Table 4.D - Agriculture, Agricultural Soils	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture
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

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

1.2.3 Overview of inventory preparation and management, including for supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

Inventory management system includes 3 main stages – inventory planning, preparation and management.

The inventory preparation stage consists of:

- Identification of key categories, which have a significant influence on a country's total inventory in terms of level or trend in emissions. In general, countries should focus on key categories for resources and improvements;
- Selection of methods, emission factors and all necessary relevant information for estimating anthropogenic GHG emissions by sources and removals by sinks;
- Collection of activity data;
- Managing recalculations from previous submissions taking into account updates of activity data by CSB, recommendations by ERT, suggestions from the third-part experts etc.
- National Inventory Report compilation;
- QA/QC plan implementation (include basic checks on entire inventory (Tier 1) and more in-depth investigations into key sources (Tier 2);
- Documentation.

The inventory management stage consists of:

- Implementation of inventory review processes (e.g., expert review, public review);
- Obtaining formal approval of final results and reporting within government;
- Submition reporting to UNFCCC;
- Making inventory information available to stakeholders and respond to information requests;
- Archiving all documentation and results (The special centralised folder is created where experts can upload/download and store all files and information related to inventory preparation);
- Continuous improvement feedback.

1.3 INVENTORY PREPARATION

1.3.1 GHG inventory and KP-LULUCF inventory

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 2014 submission contains estimates for the 1990-2012.

The organizations 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 1.1.

All involved institutions to the GHG inventory system produce emission estimates according to Regulation of Cabinet of Ministers No.217 inter alias the UNFCCC reporting guidelines.

Latvian Environment Geology and Meteorology centre is responsible for NIR compilation as well as emission data import in CRF reporter whereas Ministry of Environmental Protection and Regional Development submits GHG inventory, 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 15th January;
- updated submission by 15th March.

Concerning UNFCCC:

- the annual inventory is submitted by 15th 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 established by Regulation of Cabinet of Ministers No.217 (Part II „National Inventory System", Paragraph 3)		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 established by Regulation of Cabinet of Ministers No.217 (Part II „National Inventory System", Paragraph 3)		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
Additional meetings	All institutions involved in GHG emissions and removals preparation		Additional meetings was organized for solving different problems regarding reviews, quality control activities etc.	during inventory preparation cycle
Agreement on the changes and adjustments to be made for next year's reporting	All institutions established by Regulation of Cabinet of Ministers No.217 (Part II „National Inventory System", Paragraph 3)		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 for emission estimates in Energy and Industrial Processes sectors.	till 30th March
		Operators	LEGMC (Air and Climate division, Chemicals and Hazardous Waste division, Inland Waters Division) 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

Element	Activity	Responsible performers	Procedures	Due date
		Statistical bureau of Latvia (CSB)	CSB send to LEGMC activity data regarding Energy, Agriculture, and Industrial Processes sectors according to CoM Regulation No. 217. Many of received and used activity data is available in CSB statistical databases: http://www.csb.gov.lv/dati/statistikas-datubazes-28270.html	till 1st October
		State Firefighting & Rescue Service (SFRS)	SFRS send to LEGMC activity data - area of last years grass burning (ha).	till 1st October
		Ministry of Health collaborating with State Agency of Medicines (SAM)	SAM sends to LEGMC activity data – data of imported metered dose inhalers containing GHG (F gases subsector) and amount of used N_2O for Anesthesia (Solvent and other product use sector).	till 1st October
Emissions and descriptions	Submission to MoA, MEPRD and LEGMC	Latvia University of Agriculture collaborated with Ministry of Agriculture	Latvia University of Agriculture send to MEPRD and LEGMC report about emissions from Agriculture, including information about used assumptions, activity data which was received from CSB.	till 1st December
Emissions and descriptions	Submission to MEPRD and LEGMC	IPE according to agreement with Ministry of Environmental Protection and Regional Development	IPE send to MEPRD and LEGMC report about emissions from Transport, including information about activity data, which was received from CSB.	till 1st December
		JSC “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 MEPRD	Latvian State Forest Research Institute (LSFRI) "Silava" collaborated with Ministry of Agriculture	LSFRI "Silava” send to MoA and MEPRD NIR relevant chapters, 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 – Air and Climate division, Chemicals and Hazardous Waste division, Inland Waters division.	LEGMC experts compile CRF tables, QC and send to MEPRD.	till 10th December
CRF data Draft NIR according to Regulation (EU) No 525/2013	CRF, NIR	MEPRD - Climate and Environmental Policy Integration Department	After corrections MEPRD send to EC CRF tables and draft short NIR through the Permanent Representation. MEPRD uploaded CRF tables, XML and draft NIR in the EIONET CDR and electronically sent to EC notification about uploaded data.	15th January
Quality control checks	QA/QC procedures, reports according to QC plan	MEPRD - Climate and Environmental Policy Integration Department Other institutions involved in the	According to QC plan internal review was carried out.	January - February

Element	Activity	Responsible performers	Procedures	Due date
		preparation process		
NIR 1st draft		Sectoral experts	Sectoral experts send relevant NIR chapters to LEGMC. The LEGMC Air and Climate division summarize all information and send the NIR 1st draft to MEPRD (national inventory compiler).	End of January
NIR 1st draft		MEPRD - Climate and Environmental Policy Integration Department	According to the CoM Regulations No. 217, MEPRD send to involved institutions NIR 1st draft for comments and approving.	till 30 January
NIR 1st draft		Involved institutions	Involved institutions send to MEPRD comments about NIR 1st draft and approval.	24 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. Answers to the questions raised from EC, provide sectoral experts using QA/QC Communication tool (http://webdab1.umweltbundesamt.at/QAQC_Communication_Tool/) MEPRD approve provided answers from experts. This process includes collaboration with involved institutions for preparing of response to EC.	1st March to 15th March
Quality control checks	QA	Expert Public	NIR was uploaded in the LEGMC home page for review.	February/March
Quality assurance	QA	Third part	CRF and NIR for energy, transport, and agriculture and waste sectors were checked by third person not directly involved in the inventory preparation.	March/April
CRF data NIR according to Regulation (EU) No 525/2013	CRF, NIR	MEPRD - Climate and Environmental Policy Integration Department	MEPRD uploaded CRF tables, XML and draft NIR in the EIONET CDR and electronically sent to EC notification about uploaded data. MEPRD sends an official letter about data uploading to the EIONET CDR through the Permanent Representation.	15th March
NIR and emission data in CRF	Inventory submission	MEPRD - Climate and Environmental Policy Integration Department	MEPRD uploaded approved GHG inventory to UNFCCC portal.	15th April

1.4 BRIEF GENERAL DESCRIPTION OF METHODOLOGIES AND DATA SOURCES

1.4.1 GHG inventory and KP-LULUCF 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) and EMEP/EEA 2009 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 EMEP/EEA 2009.

The CRF Reporter version 3.6.2 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 1990–2012 (Tier-3 method). Emissions for other transport sub-sectors were estimated according to IPCC methodology (railway abd navigation by Tier 1 method and aviation by Tier 2 method).

Emissions from Solvent and Other Product Use were estimated according to EMEP/CORINAIR 2007 Guidebook, expert research and judgment about activity data and emission factors.

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

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

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/ OECD – EUROSTAT – UNECE Annual questionnaires; LEGMC "2-AIR" database; Research of experts.	LEGMC Air and Climate division, plant operators
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 the Ministry of Environmental Protection and Regional Development
Industry	National production and sales statistics; Direct information from enterprises operating with pollutants; Central Statistical Bureau; Chemicals Register; Assumption of experts.	LEGMC Air and Climate division, plant operators
Solvent	Central Statistical Bureau; State Agency of Medicines; Research of experts; LEGMC "2-AIR" database	LEGMC Chemicals and Hazardous Waste division
Agriculture	National agricultural statistics obtained from CSB; National studies.	Latvia University of Agriculture in collaboration with Ministry of Agriculture
LULUCF; LULUCF KP	National forest inventory State forest service Ministry of Agriculture of Republic of Latvia Central Statistical Bureau State Firefighting & Rescue Service National studies and expert judgment	Latvian State Forest Research Institute "Silava" in collaboration with Ministry of Agriculture and Latvia University of Agriculture
Waste	Latvian Environment, Geology and Meteorology Centre "3-Waste" and "2-Water" databases; Methane recovery installations; CSB.	LEGMC Chemicals and Hazardous Waste division, LEGMC Inland Waters Division

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

1.5.1 GHG inventory

This section provides an overview of key categories. The detailed reporting tables required by the official UNFCCC reporting guidelines are provided in the Annex 1 of this report. 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 the 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 prioritized 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.

Tier 2 method is used to identify key sources for time period 1990-2012. 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 Practice Guidance as Table 7.1 and with LULUCF is presented in Good Practice 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 categories for 2012 (Table 1.4) were identified as described in the IPCC GPG 2000 using Tier 2 level and trend assessment taking into account qualitative criteria. Category uncertainty estimates developed under Tier 1 uncertainty analysis are incorporated in Tier 2 approach for detemination of key sources.

Table 1.4 Key categories in 2012

	IPCC GHG Source and Sink Categories	**Gas**	**Key category**	**Criteria for identification**
1.A.1.a	Public Electricity and Heat Production - Gaseous Fuels	CO_2	Yes	L,T
1.A.1.a	Public Electricity and Heat Production - Liquid Fuels	CO_2	Yes	T
1.A.1.a	Public Electricity and Heat Production - Solid Fuels	CO_2	Yes	T
1.A.2.c	Chemicals - Liquid Fuels	CO_2	Yes	T
1.A.2.e	Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	Yes	L
1.A.2.e	Food Processing, Beverages	CO_2	Yes	T

	IPCC GHG Source and Sink Categories	Gas	Key category	Criteria for identification
	and Tobacco - Liquid Fuels			
1.A.2.f	Other - Gaseous Fuels	CO_2	Yes	L
1.A.2.f	Other - Solid Fuels	CO_2	Yes	L,T
1.A.2.f	Other - Liquid Fuels	CO_2	Yes	L,T
1.A.3.b	Road Transportation - LPG	CO_2	Yes	L
1.A.3.b	Road Transportation - Diesel Oil	CO_2	Yes	L,T
1.A.3.b	Road Transportation - Gasoline	CO_2	Yes	L
1.A.3.c	Railways - Liquid Fuels	CO_2	Yes	L
1.A.4.a	Commercial/Institutional - Liquid Fuels	CO_2	Yes	L,T
1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO_2	Yes	L
1.A.4.a	Commercial/Institutional - Solid Fuels	CO_2	Yes	T
1.A.4.a	Commercial/Institutional - Biomass	CH_4	Yes	T
1.A.4.b	Residential - Gaseous Fuels	CO_2	Yes	L,T
1.A.4.b	Residential - Liquid Fuels	CO_2	Yes	L,T
1.A.4.b	Residential - Biomass	CH_4	Yes	L,T
1.A.4.b	Residential - Solid Fuels	CO_2	Yes	T
1.A.4.b	Residential - Solid Fuels	CH_4	Yes	T
1.A.4.b	Residential - Biomass	N_2O	Yes	T
1.A.4.c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	Yes	L
1.A.4.c	Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	Yes	T
2.A.1	Cement Production	CO_2	Yes	L,T
2.A.3	Limestone and Dolomite Use	CO_2	Yes	T
2.A.6	Road Paving with Asphalt	CO_2	Yes	T
2.F(a).1	Refrigeration and Air Conditioning Equipment	HFCs	Yes	T
3.D	Other	CO_2	Yes	T
4.A	Enteric Fermentation	CH_4	Yes	L,T
4.B	Manure Management	N_2O	Yes	L,T
4.B	Manure Management	CH_4	Yes	L
4.D.1	Direct Soil Emissions	N_2O	Yes	L,T
4.D.2	Pasture, Range and Paddock Manure	N_2O	Yes	L,T
4.D.3	Indirect Emissions	N_2O	Yes	L,T
5.A.1	Forest Land remaining Forest	CO_2	Yes	L,T

	IPCC GHG Source and Sink Categories	Gas	Key category	Criteria for identification
	Land			
5.A.1	Forest Land remaining Forest Land	N_2O	Yes	T
5.A.2	Land converted to Forest Land	CO_2	Yes	L,T
5.B.1	Cropland remaining Cropland	CO_2	Yes	L,T
5.B.2	Land converted to Cropland	CO_2	Yes	T
5.C.1	Grassland remaining Grassland	CO_2	Yes	T
5.C.2	Land converted to Grassland	CO_2	Yes	L,T
5.E.1	Settlements remaining Settlements	CO_2	Yes	T
5.E.2	Land converted to Settlements	CO_2	Yes	L,T
5.G	Other	CO_2	Yes	L,T
6.A.1	Managed Waste Disposal on Land	CH_4	Yes	L,T
6.A.2	Unmanaged Waste Disposal Sites	CH4	Yes	L,T
6.B.2	Domestic and Commercial Waste Water	CH_4	Yes	L

1.5.2 KP-LULUCF inventory

Key category analysis for KP-LULUCF was performed according to section 5.4 of the IPCC good practice guidance for LULUCF 2003. The results are reported in CRF table NIR.3.

1.6 INFORMATION ON THE QA/QC PLAN INCLUDING VERIFICATION AND TREATMENT OF CONFIDENTIALITY ISSUES

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 CoM Regulation No. 217 (27.03.2012.) 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;

-) tasks and responsibilities of involved institutions;

-) QA/QC time schedule;

-) 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.

-) check-lists and procedure descriptions for independent experts for quality assurance of GHG inventory.

-) background for inventory improvement plan preparation activities.

Figure 1.2 shows the annual inventory process how the inventory is produced within the national system.

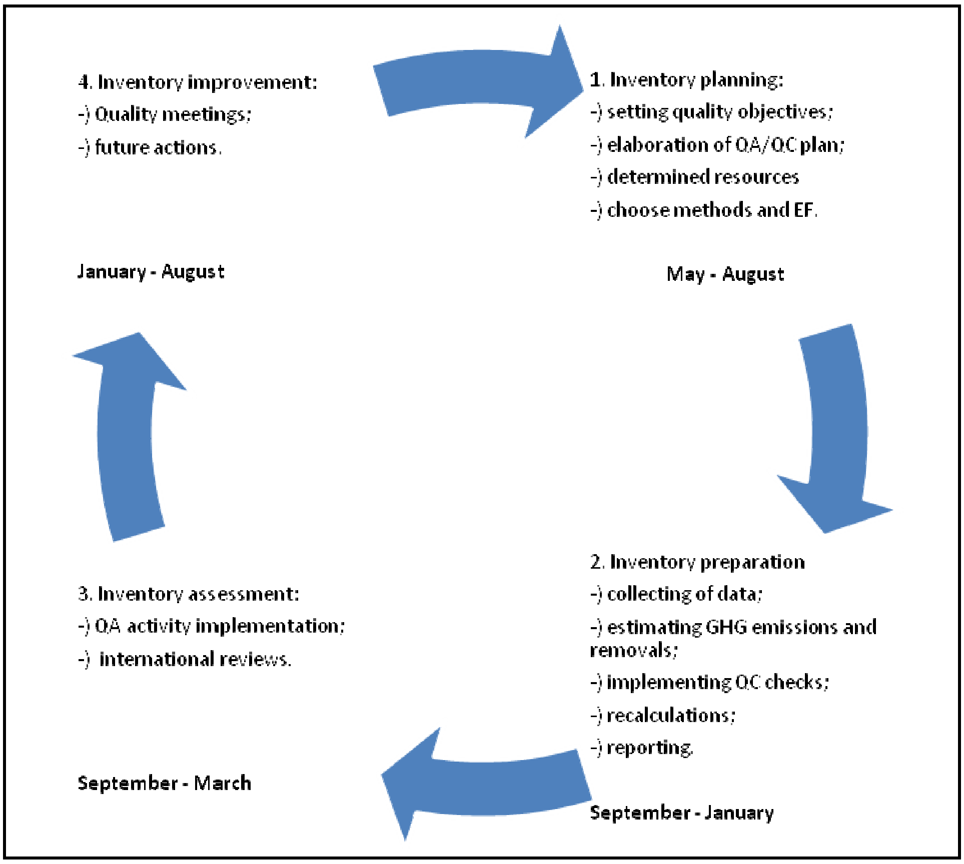


Figure 1.2 Inventory process

The result of quality depends on 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 (Figure 1.3).

Figure 1.3 QA/QC activities of the inventory

The setting of quality objectives is based on the inventory principles taking into account the available resources.

The quality objectives for the 2014 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 localized 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 are 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.

1.6.1 Quality Control procedures

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

For submission 2014, 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 - LEGMC in collaboration with MEPRD).

The centralized archiving system (common FTP folder) is created where experts can upload and download all necessary information for inventory preparation, inter alia spreadsheets which need to be filled for quality control and quality assurance. Instruction for experts how to prepare NIR to ensure comparability of NIR and CFR is prepared and available to experts.

The recent improvements of QA/QC system include QC tables that the sectoral experts, national inventory compiler and third-pary reviewers have to fill in.

QC manager from LEGMC is responsible for QC procedures before inventory submission for overall QC procedures and final approving in MEPRD.

Instruction for experts how to prepare NIR to ensure comparability of NIR and CFR as well as how to fill in QC tables are prepared and available to experts.

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 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 2014:

-) The sectoral experts sent XML files to national inventory compiler (NIC) who imports all data together in CRF Reporter. NIC and MEPRD 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. Sectoral experts before sending chapter of NIR to NIC checked if all information is consistent with information filled in the CRF Reporter. It is checked if recalculations and methodological changes are explained in NIR and CRF Reporter. NIC together with expert from LEGMC prepared final NIR according to UNFCCC reporting guidelines.

-) Experts in LEGMC prepared quality control procedures according to the IPCC GPG 2000 Tier 1 method for Energy, Industrial Processes, Solvents and other product use and Waste sectors. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.

-) LSFRI “Silava” checked data according to QC procedures that was outlined in IPCC GPG LULUCF 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.

-) Expert in Latvia University of Agriculture prepared quality control procedures according to the IPCC GPG 2000 Tier 1 method. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived. Additionally, quality control check was done by MEPRD, CSB, MoA and MoT. Findings were documented and introduced in the emission evaluation as well as in NIR.

-) Expert in FEI prepared quality control procedures according to the IPCC GPG 2000 Tier 1 method. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived. Additionally, quality control check was done by MEPRD, CSB and MoT. Findings were documented and introduced in the emission evaluation as well as in NIR.

-) The emissions for indirect GHG are cross-checked with emissions reported within CLRTAP convention to ascertain if these are equal.

Main activity data provider for Latvia’s GHG inventory – CSB of Latvia, is established Quality Guidelines[5] that is an informative document describing the CSB and the main aspects of its activity: stages, methods and organizational principles of producing the national statistics, policy of data protection and dissemination. The purpose of the Guidelines is to ensure higher quality to a maximum extent from both ethical and professional aspect, national statistics similarly to the Community statistics must follow the principles of impartiality, reliability, relevance, cost-effectiveness, statistical confidentiality and transparency.

As a general rule the statistics are revised according to a fixed, coherent and published plan, called a revision cycle. This plan determines when the individual statistics are revised, and the periods that are subject to revision:

- CSB Revision Policy is available in the CSB website;
- Database of Macroeconomic statistics data revision analysis established.

Detailed source specific 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.

1.6.2 Quality Assurance procedures

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, MoA, MoT on 1st of February for checking and approving. Received corrections were implemented in the GHG report and CRF.

[5] Central Statistical Bureau Quality Guidelines (http://www.csb.gov.lv/en/dokumenti/quality-guidelines-30868.html).

European Commission (EC) consistency report of inventory was received on 28th of February. Response to the questions from EC was provided using QA/QC Communicating tool and the corrections were elaborated in the inventory.

UNFCCC review reports indicate the issues where inventory need the improvements and elaboration. The in-country review was taking place in Riga, Latvia from 16th till 21st of September, 2013. During the in-country review ERT formulated a number of recommendations relating to potential problems in some sectors of Latvia`s previous NIR. The "Draft report of the individual review of the annual submission of Latvia submitted in 2013"[6] was recieved on 14th of March, 2014. Responses to the recommendations provided in the review report within the limits of possibility were elaborated in the Submission 2014 (Chapter 10 – Recalculations and improvements).

The improvement plan for GHG inventory is compiled based on the findings of the UNFCCC, EC, internal reviews and recommendations from third part experts.

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. 217 MEPRD is responsible for ensuring QA procedures for GHG inventory.

Periodically all sectors are revised by third part experts. Previously energy, waste and agriculture sectors were checked by personnel not directly involved in the inventory compilation. Last year the third part reviews were performed for industrial processes, solvent and other product use. For this inventory it is planned to carry out third part reviews for energy, transport, agriculture and waste sectors (March/April).

The support from EC within KP assistance project was recieved last year for LULUCF, waste, industrial processes (including F gases) sectors. Advices recieved within the project was useful for improving the inventory in these sectors.

Within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy" it is planned to ensure detailed quality control procedures for quality assurance of Industrial process and LULUCF, KP sectors.

1.6.3 Quality Assurance and Quality Control process improving the inventory

QA/QC procedures are an important component in the development of greenhouse gas emission inventory preparation. The basic aim of the QA/QC process is to ensure the quality of the inventory and to contribute to the improvement of the inventory. Improving the submission during QA/QC process, the main findings and conclusions concerning the inventory quality and improvements needs to be considered and communicated into Latvias GHG inventory system for making decisions concerning the annual inventory process and next inventory preparation.

The outcomes of the QA/QC process results in a reassessment of inventory or source category uncertainty estimates. For example, if data quality is found to be lower than previously thought and this situation cannot be rectified in the timeframe of the current inventory, the uncertainty estimates are re-evaluated. Increased effort on QC results in improved emissions estimates and reduced uncertainties.

[6] FCCC/ARR/2013/LVA DRAFT

1.6.4 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.

Documentation system in CSB:

- Survey and calculations documentation system;
- Quality indicators documentation system;
- Thesaurus;
- 2 sub systems – internal & external.

CSB a Document Storage System (ADS):

- In 2008, ADS was developed in the CSB;
- Starting with 2009, each year all fundamental processes performed for each statistical survey as well as for calculations have to be described in detail;
- All quality indicators have to be described;
- ADS provides also a technical possibility to attach a number of supporting documents;
- ADS is made accessible for external users on the CSB website.

Revisions of data are defined as any changes to statistics that have already been published.

CSB uses integrated statistical data management system (ISDMS) for data processing. It is a metadata driven system based on metadata and standardisation of data processing, which in essence does not require individual programming. This system is used for processing surveys of business (mainly) and social statistics. Data collected by means of questionnaires which are not included in the ISDMS are processed by the CSB using other especially developed data processing applications. Detailed information is given in the Annex 8.

The expert organizations have archives located in their own facilities. Experts keep all information (all disaggregated emission factors, activity data, and documentation about how these factors and data have been generated and aggregated for the preparation of the inventory) on the hard disks of the individual expert's desktops.

Every annual inventory (CRF tables, XML, SQL Databases, NIR and Registry information) is archived.

Latvia has a centralized archiving system - all information (including corresponding letters, internal documentation on QA/QC procedures, external and internal reviews, documentation on annual key sources and key source identification, planned inventory improvements) used for inventory compilation are collected on the special server and the backup of data are made periodically. All information is archived at MEPRD and LEGMC.

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

1.6.5 Verification activities

In the CSB data are verified in two data processing stages: on raw data level (processing of individual information) and on aggregated data level (verifying prepared aggregates).

CSB uses several methods for data verification at the raw data level:

- arithmetical connections;
- logical connections;
- comparison with data of previous periods;
- mutual coherence verification with other statistical questionnaires;
- statistical registers and administrative data.

Aggregates are made and different groupings are formed from the raw data produced. CSB uses similar methods for verification of aggregates to ones, which are applied in the

1.6.6 Treatment of confidentiality issues

For Latvia's GHG Inventory mainly confidentiality is related to activity data provided to LEGMC by CSB. The data then is used for emission estimation and can't be reported further. If the data that could be considered as confidential is provided to LEGMC by production plan or other enterprise then the data is not considered as confidential and can be reported within GHG Inventory.

1.6.6.1 Data of CSB

Legal, technical and administrative measures:

Legal:

"Law on State Statistics"

"Law on State Information Systems"

"Personal Data Protection Law"

"Information Publicity Law".

Technical:

Physical Security (environmental (temperature fluctuations, etc.), technical (voltage reduction, etc.) and human factors (theft, deliberate or unintentional damages, etc.).

Logical Security (security measures provided by IT: user names and passwords, antivirus, firewalls etc.).

Administrative:

Information Security Management Coordination Council (ISMCC) ensure and implement in the CSB security policy, security means and principles of data storage, information classification and confidentiality, principles of granting access rights.

Information Security Policy developed (2008).

CSB ensures confidentiality and protection of information supplied by the respondents, as well individual information received from other sources pursuant to the requirements of national legislation in force.

The CSB takes the necessary organisational, administrative and technical measures to ensure confidentiality.

Technical: described in internal regulations and procedures on security and use of Information Systems.

Organisational and administrative:

- "Confidentiality Statement" signed by every employee, laying down the personal data non-disclosure obligation;
- Confidentiality Council established to ensure that individual information possessed by the CSB is used for scientific and research purposes according to the provisions of the Official Statistics Law and other legal acts and to deal with legally unregulated confidentiality issues.
- Handbook of statistical confidentiality developed (2009) that provides explanations of the methods used by the CSB for ensuring data confidentiality.

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.

1.6.6.2 Data of ETS

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.

1.6.6.3 ETR documentation

As no significant changes were done in Latvia's ETR then ITL Initialization documentation wasn't changed either.

1.7 GENERAL UNCERTAINTY EVALUATION

1.7.1 GHG inventory

This section provides an overview of the approach to uncertainty analysis for Latvia's inventory. The mandatory reporting tables of analyses are provided in Annex 7.

The uncertainty estimates of the inventory 2014 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 default uncertainty estimates according to IPCC GPG 2000 or on expert judgment, because there is a lack of the information. For each source, the uncertainty for activity data and emission factors was estimated and given in per cent.

Generally for activity data from CSB 2% uncertainty[7] is used according to received information from CSB.

The uncertainty calculation is based on Excel file, which is send to sectoral experts for updating annualy.

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.

In the annual meeting at the beginning of the inventory cycle the experts are advised to go through the uncertainty ranges of activity data and emissions factors in order to prioritize inventory improvements.

In 2014 Submission the categories with the largest uncertainties were revised and the uncertainty levels were reduced as far as possible mainly in LULUCF and Energy sectors due to suggestions from ERT (Expert`s Review Team) during the in-country review to use uncertainty analysis in prioritizing improvements in the inventory. Further Latvia plans to undertake a Tier 2 uncertainty analysis as a part of the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy".

Detailed about uncertainty assessment is described in the each sub sector as well as data information is provided in Annex 7 of the inventory.

1.7.2 KP-LULUCF inventory

Tier 1 was implemented for estimating uncertainty rates related to activity data and emission factors employed in the estimates under Article 3.3. activities.

1.8 GENERAL ASSESSMENT OF THE COMPLETENESS

1.8.1 GHG inventory

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):

[7] http://www.researchgate.net/publication/228425689_Standard_Quality_Indicators

"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 KP-LULUCF inventory

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.

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 AND INTERPRETATION 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.

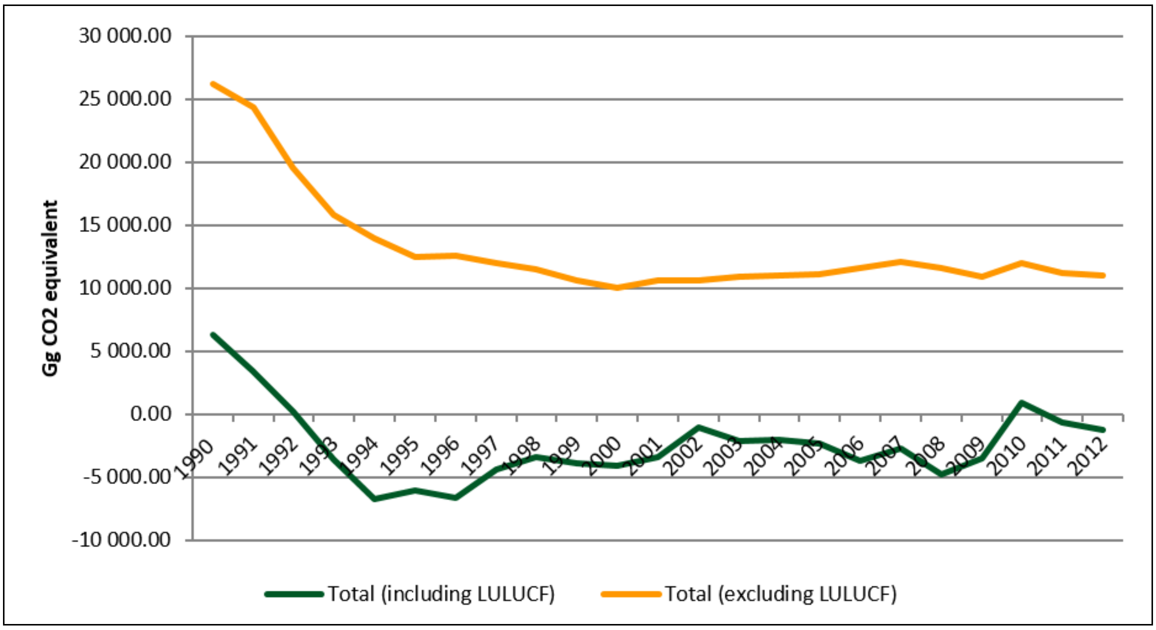


Figure 2.1 Latvia`s aggregated greenhouse gas emissions in 1990-2012 (Gg CO_2 eq)

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.

2.2 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY GAS

Carbon dioxide (CO_2) is the main greenhouse gas causing the climate change. In 2012, CO_2 emissions contribute 67.7% of Latvia's total greenhouse gas emissions. In 2012, total CO_2 emissions had decreased by approximately 60.9% since 1990.

The most important source of CO_2 emissions (Gg) in 2012 was fossil fuel combustion – 91.4%, including Energy Industries – 25.0%, Manufacturing Industries and Construction – 12.5%; Transport – 36.8%, Other sectors (Agriculture, Forestry, etc.) – 17.0%.

Other anthropogenic emission sources of CO_2 are Industrial Processes – 7.9%, Solvent and Other Product Use approximately 0.7%.

CO_2 removals take place by green plants absorbing CO_2 in the process of photosynthesis. In 2012, LULUCF in Latvia removed -12 300.54 Gg CO_2 eq.

Main sources of CH_4 emissions in Latvia are Enteric Fermentation of Livestock, Solid Waste Disposal Sites 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 2012 contribute approximately 14.9% of total GHG emissions (excluding LULUCF). The methane emissions (Gg) decreased by 51.2% in 2012 since 1990.

Agricultural soils are the main source of N_2O emission in Latvia generating 83.3% of all N_2O emissions (Gg) in 2012. 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 52.4% in 2012, mainly due the decrease in the emissions from agriculture.

Emissions from HFCs and sulphur hexafluoride (SF_6) consumption are reported for the period 1995-2012. Total HFCs emissions (Gg CO_2 eq) increased in 2012 compared with 2011. SF_6 emissions from electrical equipment are reported and contribute 13.69 Gg CO_2 eq in 2012.

Emissions by sources are illustrated in the following As it is shown in Figure 2.2, the Energy sector covers the largest part of all greenhouse gas emissions in Latvia.

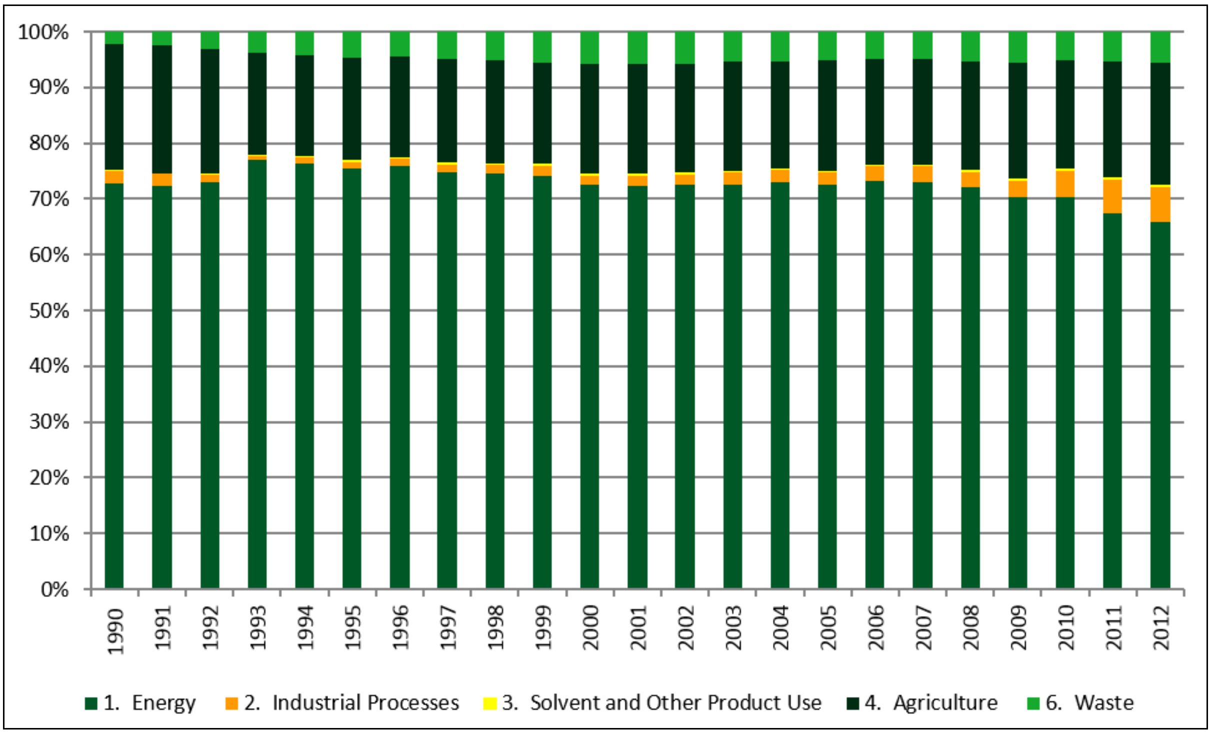


Figure 2.2 Latvia`s greenhouse gas emissions by source 1990-2012 excluding LULUCF

2.3 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY CATEGORY

2.3.1 Trends in ENERGY

There are two types of emission categories within Energy sector – Fuel combustion, where emissions from Energy Industries, Manufacturing Industries and Construction, Transport, Other sector and Other (Military) sector are produced, and Fugitive emissions where leakages from oil distribution and natural gas are occuring.

The Energy sector is the most significant source of GHG emissions with 65.78 % share of the total emissions in 2012. Most of Energy sector emissions – 99.17% - are produced by combusting fuels (Figure 2.3).

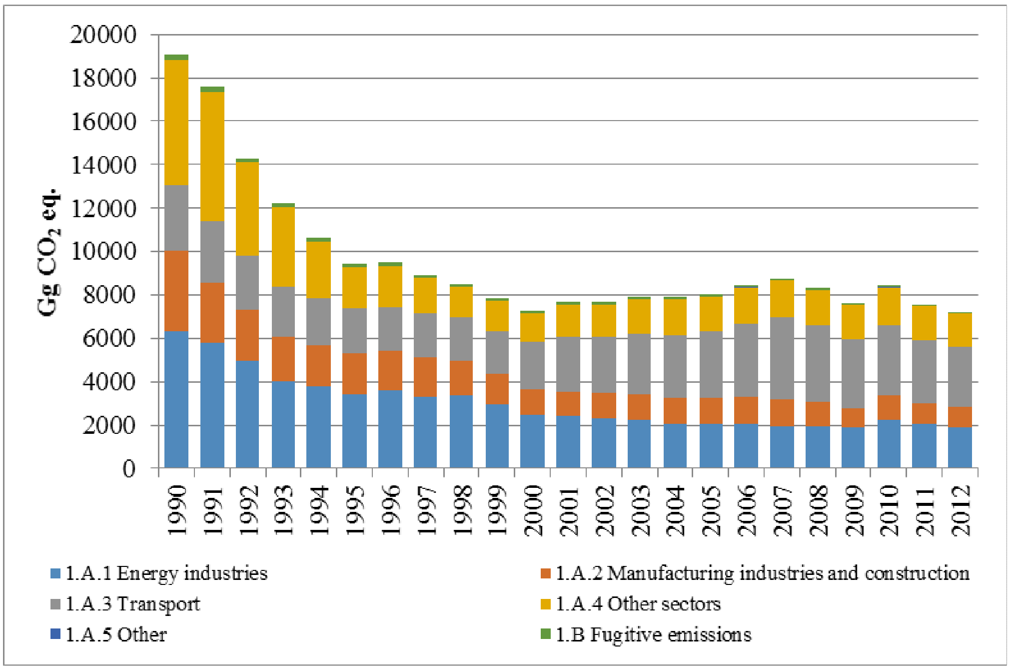


Figure 2.3 Trend in GHG emissions from Energy sector 1990–2012

GHG emissions from Energy sectors are influenced by climate conditions (warm or cold winters significantly influences amounts of energy resources consumed), economic trend and energy supply structure.

As average temperature in 2012 was lower than in 2011, the consumption of energy resources slightly increased in stationary combustion (CRF 1.A.1, 1.A.2, 1.A.4), but emissions decreased by 4.7%, comparing with 2011. The decrease can be seen in consumed amounts of liquid, solid and gaseous fuels, whereas the consumption of biomass increased.

The greatest decrease in emissions by 10.3% can be observed in CRF 1.A.1 Energy Industries because of liquid and gaseous fuels which have been consumed by 3.9 PJ less. At the same time the consumption of biomass has increased by 2.3 PJ.

Also a decrease in emissions by 3.5% can be observed in CRF 1.A.3 Transport sector, mainly due to decreased use of gasoline by 15.2% in 2012. Regarding Transport subsector, there was in place emission reduction by 35% points in the time period 1990 – 1999 due to retructuring of economic and recession. In the next time period (2000 – 2007) we can recognize emission increasing by 95% points. The main reason for this trend was a sharp development of road transport (number of passenger cars). Total GHG emissions have decreased 6.84% in 2012 comparing with the base year.

A decrease in emissions by 3.6% in CRF 1.A.4 Commercial and Residential sector in 2012 can be seen, which can be explained with less use of solid fuels by 58%, comparing with 2011.

At the same time there can be seen an increase in CRF 1.A.2 Manufacturing industries by 6.4% comparing with 2011 because of increased use of liquid fuels and natural gas. There is also an increase in Fugitive emissions by 43.6% in 2012.

There are negligible fluctuations in emissions in CRF 1.A.5 Other sector (Military) as well, however, the amounts of emissions produced in this sector are very small.

2.3.2 Trends in INDUSTRIAL PROCESSES

Emissions from Industrial Processes sector in Latvia are divided into the following emissions categories: Mineral Products (CRF 2.A), Metal Production (CRF 2.C), Other production (CRF 2.D) and Consumption of Halocarbons and SF_6 (CRF 2.F). Under Mineral products Latvia reports emissions from cement, lime, glass, bricks and tiles production as well as emissions from soda ash use. NMVOC emissions from road paving with asphalt also are reported in this category.

The category Consumption of Halocarbons and SF_6 covers the emissions of F-gases from refrigeration and air-conditioning, foam blowing, medical aerosols and electrical equipment, as well as fire extinguishers and other - like HFC-134a from shoes. Under Other production Latvia reports NMVOC emissions from pulp and paper and food industries.

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. Also radical decrease of CO_2 emissions from 1999 to 2000 are influenced by economic crisis in neighbourhood Russian Federation whom Latvia had strong foreign trade linkage.

Due to Latvia's economical features since 2007–2008 the industry development was slowing down as the financing and real estate sectors started dominating in national economy. In 2009-2010 emissions from 2.A.1 Cement production increased as cement production plant switched the production technology and installations and increased its capacity by approximately 2.4 times.

In 2012 industrial GHG emissions contributed 6.3% of the total GHG emissions in Latvia, totaling 687.51 Gg CO_2 equivalent. The most important GHG emissions from Industrial Processes in Latvia's inventory in 2012 are the CO_2 emissions from Cement Production and Road Paving with asphalt with 76.45% and 8.87%, respectively, and F-gas emissions comprised together 0.0007% of the total GHG emissions.

Increase in 2012 emissions was caused by increase of cement production. The overall progressing of GHGs in the Industrial Processes sector in CO_2 equivalent is presented in Figure 2.4.

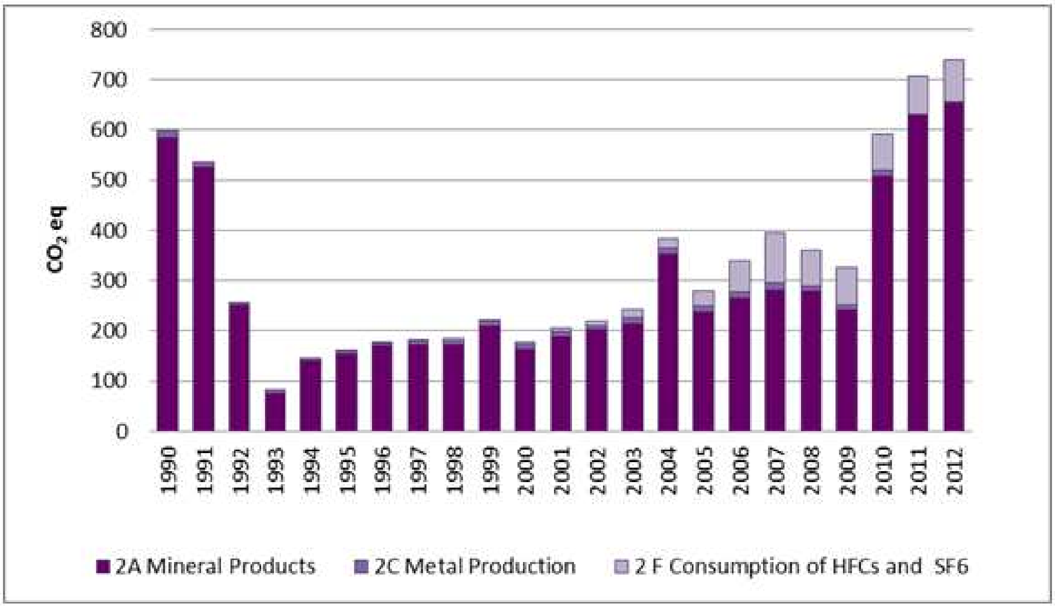


Figure 2.4 Trends in Emissions from Industrial Processes Sector 1990–2012, CO_2 eq

2.3.3 Trends in SOLVENT AND OTHER PRODUCT USE

Latvia`s emissions from Solvent and Other Product Use sector consists of the following indirect greenhouse gases emissions categories: Paint Application (CRF 3.A), Degreasing and Dry Cleaning (CRF 3.B), Chemical Products, Manufacture and Processing (3.C) and Other (3.D). Other (3.D) sector includes also N_2O emissions from the Use of N_2O for Anaesthesia (CRF 3.D.1). The trend in emissions in CO_2 equivalents by category is presented in Figure 2.5.

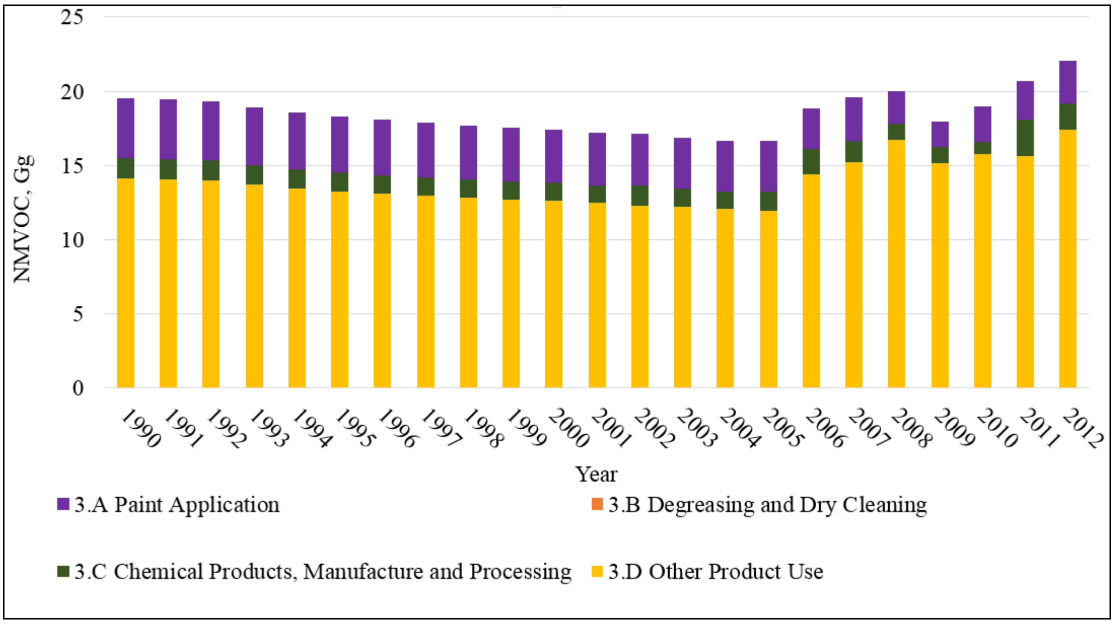


Figure 2.5 Trends in emissions from Solvent and Other Product Use sector 1990-2012

In 2012 indirect greenhouse gas emissions from Solvent and Other Product Use sector contributed a small amount of the total greenhouse gases emissions in Latvia. Emissions of total greenhouse gases from the Solvent and Other Product Use sector (CRF 3) have increased by 13.1%, from 42.9 Gg CO_2 equivalents in 1990 to 48.5 Gg CO_2 equivalents in 2012. The rise can mostly be explained by an increase in the use of solvents in CRF 3.B (Degreasing and Dry Cleaning) and 3.D (Other) due to the economic welfare of the country.

Decrease in NMVOC emissions in the period 1990-2005 has occurred mostly due to the industry going through a crisis. Between 2005 and 2008 the economic growth induced the increasing usage of NMVOC containing products from application of underseal treatment and conservation of vehicles, glues and adhesives, preservation of wood, domestic solvent use and other. At the end of 2008 the world was struck by the economic crisis, which also affected the Solvent and Other Product Use sector in Latvia. There is an increase in trends of NMVOC emissions from Solvent and Other Product Use in later years. Since 2009 in CFR 3 sector NMVOC emissions have increased by 19%. NMVOC emissions from the Solvent and Other Product Use sector constituted 41.6% (22.1 Gg) of the total NMVOC emissions of Latvia in 2012.

N_2O emissions as CO_2 equivalent from the Use of N_2O for Anaesthesia were negligible (0.005 Gg) in this sector in 2012.

2.3.4 Trends in AGRICULTURE

Agricultural GHG emissions in Latvia consist of CH_4 emissions from enteric fermentation of domestic livestock, N_2O emissions from manure management and N_2O emissions from agricultural soils. The trend of emissions in CO_2 eq. by category is presented in Figure 2.6. In 2012, Agriculture sector contributed 22.0% of the total GHG emissions originated in Latvia or 2420.30 Gg CO_2 eq. Emissions from agricultural soils contributed major share of the total emissions from the sector – 62.5%. Emissions from the agricultural sector have declined by 59.2% compared to 1990, due to the decrease of livestock population and in amounts of synthetic fertilizer use. GHG emissions increased in 2012 by 4.1% comparing to 2011 due to increase of cattle and sheep numbers, synthetic N fertilizer consumption and crop production.

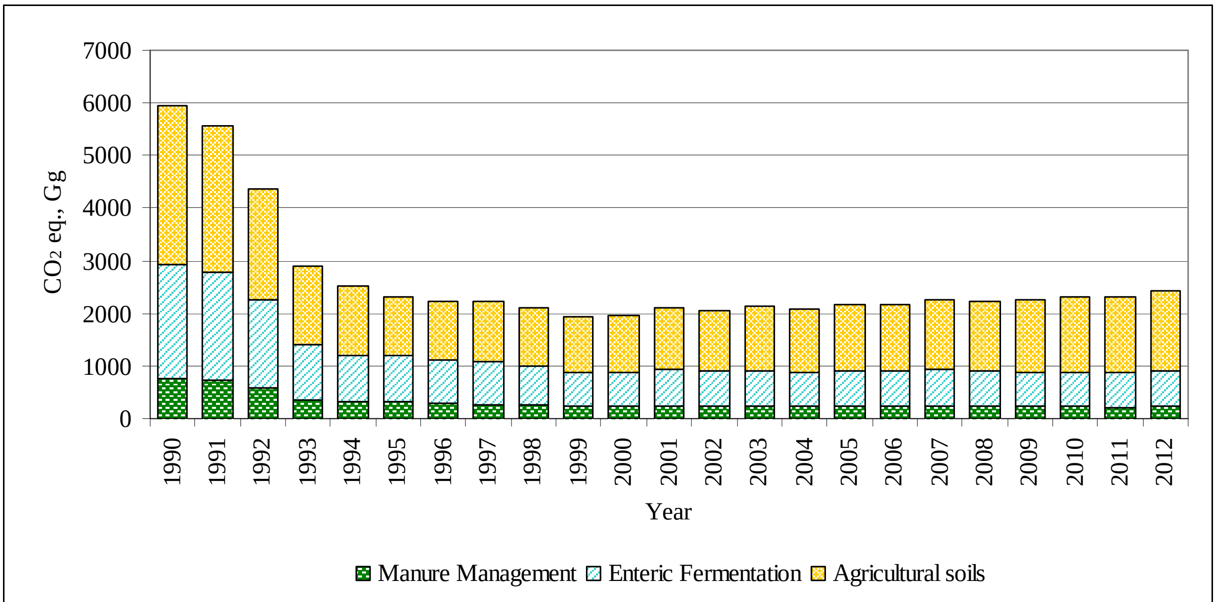


Figure 2.6. Trends of emissions by category within the sector, 1990-2012 (Gg, CO_2 eq.)

2.3.5 Trends in LULUCF

Net aggregated emissions in LULUCF sector considerably increased since 1990 due to growth of economic activity in forest sector and due to conversion of forest lands to settlements and croplands. In spite increment of living biomass in forest land remaining forest and afforested lands is still bigger than natural mortality and commercial felling, the difference is decreasing causing reduction of net removals of CO_2 in forest lands in spite total growing stock of living biomass is constantly increasing in forest lands. Summary of net emissions excluding harvested wood products is shown in Figure 2.7.

Absolute increase of emissions in LULUCF sector if compare 1990 and 2012 is 7566 Gg CO_2 eq. annually, mostly because of increase of emissions in forest lands (by 9051 Gg CO_2 eq. between 1990 and 2012). Emissions increased also in settlements – by 761 Gg CO_2 eq. between 1990 and 2012. In croplands and in grassland emissions decreased by, respectively, 476 Gg CO_2 eq. and 745 Gg CO_2 eq. annually between 1990 and 2012. Reduction of emissions in cropland is caused by abandonment of farmlands and conversion of cropland into grassland. Reduction of net emissions in grassland is also result of conversion of cropland and accumulation of carbon in soil in converted lands. Net increase of emissions in LULUCF sector in 2012 in compare to 1990 is 38 %.

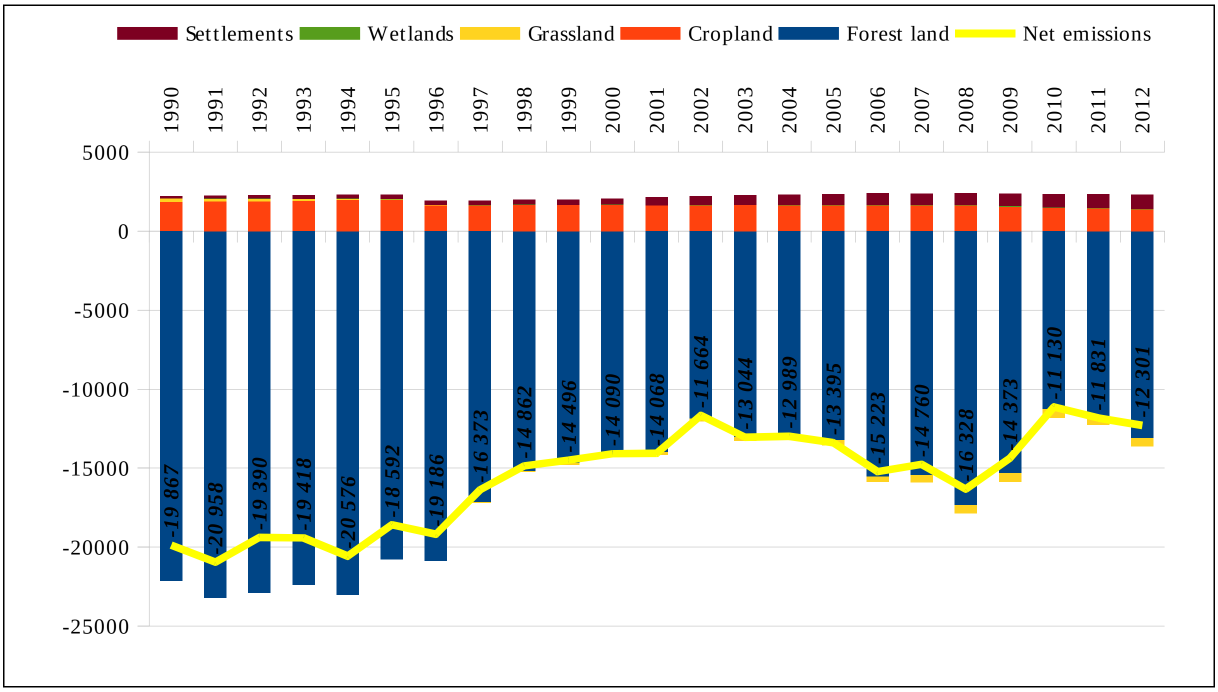


Figure 2.7 Summary of contribution of different land use categories to aggregated emissions in Gg CO_2 eq

2.3.6 Trends in WASTE

GHG emissions from Waste sector have been fluctuated from 1990-2012. In 2012, emissions were approximately 2 % higher than in 1990. In 2012, emissions from the Waste sector were 600.1 Gg CO_2 equivalents; it contributes about 5.5% of total GHG emissions (excluding LULUCF).

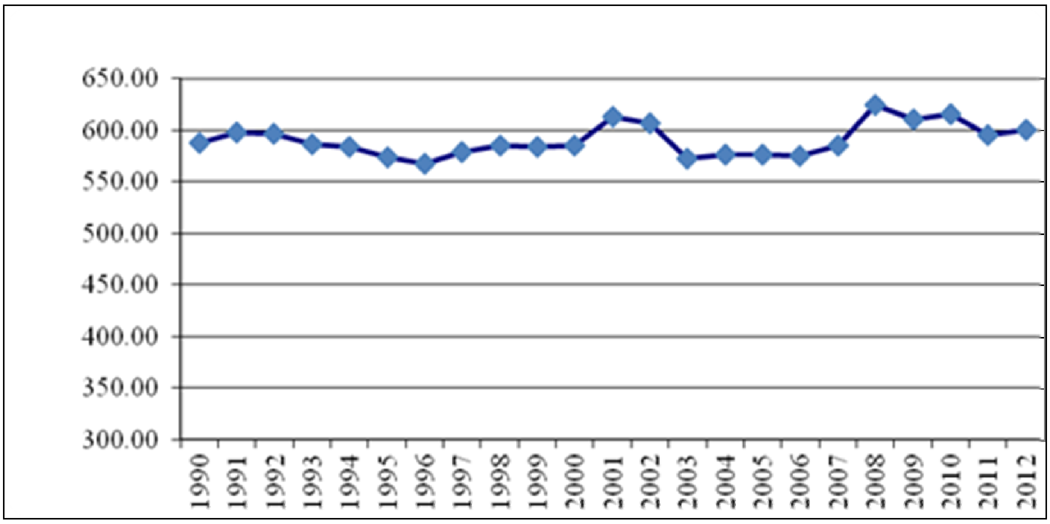


Figure 2.8 Total emissions from Waste sector in CO_2 equivalent (Gg)

Fluctuations in total GHG emissions in waste sectors could be explained with changes of economical situation in last 20 years (Figure 2.8). Some industry sectors were almost closed in the middle of 90-ties.

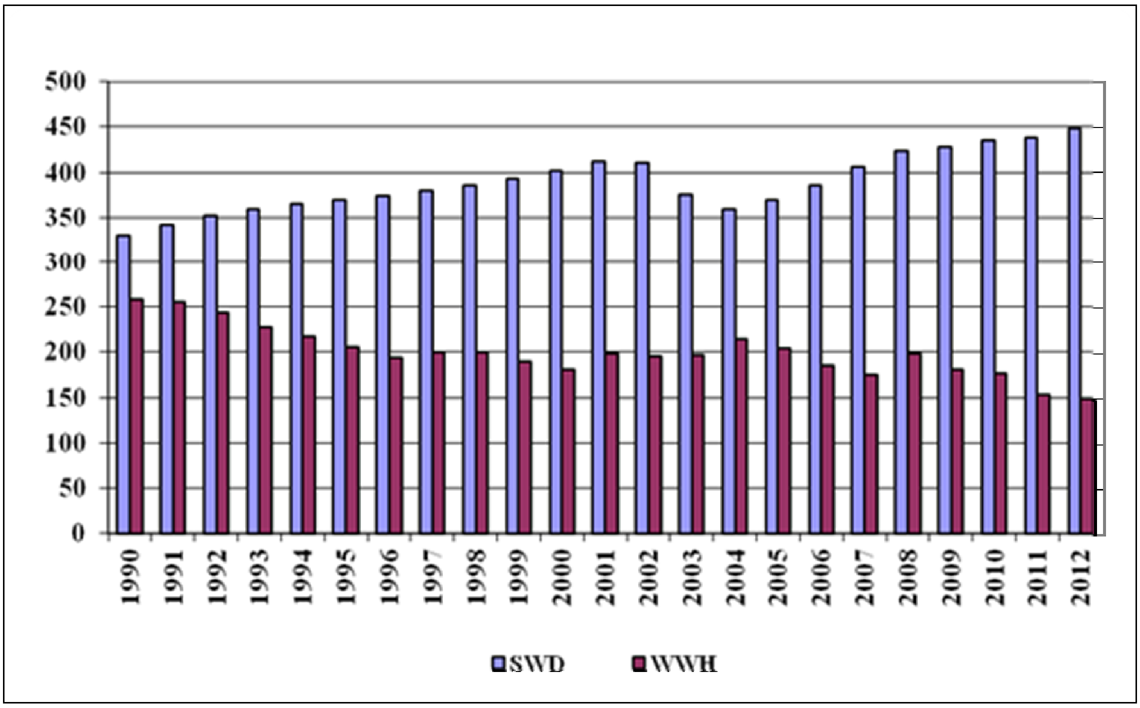


Figure 2.9. Emissions from SWD and WWH sectors in CO_2 equivalent (Gg)

Emissions from Waste Incineration (WI) and Composting in last year's, when emissions from these sectors were calculated, are very small in comparison with other sectors – Solid waste disposal (SWD) and Waste water handling (WWH) (Figure 2.9, Figure 2.10).

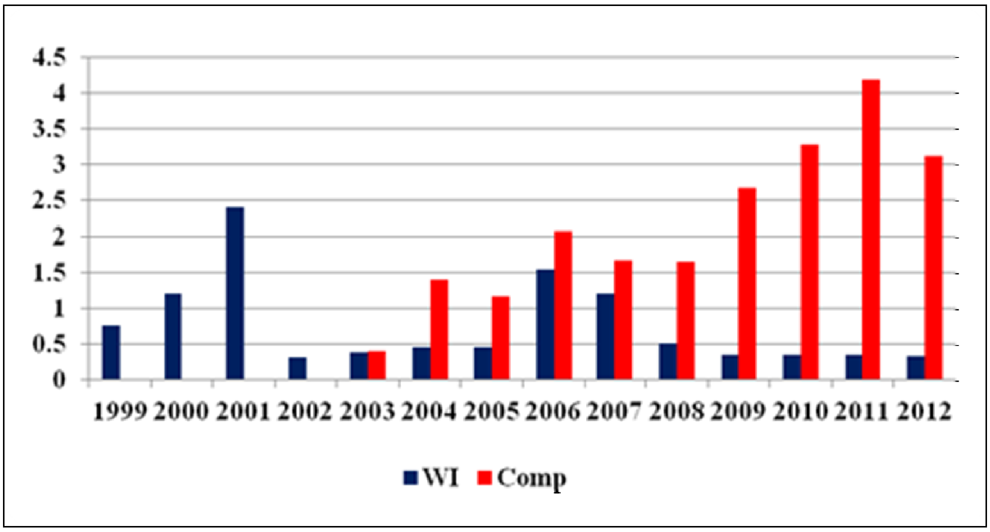


Figure 2.10 Emissions from WI and composting sectors in CO_2 equivalent (Gg)

2.4 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS OF INDIRECT GREENHOUSE GASES AND SO_2

The emissions trends of the indirect greenhouse gases, sulphur dioxide, nitrogen oxides, carbon monoxide and non-methane volatile organic compounds, are presented in Figure 2.11.

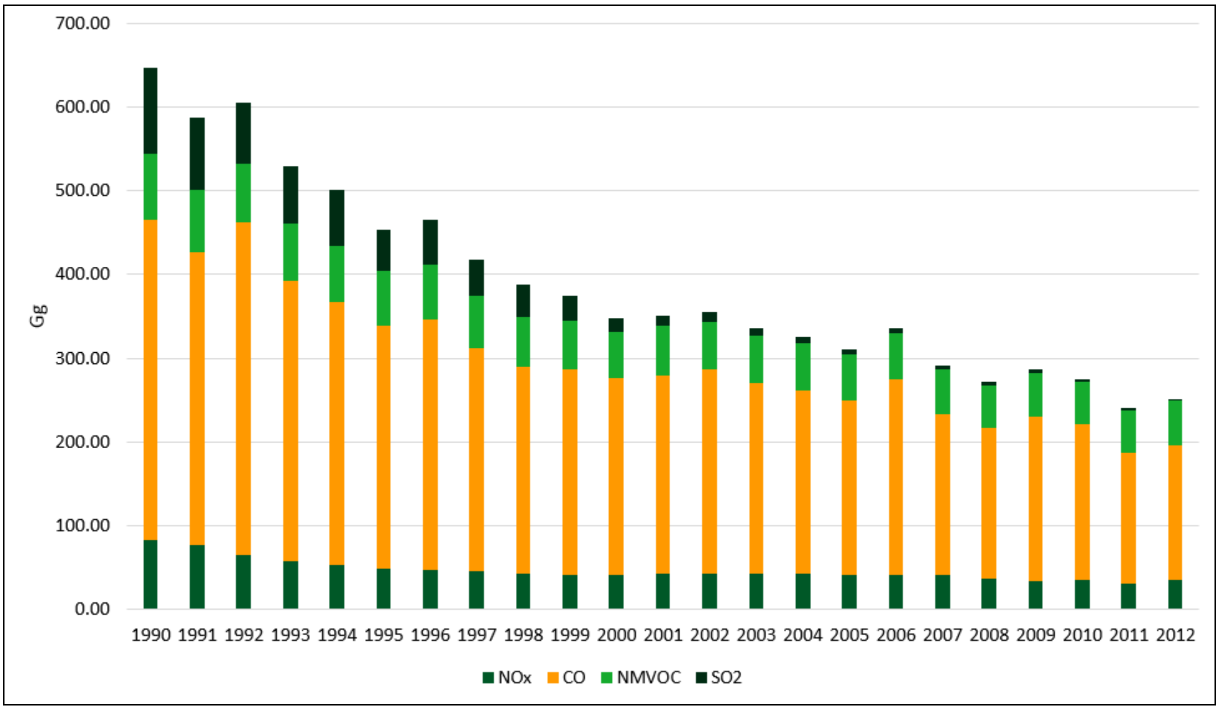


Figure 2.11 Total indirect greenhouse gas emissions trend 1990-2012 (Gg)

In 2012, the **sulphur dioxide emissions** were 2.39 Gg from which 80.9% originated in the Energy sector and 19.1% from Industrial Processes. Since 1990 to 2012 the total SO_2 emissions have decreased by 97.7%. The reduction is mainly due to use of fuels with lower content of sulphur as well as fuel switching from solid and liquid types of fuel to natural gas and biomass.

Nitrogen oxides were generated generally in the Energy sector (83.5%) and 16.4% in the Industrial Processes. In 2012, the total emissions were 34.87 Gg. The Transport sector was responsible for 44.9% of the total NO_x emissions. The total NOx emissions have decreased by

58.2% from 1990 to 2012. Generally the reduction is due to decrease of total fuel consumption that was caused by transformation of national economy as well as energy efficiency and control measures and also solid fuels and heavy liquid fuels replacement with natural gas and biomass fuels.

In 2012, **Carbon monoxide** emissions were 161.22 Gg, originated generally in the Energy sector (96.9%). Residential sector generates the biggest part of the total CO emissions – 71.03%. The CO emission trend shows a decrease of emissions for period 1990 – 2012 by 57.8%.

In 2012, total emissions of **Non-methane volatile organic compounds** were 53.08 Gg from which Energy sector (Residential stationary plants) generated 54.4 %, Solvent and Other Product Use (Domestic solvent use including fungicides and Other product use) generates approximately 41.6 %, but Industrial Processes 3.3%.

2.5 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS FOR KP-LULUCF ACTIVITIES

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 2.1.

Table 2.1 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)

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 in the Energy sector in Latvia (Table 3.1). Mainly the imported fuels (natural gas and heavy oil) are used in heat generation. Smaller boiler houses burn local fuel and coal as well.

Table 3.1 Consumption of energy resources in Latvia (TJ)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Energy consumption	*304961*	*173149*	*147462*	*172269*	*180376*	*183961*	*176182*	*170724*	*184574*	*169039*	*170827*
Shale oil		79	2440	157	118	118	79	39	39	79	39
Liquefied petroleum gas	3689	1548	2140	2550	2687	2414	2186	2003	2103	2414	3279
Gasoline and aviation gasoline	26796	18128	14831	15126	16753	18299	16672	13941	12667	11926	10146
Jet kerosene	3067	1166	1123	2463	2852	3414	4105	4297	4926	4925	5012
Other kerosene	648	432	43								
Diesel oil (including gasoil)	43000	17166	20693	32887	36371	41343	39133	36500	38994	35268	35182
Residual fuel oil	63092	36134	9460	3167	2152	1624	1096	1421	1069	735	568
White spirits	84	84	126	126	126	84	84	42	40	42	42
Lubricants	1633	963	879	1088	1088	1088	1047	628	586	795	922
Bitumen	1633	712	2009	2512	3098	3349	3600	2218	1967	2930	2888
Paraffin waxes			126	335	251	251	209	293	461	293	251
Petroleum coke				429	627	132		165	627	0	
Other liquids	2637	712	2553	209	1088	963	795	711	1005		
Used oils	879			848	263	234	263	117	95	88	58
Liquid fuels, total	*147158*	*77124*	*56423*	*61897*	*67474*	*73313*	*69269*	*62375*	*64579*	*59495*	*58387*
Coal	26098	7172	2761	3146	3409	4248	4248	3409	4378	4509	3645
Peat	3286	3838	2452	80	70	90	90	30	100	40	30
Peat briquettes	867	403	31			1	1	6	6	3	4
Coke	290	211	290	188	161	107	134	134	80	80	161
Oil shale	28										
Solid fuels, total	*30569*	*11624*	*5534*	*3414*	*3640*	*4446*	*4473*	*3579*	*4564*	*4632*	*3840*
Natural gas	*99653*	*42279*	*45635*	*56852*	*58892*	*56922*	*55814*	*51381*	*61313*	*54034*	*50806*
Wood and wood products:	27581	42102	39695	49396	49748	48706	46018	52591	51354	46901	52503
firewood				34351	34257	33808	32696	36354	33993	29741	31665
wood remains				8421	8102	7011	6129	7687	7829	8008	7922
wood chips				6134	6934	7361	6667	8112	8596	8221	9911
wood briquettes				221	221	238	238	204	374	343	548
wood pellets				270	234	288	288	234	562	588	2457
Charcoal				60	30	45	60	60	60	60	59
Bioethanol					43	0	1	108	350	318	279

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Biodiesel				107	60	73	82	73	808	749	659
Landfill gas				251	259	271	290	323	331	349	347
Other biogas								7	91	497	1731
Sewage sludge gas		20	44	118	100	79	80	120	119	104	109
Straws				0	11	16	14	29	60	43	38
Biomass, total	*27581*	*42122*	*39739*	*49932*	*50251*	*49190*	*46545*	*53311*	*53173*	*49021*	*55725*
Used tires				131	174	119	90	81	21	107	424
Municipal wastes								57	838	1433	1756
Other fuels, total	*0*	*0*	*131*	*174*	*119*	*90*	*81*	*78*	*945*	*1857*	*2069*

The use of natural gas as a primary energy resource has grown increasingly since middle of the nineties. The largest consumers of natural gas are combined heat and power plant, 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 30.63% in 2012, including heavy fuel – residual fuel oil and shale oil, with about 0.32% of total energy consumption. The residual fuel oil consumption has a significant decrease - in 1990 it was 20.81% from total fuel consumption, but in 2012 it is 0.30%. The 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 approximately 78% from total liquid fuel consumption where gasoline is mostly consumed in transport sector and only a small part is used in off-roads. Diesel oil consumption divides by combusted in transport sector – 73.9%, and combusted in stationary combustion installations – 26.1% from total diesel oil consumption.

Total share of solid fuels in national market is quite low – approximately 2.01%. The solid fuel consumption in last years is stable although the consumption had decreased by 87.07% since 1990. From 2009 to 2011 solid fuel consumption had increased by 29.42% that is mainly explained with an increase of coal consumption, but in year 2012 there can be seen a decrease in emissions by 17.09% due to reduced use of coal.

Natural gas consumption has a stable place in total fuel consumption where natural gas consumption is 32.86% in 1990 and 26.66% in 2012. Natural gas consumption has decreased by 49.02% in 1990-2012. Recent years until 2011 the consumption of natural gas has an increasing trend – from 2009 to 2010 even by 19.33%, but in 2010-2012 there can be seen a decrease of natural gas by 17.14%.

Biomass fuels are wood and wood products, straw, charcoal and biofuels. In the total fuel consumption the share of firewood and other wood products is quite substantial and has reached its peak point 27.8% in 2010 by the side of 1990 when firewood consumption was only about 9.1% from total energy consumption. However, in 2010-2011 the consumption of wood and wood products dropped but in 2011-2012 it increased reaching 27.55% of all fuels consumed.

In latest years liquid and gaseous biofuels are becoming more popular and from 0.056% in 2005 to 2012 their consumption has reached 0.49%. In latest years also such biomass fuels as straws are used, and it has an increasing tendency with fluctuations, especially in year 2011, which can mainly be explained with warm winter.

There are also used tires and municipal wastes used as fuel in the latest years, and the most significant increase can be observed in year 2011 – comparing with year 2010 the consumption of other fuels has increased by 96.51% and reached 1.10% from total share. However, in year 2012 the increase of other fuels consumed was not as rapid as in previous year, and the increase in other fuels' use in 2011-2012 was 11.42%, and the share of total fuel amount consumed was 1.22% in 2012.

Hydroelectric power plants (HPP) and combined heat and power plants (CHP) produce part of the electrical power, while part is imported (Table 3.2, Table 3.3). 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 3.2 Electricity production and consumption in Latvia (TJ)

	Electricity							
	Production	Own use and losses	Import	Export	Final consumption			
					CRF 1.A.2.	CRF 1 A.3.	CRF 1.A.4.	TOTAL
1990	16186	6883	25700	12798	11484	918	17550	29952
1991	11790	6682	15217	7	10807	785	17255	28847
1992	9076	5645	14688	7	8316	745	13777	22838
1993	10350	6102	9619	612	5440	688	10904	17032
1994	11898	6681	9533	2988	5076	670	10102	15848
1995	10573	6372	9529	1408	5130	677	10267	16074
1996	6700	7989	12377	760	4975	641	9266	14882
1997	10634	7694	6566	4	5519	634	8935	15088
1998	15545	6559	3290	1382	5296	612	10310	16218
1999	9932	5774	9349	2311	5130	554	10375	16059
2000	10163	5202	7589	1159	5159	547	10411	16117
2001	10210	5688	8424	1645	5562	623	10314	16499
2002	8906	5188	10217	1764	5494	518	11563	17575
2003	8330	5065	9616	137	5778	490	12456	18724
2004	11369	4975	9839	2290	5882	500	13072	19454
2005	12139	4767	10278	2545	6120	533	13972	20625
2006	9878	4522	10116	1087	6332	540	15242	22114
2007	10030	4194	17870	7070	6538	504	16740	23782
2008	11405	4198	16715	7643	6066	497	17298	23861
2009	12625	4032	15333	9378	5421	436	16114	21971
2010	12848	4626	14303	11160	5724	453	16197	22374
2011	10649	4137	14432	9950	6012	446	15829	22287
2012	13756	3639	17766	11678	7175	464	17015	24654

Table 3.3 Heat production and consumption in Latvia (TJ)

	Heat				
	Production	Own use and losses	Final consumption		
			CRF 1.A.2	CRF 1.A.4	TOTAL
1990	99439	15171	32929	51339	84268
1991	96120	16096	33394	46630	80024
1992	75442	10953	22632	41857	64489
1993	54846	9954	7154	37738	44892
1994	46822	7330	1998	37494	39492
1995	46112	8215	1969	35928	37897

	Heat				
	Production	Own use and losses	Final consumption		
			CRF 1.A.2	CRF 1.A.4	TOTAL
1996	47137	8838	2046	36253	38299
1997	45721	8317	1976	35428	37404
1998	42872	8950	1940	31982	33922
1999	36191	8115	1162	26914	28076
2000	31867	6815	659	24393	25052
2001	33937	7038	641	26258	26899
2002	33048	6541	630	25877	26507
2003	33516	6409	626	26481	27107
2004	31093	6174	608	24311	24919
2005	31144	5886	684	24574	25258
2006	30056	5454	634	23968	24602
2007	28685	4911	554	23220	23774
2008	26402	4010	356	22036	22392
2009	26308	4099	298	21911	22209
2010	28662	4590	387	23685	24072
2011	25000	4104	268	20628	20896
2012	26857	4464	259	22134	22393

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:

- shale oil;
- liquefied petroleum gas;
- motor gasoline and aviation gasoline;
- kerosene type jet fuel;
- other kerosene;
- gasoline type jet fuel;
- motor diesel oil and heating gas oil;
- residual fuel oil;
- other liquids:
- used oils,
- pyrolysis resin,
- petroleum coke.

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:

- solid biomass – wood and other wood products, charcoal, straw, 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, and also other biogases from anaerobic fermentation,

- liquid biofuels – biogasoline and biodiesel, that are mainly imported from Latvia's neighbourhood countries.

Other fuels are municipal wastes and industrial wastes – used tires, collected by and combusted in cement production plant in Latvia.

Types of fuels used as <u>feedstocks</u> in Latvia:

Liquid fuels – 100% imported from Latvia's oil importers from neighbourhood countries and Scandinavian countries:

- white spirits;
- lubricants;
- bitumen;
- paraffin waxes.

3.1.2 Description

As it can be seen on the Figure 3.1, there are significant differences between share of subsectors in the Energy sector, especially in 1.A.3 Transport sector, 1.A.4 Other sectors and 1.A.1. Energy industries, and these changes are explained in the corresponding sub-chapters.

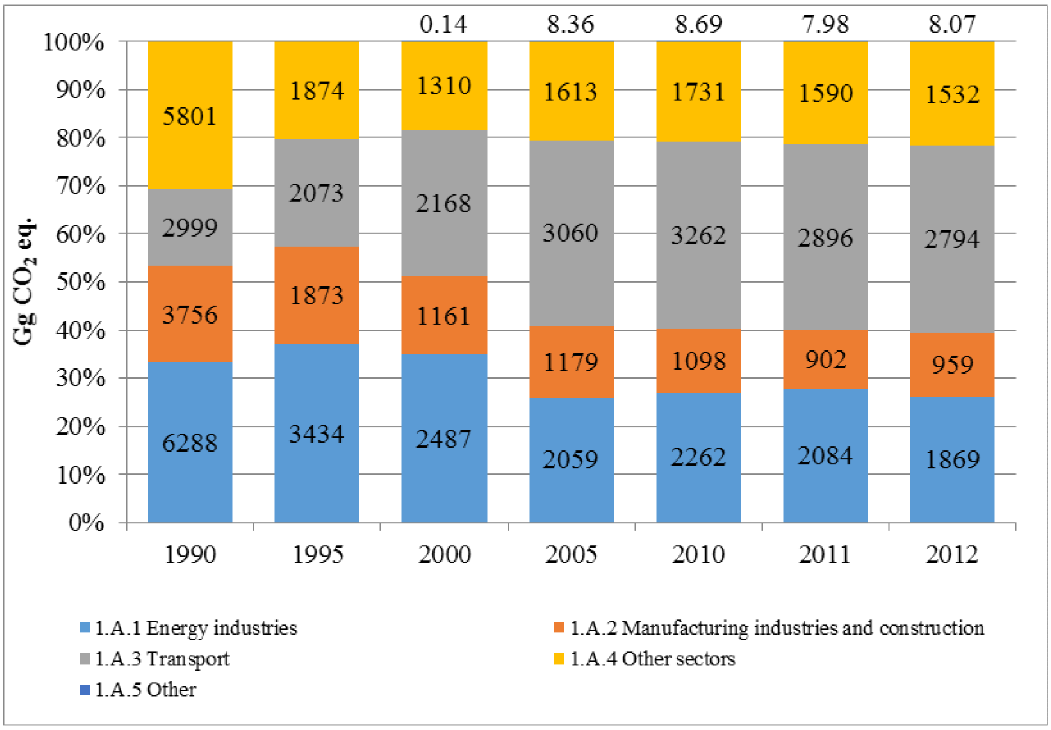


Figure 3.1 Share of emissions in the Energy sector in 1990-2012 (Gg CO_2 eq)

In 1990 the biggest share of GHG emissions was held by Energy industries with 33.4% as well as Other sectors with 30.8% from all emissions produced in Energy sector. 19.9% of emissions were produced also in Manufacturing industries and construction sector, and the smallest share of emissions was held by Transport sector with only 15.9%. Emissions in military sector (1.A.5) were not produced until 1996.

However, starting from 1990, the share of Transport emissions have constantly grown, reaching 38.6% in 2005. Since then, the Transport sector have been the largest emissions' producer in Energy sector, which can be generally explained with the increase of population's well being and growth of economy and also with restrictions related with use of fossil fuels in stationary combustion.

In 2012 the biggest share of GHG emissions in Energy sector is held by Transport sector with 39% of total Energy sector's GHG emissions. The second largest subsector with 26.1% share is Energy Industries, and a quite significant part of emissions – 21.4% – is produced within 1.A.4 Other sectors (small combustion in commercial and residential subsectors). Emissions from Military sector (1.A.5) have a 0.1% share from Energy emissions.

Table 3.4 GHG emissions from Energy sector in 1990–2012 (Gg)

	A Fuel combustion			B Fugitive emissions from fuels		Aggregate GHGs
	CO_2	**CH_4**	**N_2O**	**CH_4**	**CO_2**	**CO_2, CH_4, N_2O, HFCs, PFCs, SF_6**
	Gg			Gg		Gg CO_2 equivalent
1990	18412.06	22.41	0.55	9.90	0.01	19052.21
1991	16900.11	23.42	0.54	9.54	0.01	17559.26
1992	13704.18	21.30	0.48	8.70	0.01	14301.61
1993	11614.20	21.54	0.43	8.32	0.01	12199.23
1994	10044.74	21.20	0.41	8.13	0.01	10617.82
1995	8840.24	21.44	0.42	7.92	0.01	9420.737
1996	8916.96	21.52	0.42	7.63	0.01	9499.442
1997	8383.68	20.31	0.41	7.12	0.01	8937.072
1998	7999.16	19.14	0.39	6.83	0.01	8520.615
1999	7365.97	18.53	0.38	6.51	0.01	7871.456
2000	6773.55	17.36	0.37	6.03	0.01	7252.05
2001	7177.87	18.34	0.40	5.84	0.01	7687.461
2002	7186.45	18.32	0.40	6.10	0.01	7695.042
2003	7384.49	17.52	0.44	4.76	0.01	7888.605
2004	7405.92	17.81	0.45	4.71	0.01	7919.951
2005	7506.73	18.40	0.45	5.33	0.01	8031.182
2006	7952.19	16.57	0.43	3.82	0.00	8434.479
2007	8264.52	16.61	0.43	3.92	0.00	8748.044
2008	7837.86	15.76	0.41	4.03	0.00	8295.725
2009	7162.28	16.66	0.41	3.81	0.00	7638.315
2010	7978.00	15.84	0.41	3.66	0.00	8438.426
2011	7135.27	12.49	0.40	1.98	0.00	7521.253
2012	6794.83	14.17	0.42	2.85	0.00	7222.089

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 (Table 3.4).

GHG emissions from the Energy sector in the latest years (since 2000) are fluctuating with a peak point in 2007 that is explained with a sharp increase of national economy (Figure 3.2). GHG emissions in the Energy sector increased by 21.96% in 2000-2007. In the second half of

2008, a recession in national economy started caused by the crisis. That is the main reason why all GHG emissions in Energy sector decreased by 13.33% in 2007-2009. In 2010, total GHG emissions again increased by 11.38% compared with 2009 as consumption of fuel increased, too. However, since then the emissions decreased again because of increase of average temperature – in 2011 it was 1.6°C above normal temperature, which was especially because of the warm winter where the average temperature in January was lower by 8.5°C comparing to January, 2010, and also the end ot the year when the average temperature in December was lower by 8.6°C. In 2012 fuel consumption decreased even more as well as the amount of GHG emissions produced.

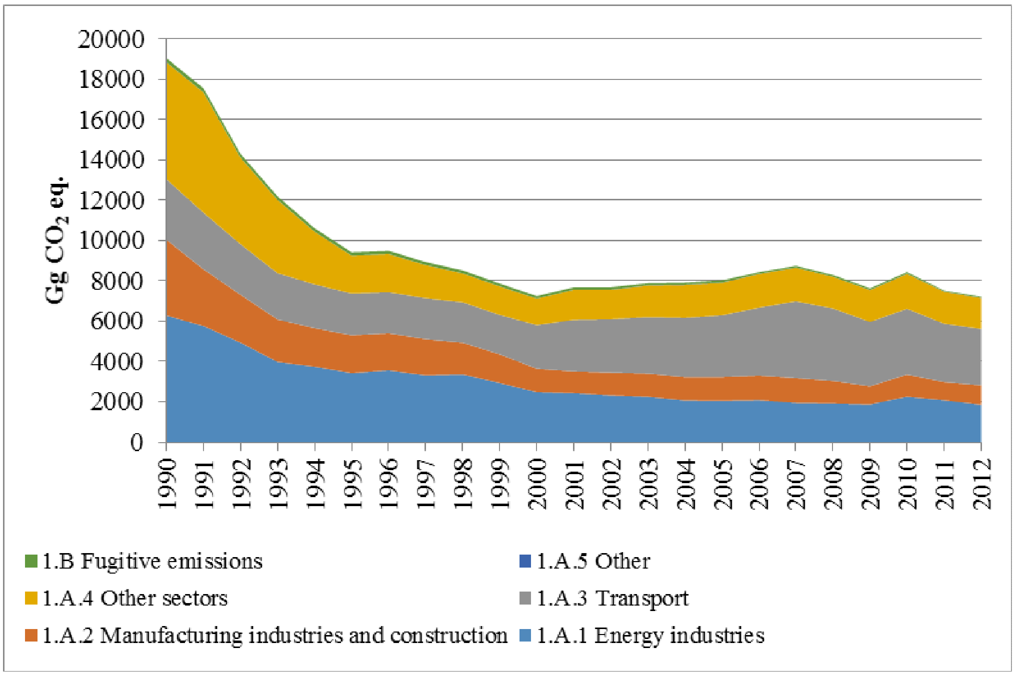


Figure 3.2 GHG emissions from Energy sector 1990–2012 (Gg CO_2 eq)

The emissions are decreasing from 1990 to 2012 with some fluctuations in between. In 1.A.1 sector sharp decrease in 2008-2009 by 7.92% can be explained with the crisis in national economy caused by global financial crisis, also the winter in 2009 was quite warm with 0.8°C above average temperature, therefore in 2009 GHG aggregated emissions in CRF 1.A.1 were 2.56% less than in 2008, but in 2010 an increase of emissions by 20.42% in Energy industries was observed, mostly because of the ending of the global crisis and also the average temperature in winter was lower than in year 2009. As year 2011 was warmer than previous year, the fuel consumption, as well as the emissions decreased by 7.88% if compared with year 2010. However, the average temperature in 2012 was less than in 2011, but the amounts of consumed energy resources continued to decrease as well as the emissions which decreased by 10.31% comparing to 2011.

The decrease of industrial production (1.A.2) was influenced by economical situation when development of national economy was made in financial and real estate sectors but the import dominated over export. Increase of cost and price as well as total inflation led to a total decrease of industry. Therefore the GHG emissions from CRF 1.A.2 sector had decreased by 19.10% in 2008-2009, but in 2010 emissions increased by 21.62% as fuel consumption increased. In year 2011 the emissions have decreased by 17.85% that can be explained with great reconstructions in the enterprise "Liepājas Metalurgs" under 1.A.2.a sector where the fuel consumption decreased significantly. In year 2012 comparing to year 2011 the GHG emissions increased by 6.41% mainly due to intensified steel melting in „Liepājas Metalurgs".

For Transport sector (1.A.3) emissions decreased from 2008 to 2009 by 11.32% that was influenced by sharp increase of fuel price and economy crisis. Decrease is also explained with improvement of car park in country and use of mostly new cars. Starting from 2010 growth of emissions from transport sector is observed by 2.36% comparing to 2009, although in year 2011 the emissions decreased again and comparing with year 2010 the decrease was 11.24%. The decrease in emissions can be seen also in 2011-2012 by 3.51%.

The emissions in 1.A.4 Other sectors are constantly decreasing since 1990, with fluctuations in emissions in the time scale which mostly depend on the temperatures in winter. In 2012 comparing with 2011, the emissions have decreased by 3.68%.

The emissions in 1.A.5 Other have increased by 1.21% in 2012, and it is not related neiter with financial circumstances nor weather conditions, and the trend is not predictable.

Decrease of methane fugitive emissions is explained with a constant improvement of natural gas supply infrastructure.

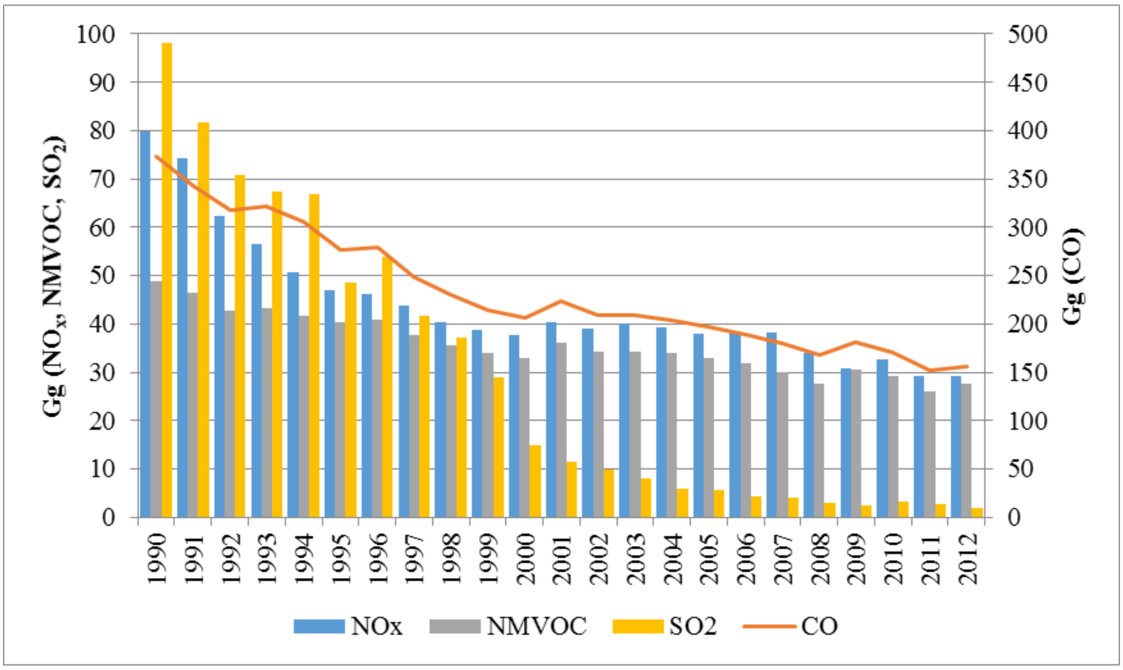


Figure 3.3 Total indirect GHG emissions from fuel combustion in 1990–2012 (Gg)

In 2012, the largest part of indirect emissions contributes CO then NMVOC and NOx emissions (Figure 3.3). Most CO and NMVOC emissions come from wood combustion in the Residential sector while largest share of NOx emissions comes from Transport sector.

The biggest decrease is observed in SO_2 emissions where emissions decreased from 97.68 Gg in 1990 to 1.93 Gg in 2012. 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.

The indirect emissions in general are higher in 2012 if compared to 2011: CO emissions have increased by 3.21%, NMVOCs have increased by 5.80%, NO_x emissions have decreased by 0.49%, but the greatest decrease in emissions can be seen in SO_x – 24.10% which can be explained with an increased amounts of biomass burned comparing with previous year.

Key categories

Key categories reported in the Table 3.5 are estimated without taking into account LULUCF sector by using Tier 1 estimation level. Tier 1 approach for determination of the key source is used by incorporating category uncertainty estimates developed under Tier 1 uncertainty analysis.

Table 3.5 Key categories in Energy sector in 2012

	IPCC GHG Source and Sink Categories	**Gas**	**Key category**	**Criteria for identification**
1.A.1.a	Public Electricity and Heat Production - Gaseous Fuels	CO_2	Yes	L,T
1.A.1.a	Public Electricity and Heat Production - Liquid Fuels	CO_2	Yes	T
1.A.1.a	Public Electricity and Heat Production - Solid Fuels	CO_2	Yes	T
1.A.2.c	Chemicals - Liquid Fuels	CO_2	Yes	T
1.A.2.e	Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	Yes	L
1.A.2.e	Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	Yes	T
1.A.2.f	Other - Gaseous Fuels	CO_2	Yes	L
1.A.2.f	Other - Solid Fuels	CO_2	Yes	L,T
1.A.2.f	Other - Liquid Fuels	CO_2	Yes	L,T
1.A.3.b	Road Transportation - LPG	CO_2	Yes	L
1.A.3.b	Road Transportation - Diesel Oil	CO_2	Yes	L,T
1.A.3.b	Road Transportation - Gasoline	CO_2	Yes	L
1.A.3.c	Railways - Liquid Fuels	CO_2	Yes	L
1.A.4.a	Commercial/Institutional - Liquid Fuels	CO_2	Yes	L,T
1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO_2	Yes	L
1.A.4.a	Commercial/Institutional - Solid Fuels	CO_2	Yes	T
1.A.4.a	Commercial/Institutional - Biomass	CH_4	Yes	T
1.A.4.b	Residential - Gaseous Fuels	CO_2	Yes	L,T
1.A.4.b	Residential - Liquid Fuels	CO_2	Yes	L,T
1.A.4.b	Residential - Biomass	CH_4	Yes	L,T
1.A.4.b	Residential - Solid Fuels	CO_2	Yes	T
1.A.4.b	Residential - Solid Fuels	CH_4	Yes	T
1.A.4.b	Residential - Biomass	N_2O	Yes	T
1.A.4.c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	Yes	L
1.A.4.c	Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	Yes	T

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 3.6.

Table 3.6 Reported emissions from fuel combustion in Latvia in 2012

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	NO	NO	NO	NO	NO	NO	NO
	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	NO	NO	NO	NO	NO	NO	NO
	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	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	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

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
d. Pulp, Paper and Print								
	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
e. Food Processing, Beverages and Tobacco								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
f. Other								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	NO
	Biomass	√	√	√	√	√	√	NO
	Other Fuels	√	√	√	√	√	√	√
1.A.3 Transport								
a. Civil Aviation								
	Aviation Gasoline	√	√	√	√	√	√	√
	Jet Kerosene	√	√	√	√	√	√	√
b. Road Transportation								
	Gasoline	√	√	√	√	√	√	√
	Diesel Oil	√	√	√	√	√	√	√
	LPG	√	√	√	√	√	√	√
	Other Liquid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO
	Biomass	√	√	√	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
c. Railways								
	Liquid Fuels	√	√	√	√	√	√	√
	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
d. Navigation								
	Residual Oil (Residual Fuel Oil)	NO	NO	NO	NO	NO	NO	NO
	Gas/Diesel Oil	√	√	√	√	√	√	√
	Gasoline	√	√	√	√	√	√	√
	Other 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
	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

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
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 6794.83 Gg (including Transport sector) in 2012 and accounted 90.59% of the total CO_2 emissions.

CH_4 emissions from fuel combustion were 11.32 Gg (including Transport sector) in 2012 that makes 18.20 from total CH_4 emissions. The biggest part of CH_4 emissions contributes to Other sectors – 10.37 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. A research to determine country specific CH_4 emissions from biomass combustion have been carried out, but the information obtained is incomplete and additional studies have to be carried out.

N_2O emissions from fuel combustion were 0.42 Gg (including Transport sector) and accounted 7.03% of the total N_2O emissions in 2012.

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 1990-2012 prepared for EUROSTAT[8].

Difference between CO_2 emissions estimated with RA and SA for liquid fuels is quite high – from 3.30% in 1995 to -8.47% in 1999 (Table 3.7). Difference for solid fuels is smaller -

[8] EUROSTAT Annual Questionnaire by CSB, 2013

7.72% in 2003 to -4.05% in 1996. Difference for gaseous fuels fluctuates from 0.15% in 1990 to 3.15% in 1993. However, for other fuels the fluctuations are higher – from 0.07% in 1999 to 70.59% in 2011.

Table 3.7 Difference (%) between Sectoral and Reference approach data (PJ) and CO_2 emissions (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fuel consumption - Liquid fuels											
RA	143.92	124.69	105.15	97.81	94.66	78.72	80.87	71.27	70.75	60.73	53.22
SA	139.23	123.94	103.96	96.92	91.13	74.38	80.24	68.90	67.76	63.12	51.91
Diff., %	0.97	-0.75	0.09	-0.46	2.09	3.47	-1.61	-0.33	-0.28	-9.23	-3.52
CO_2 emissions - Liquid fuels											
RA	10377.78	9064.17	7664.21	7104.47	6876.69	5673.78	5841.85	5055.42	4968.22	4236.57	3642.24
SA	10296.56	9155.29	7676.36	7156.45	6753.41	5499.07	5951.23	5085.48	4993.79	4628.79	3762.98
Diff., %	0.79	-1.00	-0.16	-0.73	1.83	3.18	-1.84	-0.59	-0.51	-8.47	-3.21
Fuel consumption - Solid fuels											
RA	29.70	26.00	22.86	20.91	15.73	11.20	10.51	9.36	6.90	5.27	5.50
SA	30.39	26.53	23.50	21.29	16.04	11.60	10.94	9.70	7.06	5.35	5.47
Diff., %	-2.25	-2.01	-2.70	-1.77	-1.93	-3.47	-3.96	-3.51	-2.27	-1.55	0.54
CO_2 emissions - Solid fuels											
RA	2587.84	2272.24	2017.04	1846.52	1401.39	1024.90	960.02	862.05	633.50	474.62	514.77
SA	2651.57	2322.16	2077.07	1881.53	1429.88	1062.47	1000.59	893.85	648.26	482.05	511.09
Diff., %	-2.40	-2.15	-2.89	-1.86	-1.99	-3.54	-4.05	-3.56	-2.28	-1.54	0.72
Fuel consumption - Gaseous fuels											
RA	98.80	99.61	72.24	47.60	34.64	42.30	36.58	44.58	43.71	41.86	45.84
SA	98.70	98.02	70.78	46.17	33.65	41.32	35.59	43.54	42.67	40.85	45.07
Diff., %	0.10	1.62	2.07	3.09	2.96	2.36	2.77	2.39	2.44	2.46	1.70
CO_2 emissions - Gaseous fuels											
RA	5469.28	5513.98	4038.03	2660.53	1919.93	2340.45	2022.93	2463.33	2416.13	2309.03	2534.79
SA	5460.88	5422.65	3953.78	2579.25	1863.56	2285.05	1967.25	2404.34	2357.10	2252.09	2490.74
Diff., %	0.15	1.68	2.13	3.15	3.02	2.42	2.83	2.45	2.50	2.53	1.77
Fuel consumption - Other fuels											
RA	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.04	0.13
SA	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.04	0.13
Diff., %	0.00	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											
RA	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.04	10.86
SA	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	3.04	10.85
Diff., %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07

Continuation of Table 3.7

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fuel consumption - Liquid fuels												
RA	52.75	51.54	56.45	58.48	59.18	64.92	69.82	65.22	57.94	58.76	53.67	52.90
SA	52.65	52.87	54.39	55.83	55.59	60.32	65.29	60.40	55.08	56.87	50.65	49.47
Diff., %	-4.82	-8.54	-2.37	-1.32	-0.85	0.07	-0.37	-0.19	-0.57	-2.07	-2.05	-1.36
CO_2 emissions - Liquid fuels												
RA	3631.18	3503.68	3871.78	3983.28	3960.89	4371.04	4700.63	4352.19	3965.60	4057.37	3589.81	3528.00
SA	3804.20	3824.22	3957.32	4063.25	4044.57	4365.02	4717.27	4363.71	4022.49	4164.94	3691.36	3597.47
Diff., %	-4.55	-8.38	-2.16	-1.97	-2.07	0.14	-0.35	-0.26	-1.41	-2.58	-2.75	-1.93
Fuel consumption - Solid fuels												

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
RA	5.15	4.18	3.72	2.85	3.41	3.64	4.45	4.47	3.54	4.46	4.63	3.84
SA	5.17	4.18	3.48	2.84	3.41	3.64	4.45	4.41	3.57	4.51	4.65	3.86
Diff., %	-0.30	0.00	6.93	0.35	0.00	0.00	-0.02	1.40	-0.73	-1.03	-0.39	-0.57
CO_2 emissions - Solid fuels												
RA	461.99	374.15	353.15	262.53	314.71	335.56	410.46	412.76	325.95	410.86	427.14	353.82
SA	463.14	373.89	327.85	261.31	314.49	335.32	410.28	406.31	328.38	415.32	428.53	355.64
Diff., %	-0.25	0.07	7.72	0.47	0.07	0.07	0.05	1.59	-0.74	-1.07	-0.33	-0.51
Fuel consumption - Gaseous fuels												
RA	53.27	54.15	56.41	55.86	56.93	58.98	57.02	55.89	51.49	61.27	54.00	50.81
SA	52.37	53.59	55.68	55.33	56.77	58.72	56.69	55.33	50.85	60.86	53.37	50.15
Diff., %	1.72	1.05	1.32	0.96	0.28	0.44	0.58	1.02	1.26	0.68	1.19	1.31
CO_2 emissions - Gaseous fuels												
RA	2941.72	2993.95	3117.75	3086.68	3144.66	3258.86	3149.88	3087.30	2844.36	3406.27	3001.21	2817.01
SA	2890.23	2960.85	3075.33	3055.49	3133.84	3242.38	3129.79	3054.12	2807.07	3363.92	2949.19	2764.33
Diff., %	1.78	1.12	1.38	1.02	0.35	0.51	0.64	1.09	1.33	1.26	1.76	1.91
Fuel consumption - Other fuels												
RA	0.25	0.33	0.29	0.31	0.17	0.12	0.09	0.24	0.08	0.94	1.86	2.04
SA	0.25	0.33	0.29	0.31	0.17	0.12	0.09	0.24	0.08	0.94	1.86	2.07
Diff., %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.41
CO_2 emissions - Other fuels												
RA	20.31	27.49	24.00	25.89	13.85	9.48	7.19	13.72	4.38	39.82	113.02	90.56
SA	20.30	27.47	23.99	25.87	13.83	9.47	7.18	13.71	4.33	33.81	66.25	77.38
Diff., %	0.07	0.07	0.07	0.07	0.12	0.07	0.12	0.07	1.11	17.79	70.59	17.03

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.

Amount of used tires combusted in cement production plant is reported as Other fuels as well as municipal wastes combusted in the same cement production plant for years 2008-2012.

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. To improve the transparency of reporting, the statistical differences, distribution losses, as well as interproduct changes for the whole time series are presented in Annex 4.

CSB estimates total consumption data by taking production, import, export and international bunkering data into account. 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.

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. For Lubricants total fuel consumption reported as feedstocks is higher than fuel consumption reported in RA because interproducts transfer is not taken into account.

The changes larger than 2% between fuel consumption in RA and SA are explained below for each fuel type.

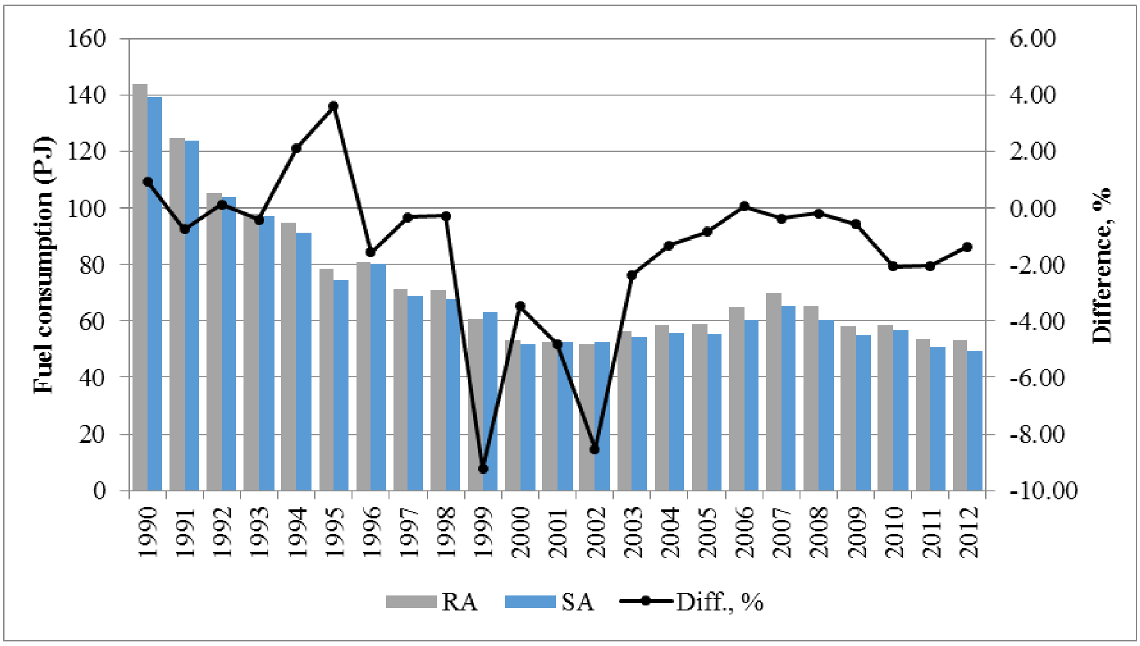


Figure 3.4 Difference in consumption of Liquid Fuels between Reference and Sectoral Approach

The difference between fuels varies from -2% to 2% with exceptions in some years (Figure 3.4). In 1995, the difference can be explained with statistical differences in diesel oil energy balance which are not taken into account when calculating Reference Approach. In 1999, there are large statistical differences in gasoline consumption (-6.38 PJ) as well as statistical difference in consumption of RFO (0.65 PJ). In 2000-2003 statistical differences mainly for these fuels are quite large. For example, in year 2002 the statistical differences for RFO are -1.42 PJ and gasoline -2.95 PJ.

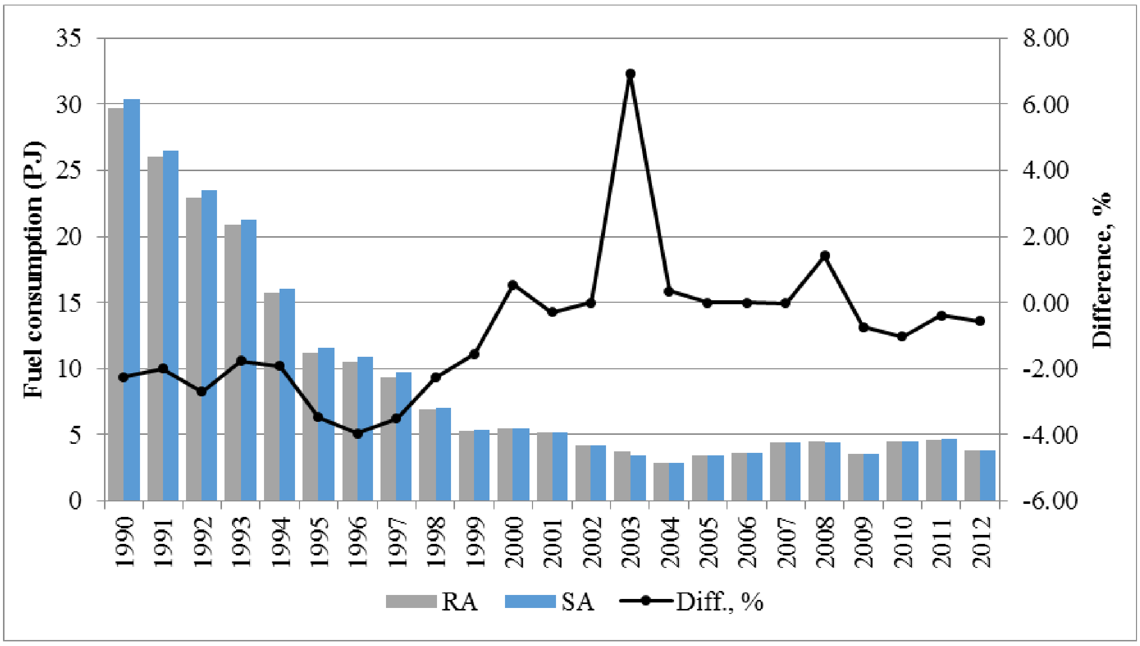


Figure 3.5 Difference in consumption of Solid Fuels between Reference and Sectoral Approach

The difference for solid fuels is quite large in the 1990-ties, and there is a large difference in a particular year – 2003 (Figure 3.5). The difference in 1990-1998 can be explained with fact that in Reference Approach there is no possibility to report produced amounts of peat briquettes, but in these years remarkable amounts were produced in Latvia (170-867 TJ/year) therefore the differences exist as long as peat briquettes are produced. As for year 2003, the main difference in RA/SA fuel consumption is because of distribution losses of peat by 241 TJ.

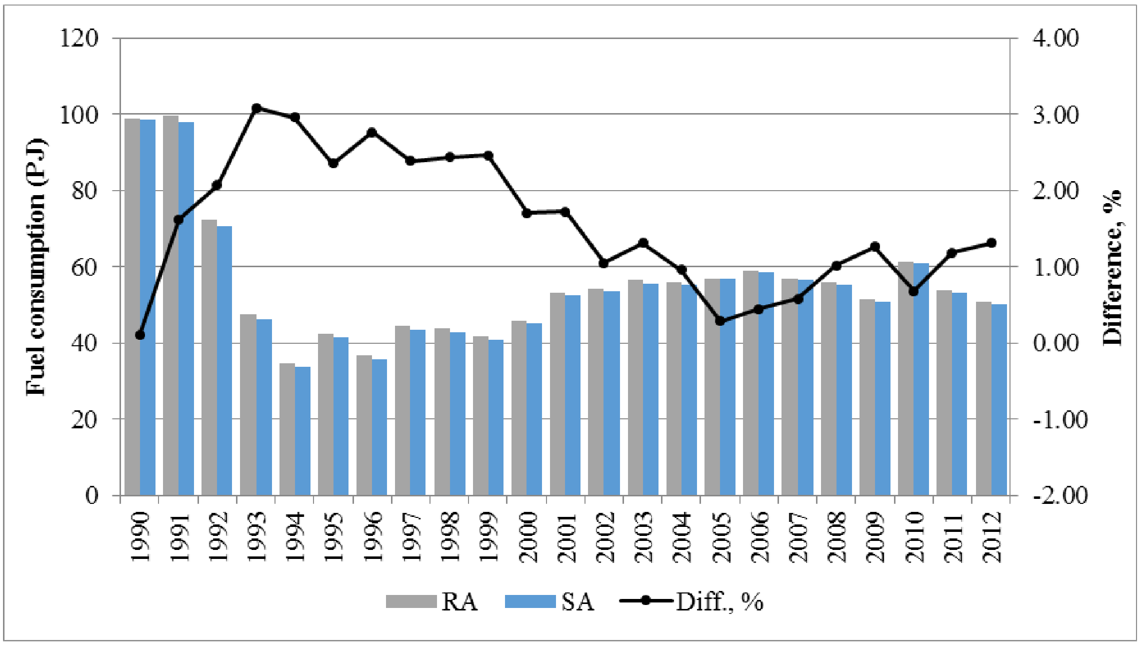


Figure 3.6 Difference in consumption of Gaseous Fuels between Reference and Sectoral Approach

The differences in natural gas consumption between both approaches are mainly due to distribution losses that occur every year (Figure 3.6).

The differences for other fuels are not larger than ±2% therefore not analysed.

CO_2 emissions

Default country specific emission factor for gasoline is used in the 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 waxes and white spirits in RA tables have to be estimated as zero values, because these fuels do not emit CO_2 and are only used as feedstocks.

Due to fact that interproducts transfer amount is not taken into account, in RA carbon and CO_2 emissions from Lubricants consumption resulted in negative number because fuel consumption in RA tables does not include amounts of fuel reported in interproducts transfer, but fuel consumption given in feedstocks is reported with this amount.

3.2.1.2 Explanation of the fluctuations

Fluctuations of emissions estimated with Sectoral and Reference Approach are more or less equal. All fuels had decreased in 1990-1995 due to continued changes of national economy structure, inflation and collapse of national industry. Still in 1995-1996 the government adopted strict rules to cut back the inflation and downward of industry so the fuel consumption since 1995-1996 also was restructured. Since 1996 the natural gas consumption is increasing but other fuel consumption are increasing only after 2000 – after crisis in national economy of neighbourhood Russian Federation and due to development of national economy that was prepared for joining European Union. In the recent years there can be seen the influence of global economic crisis in 2007-2009 and a recovery after that in 2010-2012 with a decreasing trend of emissions.

3.2.1.3 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. However, the consumption of shale oil, other liquid fuels, waste oils and petroleum coke was taken from CSB on-line database due to aggregated reporting of particular fuels in Annual Questionnaires, therefore, in order to improve transparency of the reporting, it was decided to use data from Energy Balance instead of Annual Questionnaires. Also the NCV from natural gas has been taken from the enterprise "Latvijas Gāze" which reports NCVs of natural gas consumed to LEGMC every year.

For several fuels NCV changes once 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.

Table 3.8 Carbon emission factors (t/TJ)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Gasoline	18.89	18.89	18.89	18.91	18.91	18.91	18.91	18.91	18.91	18.91	18.91
Diesel oil	20.40	20.40	20.40	20.40	20.40	20.40	20.40	20.40	20.40	20.40	20.40
RFO	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11
LPG	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13
Jet kerosene	19.72	19.72	19.72	19.71	19.71	19.71	19.71	19.71	19.71	19.71	19.71
Other kerosene	19.72	19.72	19.72	19.71	19.71	19.71	19.71	NO	NO	19.71	19.71
Other oil	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01
Shale oil	NO	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05
Bitumen	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Lubricants	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01
Petroleum coke	NO	NO	NO	27.50	27.50	27.50	NO	27.50	27.50	NO	27.50
Gasoline type jet fuel	NO	NO	NO	19.35	19.35	19.35	NO	NO	NO	NO	NO
Paraffin waxes	NO	NO	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Used oils	20.01	NO	NO	28.66	28.66	28.66	28.66	28.66	28.66	28.66	28.66
White spirit	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	26.80
Coal	23.65	23.65	23.65	25.68	25.68	25.68	25.68	25.68	25.68	25.68	25.68
Lignite	23.65	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	24.22	24.22	24.22	23.84	23.84	23.84	23.84	23.84	23.84	23.84	23.84
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	28.93	28.93	28.93	28.93	28.93	28.93	28.93	NO	NO	28.93	28.93
Natural gas	15.17	15.17	15.16	15.14	15.14	15.14	15.14	15.14	15.16	15.16	15.12
Solid biomass	29.90	29.90	29.90	29.90	29.90	29.90	29.90	29.90	29.90	29.90	29.90
Biogas	NO	NO	NO	30.60	30.60	30.60	30.60	30.60	30.60	30.60	30.60
Liquid biofuels	NO	NO	NO	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Industrial wastes	NO	NO	23.05	21.68	21.67	21.68	23.20	23.20	16.62	16.62	16.62
Municipal wastes	NO	NO	NO	NO	NO	NO	12.05	12.53	10.84	16.59	11.38

Carbon emission factor for bitumen and lubricants taken from IPCC 1996[9] was used (Table 3.8). Emission factor for paraffin wax were taken from Lithuanian submission but white spirit emissions factor were taken from Denmark submission. Estonia's 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 Estonia. Carbon emission factor for industrial wastes (used tires) was estimated based on CO_2 emission factor reported by cement production plant within ETS.

3.2.1.4 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

[9] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf, page 1.13

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

Municipal wastes structure also influenced carbon emission factor change in 2008-2012.

The series consistency was checked by verifying IEF changes and attention was paid to changes that exceeded 10% level (Table 3.9).

Table 3.9 IEF changes higher than 10% for 1.AB Reference Approach sector

Sector	Fuel	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.AB	Industrial Wastes (used tires)	t/TJ	2009	23.20	2010	16.62	-28.35%	Changes in IEF are due to different content of biomass in used tires, which influenced CO_2 EF.
1.AB	Municipal Wastes	t/TJ	2011	16.59	2012	11.38	-31.43%	Changes in IEF are due to different structure in municipal waste (biomass fraction, NCV).
1.AB	Municipal Wastes	t/TJ	2010	10.84	2011	16.59	53.00%	
1.AB	Municipal Wastes	t/TJ	2009	12.53	2010	10.84	-13.44%	
1.AB	Used Oils	t/TJ	2002	20.01	2003	28.66	43.21%	In 2003 the structure of waste oils changed therefore average NCV in 2003 was lower (more light waste oils were used).

3.2.1.5 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.
- 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. All significant differences (more than 2%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.
- By comparing used carbon emission factor with CO_2 emission factors used in Sectoral Approach.
- 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. Taking into consideration the fact that ports in Latvia are focused on transit cargo transport, navigation activities have big fluctuations and depend on neighbouring countries' economical and international trading activities and competitiveness of Latvian ports' with other neighbouring ports in Baltic Sea. At the same time emissions from aviation are more stable, and recent trend depicts a persistent increase. Total GHG emissions of International Bunkering are shown in the Figure 3.7.

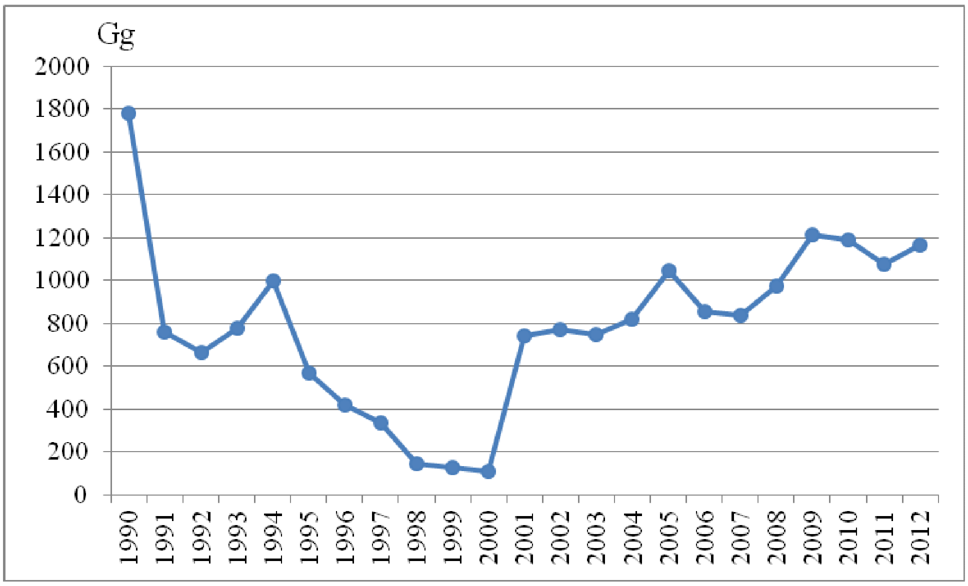


Figure 3.7 Emissions from International Bunkers (Gg CO_2 eq.)

Data about international bunker fuel consumption is provided by CSB (Table 3.10). CSB split of fuel for national and international navigation/aviation is based on EUROSTAT and IEA guidelines on data collection. Defined approach about energy consumption allocation for international and national navigation/aviation fully is in line with the defined criteria in IPCC Good Practice Guidance 2000 (for more details see "Energy Statistics Manual", IEA, EUROSTAT (2005)). In Latvia case there are not situations when international marine/aviation transport departs from port in Latvia and stops in port in Latvia to drops and picks up passengers or freight and than departs to final destination in other country. Therefore implemented data collections of fuel consumption in international and national navigation/aviation fully ensure a correct allocation between national and international mode.

To provide the consistent allocation of fuel consumption between domestic and international mode in the navigation and aviation, CSB each month collects and summarises the information which is submitted by every one of enterprises which perform fuel bunkering; For this purpose the particular statistical report format is elaborated in which the enterprises have to fill in the data regarding amount of fuel sold respectively in domestic and international navigation and aviation.

Table 3.10 Energy consumption in international transport (TJ)10

	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
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	4953,2
2008	4062,0	1912,1	6699,0
2009	4278,0	2591,9	8850,8
2010	4907,0	2932,0	7592,0
2011	4926,0	3171,0	5806,0
2012	4984,0	3697,0	6374,0

The emission factors are shown in Table 3.11.

Table 3.11 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	1.8475	0.1742	0.0659
RFO	76.6	0.005	0.002	1.9532	0.1822	0.0665

The methodology used for calculation of emissions from international aviation corresponds to the IPCC 1996 Tier 2a (as denominated in accordance with 2000 GPG), where the amount of LTO/cruises is crucial. Emissions from international navigation are calculated in pursuance with IPCC 1996 Tier 1.

The relevant emission factors are taken from different sources. All of the international aviation and navigation emission factors (CO_2, CH_4 and N_2O) are derived from the IPCC

[10] CSB. Annual Eurostat Energy Questionnaire, 2013

1996, while the remaining factors – from EMEP/EEA 2009 (for determination of SO_2 EF country-specific sulphur content is applicable) (see Table 3.12 and Table 3.13).

Table 3.12 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)
1990-2002	0.2	42.49	0.094
2003-2004	0.05	42.49	0.024
2004-2007	0.2	42.49	0.094
2008-2012	0.1	42.49	0.047

Table 3.13 SO_2 Emission factors used for RFO in the SO_2 calculation of emissions International Bunkering

RFO	Fuel content	NCV	EF (Gg/PJ)
1990-2007	2.8	40.6	1.352
2007-2012	1.5	40.6	0.74

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 1990–2012.

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. It was assumed that neighbourhood countries are importing their liquid fuels from the same liquid fuels supplying countries therefore liquid fuels with similar characteristics are used in countries of one region.

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 3.14 Activity data for Feedstocks and Non-energy use of fuels in 1990–2012 (TJ)

	Bitumen	Lubricants	Paraffin Wax	White Spirit
1990	1632.54	1632.54	NO	83.72
1991	544.18	1046.50	NO	83.72
1992	83.72	920.92	NO	83.72
1993	167.44	1088.36	NO	83.72
1994	544.18	1004.64	NO	83.72
1995	711.62	962.78	NO	83.72
1996	879.06	962.78	NO	83.72
1997	1632.54	879.06	NO	83.72
1998	2051.14	1004.64	NO	125.58
1999	2344.16	879.06	125.58	83.72
2000	2009.28	879.06	125.58	125.58
2001	1506.96	837.20	167.44	125.58
2002	2093.00	837.20	167.44	83.72
2003	2176.72	920.92	167.44	83.72
2004	2009.28	1004.64	251.16	125.58
2005	2511.60	1088.36	334.88	125.58
2006	3097.64	1088.36	251.16	125.58
2007	3348.80	1088.36	251.16	83.72
2008	3599.96	1046.50	209.30	83.72
2009	2218.58	627.90	293.02	41.86
2010	1967.42	586.04	460.46	41.86
2011	2930.20	795.34	293.02	41.86
2012	2888.34	920.92	251.16	41.86

Constant increase of bitumen use since 2004 until 2008 (Table 3.14) 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. However, during the economic crisis the funding reduced and the amounts of bitumen used decreased in 2008-2010. After the crisis there can be seen an increase in bitumen use.

Coke consumption is not 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 are mainly used in transport sector. According to Transport sector expert the percentage amount of lubricants that are combusted in mobile vehicles system was estimated using the amount if lubricants combusted. Approximately 99.7% in 2012 from total lubricants consumption are used as feedstocks and therefore 99.7% of carbon is reported as stored. Only 0.3% of total lubricant consumption is assumed as combusted and the emissions for the activity are included in Road Transport sector.

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

3.2.3.3 CO_2 capture from flue gases and subsequent CO_2 storage

There is no CO_2 captured and further storaged in Latvia.

3.2.3.4 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 the Annexes.

3.2.4 Energy Industries (CRF 1.A.1)

3.2.4.1 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 autoproducer combustion installations is excluded from this sector and included in particular sectors of 1.A.2, 1.A.4.a and 1.A.4.c sectors according to IPCC 1996.

Emissions from combustion installations with NACE 2 codes 35.11 and 35.30 are reported in 1.A.1.a sector. There are no direct electricity production only plants in Latvia. There are no petroleum reifneries in Latvia. 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 and charcoal production plants) – these emissions are reported under 1.A.1.c Manufacture of solid fuels and other energy industries sector.

Table 3.15 Emissions from 1.A.1 Energy industries in 1990–2012 (Gg)

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
1990	6267.55	0.27	0.046	6287.54	10.72	2.60	0.22	36.99
1991	5747.49	0.26	0.042	5765.89	9.77	2.55	0.20	30.18
1992	4923.30	0.25	0.041	4941.27	8.52	2.10	0.17	27.53
1993	3969.77	0.24	0.039	3986.81	7.19	1.48	0.13	28.69
1994	3731.92	0.24	0.040	3749.42	6.99	1.28	0.13	32.47
1995	3417.88	0.23	0.036	3433.97	6.34	1.39	0.12	23.12
1996	3549.52	0.25	0.039	3567.00	6.67	1.33	0.13	28.76
1997	3305.68	0.29	0.041	3324.49	6.21	1.71	0.14	19.58
1998	3349.94	0.28	0.041	3368.71	6.17	1.76	0.15	20.41
1999	2923.74	0.23	0.034	2939.02	5.28	1.62	0.13	15.64
2000	2472.58	0.22	0.030	2486.64	4.42	1.56	0.12	7.14
2001	2419.14	0.21	0.028	2432.38	4.40	1.78	0.13	5.17
2002	2314.55	0.22	0.029	2328.08	4.25	1.77	0.13	4.86

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
2003	2246.69	0.23	0.031	2260.99	4.17	1.89	0.14	3.52
2004	2059.10	0.21	0.027	2071.95	3.81	1.81	0.13	2.12
2005	2047.78	0.18	0.024	2058.94	4.07	1.76	0.13	2.16
2006	2073.32	0.20	0.026	2085.41	3.75	1.87	0.13	1.22
2007	1943.80	0.19	0.026	1955.82	3.87	1.77	0.13	1.25
2008	1916.58	0.19	0.025	1928.29	3.38	1.76	0.12	0.74
2009	1867.06	0.19	0.025	1878.86	3.12	1.71	0.12	0.75
2010	2249.50	0.21	0.028	2262.49	3.50	2.04	0.14	0.78
2011	2072.05	0.20	0.026	2084.22	3.10	1.90	0.13	0.36
2012	1855.24	0.23	0.030	1869.28	3.03	1.90	0.14	0.35

Emissions from 1.A.1 sector have a decreasing trend with few peak points from which the most recent is in 2010 (Table 3.15). 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 completely reorganized. Decrease in the end of 90-ties is explained with economical crisis in Russian Federation with whom Latvia has close economical collaboration. Decrease of emissions in 2008-2009 years is explained with crisis in national economy caused by global financial crisis. Although the heat and electricity production for population use is influenced by crisis in national economy in smaller level than industrial production the emissions are decreasing as population is using less electricity and residential sector is switching from central district heating to individual heating. The increase of GHG emissions in 2010 were 20.42% comparing with 2009. That can mostly be explained with a relatively cold winter. In 2011 the emissions decreased again because of much warmer winter when the temperature was 1.6°C above average, and in 2012 the emissions continued to decrease, however, the average temperature was lower than in previous year.

Still in 2008-2010 CH_4 and N_2O emissions increased by 11.43% and 10.68% respectively due to increase of liquid solid and biomass fuel consumption and share of liquid and solid fuel consumption in total amount of fuel combusted in CRF 1.A.1 sector. In year 2011 the amounts of CH_4 and N_2O emitted decreased comparing with year 2010 by 6.42% and 6.25% respectively. However, in year 2012 the emissions increased again by 14.78% and 15.72%, while CO_2 emissions decreased by 10.46%. That can mainly be explained with increased use of wood which increases CH_4 and N_2O emissions, and at the same time is CO_2 neutral. Also, 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.

Indirect GHG emissions from 1.A.1 Energy Industries were estimated as well. SO_2 had the biggest decrease by 99.05% in 1990–2012. It is explained with fuel switching from coal, peat and heavy fuel oils to natural gas and biomass from what sulphur dioxide emissions are not emitted. Also a strict national legislation was approved to improve quality of used liquid fuels in country. The most recent sharp decrease in SO_2 emissions in 2010-2011 by 53.59% is because of the largest company which uses residual fuel oil – the fuel was replaced with one which contained less sulphur therefore the emissions decreased even two times. In 2012 the decrease in SO_2 emissions is quite small – 3.28%.

3.2.4.2 Methodological issues

IPCC GPG 2000 Tier 2 method was used to estimate CO_2 emissions from fuel combustion as country specific parameters were used to estimate CO_2 emission factor. However, there are no country-specific emission factors due to lack of information for biodiesel, and IPCC 2006 EF was used instead. IPCC GPG 1996 Tier 1 Sectoral approach was used to calculate CH_4 and N_2O emissions from the 1.A.1 sector.

As sludge gas consists almost 50% of non-combustible components such as CO_2 sulphur and others and only approximately 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. Tier 2 method from IPCC GPG 2000 was used to calculate CO_2 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 the 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 2005-2012 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;
- Data from only natural gas supplier company of natural gas physical characteristics;
- IPCC 1996;
- IPCC 2006;
- EMEP/EEA 2013.

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

CO_2 emission factors

In 2004 a research by a 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.

Solid and liquid fuels and solid biomass

For calculating CO_2 emission factors for liquid and solid fuels following equation was used:[11]

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

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)
M_C – molecule weight for C – 12.011 (g/mcl)

For Submission 2014 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 to CSB within annual reporting (Table 3.16).

Table 3.16 Characteristics of liquid solid and solid biomass fuels and estimated CO_2 emission factors

Fuel type	Carbon content in working mass of fuel (C^d) %	NCV (Q_z^d), GJ/t	Oxidation factor	Emission factor with oxidation factor (EF CO_2), t/TJ
Coal	67.32	28.46 (1990-2002) 26.22 (2003-2012)	0.98	84.9387 92.1951
Peat W_d=40%	29.07	10.05	0.98	103.8664
Coke	63.87	26.37 (1990-2001) 26.79 (2002-2012)	0.98	86.9727 85.6092
Motor gasoline (for off-roads)	83.13	44 (1990-2002) 43.97 (2003-2012)	0.99	68.5347 68.5815
Diesel oil	86.68	42.49	0.99	74.001
RFO	85.72	40.6	0.99	76.5881
Shale oil	82.82	39.35	0.99	76.3477
LPG	77.99	45.54	0.995	62.4366
Jet fuel	85.18	43.2 (1990-2002) 43.21 (2003-2012)	0.99	71.5252 71.5087
Other kerosene	85.17	43.2 (1990-2000) 43.21 (2004) 43.2 (2005-2012)	0.99	71.5168 (Q_z^d 43.2) 71.5003 (Q_z^d 43.21)
Used oils	83.77	41.86	0.99	72.593
Wood W_d = 55%	20.11	6.7	0.98	107.7789

For biodiesel, default CO_2 emission factor (70.8 Gg/PJ) from IPCC 2006 was taken due to unavailability of country specific data.

Natural gas

For calculating CO_2 emission factors for natural gas following equation was used:[12]

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

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

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 – 12011 (g/mcl)
ρ – natural gas density – for transition from density to mass units (t/1000m^3)

Data of carbon content NCV and natural gas density for all years in 1990-2012 were obtained from only natural gas supplier JSC "Latvijas Gāze" that collects / measures these data by themselves.

Table 3.17 Characteristics of natural gas and estimated CO_2 emission factors

	Carbon content in working mass of fuel (C^d) %	NCV (Q_z^d) TJ/1000m^3	Oxidation factor (p)	Natural gas density (ρ) t/1000m^3	Emission factor with oxidation factor (EF CO_2) kg/GJ
1990	74.33	33.64	0.995	0.6867	55.3183
1991	74.33	33.64	0.995	0.6867	55.3183
1992	74.36	33.6	0.995	0.6923	55.8583
1993	74.15	33.71	0.995	0.6965	55.8556
1994	74.04	33.7	0.995	0.6914	55.3808
1995	74.26	33.73	0.995	0.6889	55.2953
1996	74.3	33.62	0.995	0.6859	55.2644
1997	74.39	33.62	0.995	0.6845	55.2184
1998	74.35	33.65	0.995	0.6857	55.2361
1999	74.31	33.62	0.995	0.6841	55.1268
2000	74.32	33.73	0.995	0.6879	55.2596
2001	74.36	33.78	0.995	0.6876	55.1835
2002	74.36	33.65	0.995	0.6858	55.2516
2003	74.38	33.64	0.995	0.6851	55.2265
2004	74.39	33.59	0.995	0.6839	55.2192
2005	74.4	33.59	0.995	0.6835	55.1944
2006	74.39	33.59	0.995	0.6838	55.2112
2007	74.38	33.54	0.995	0.6828	55.2052
2008	74.38	33.57	0.995	0.6833	55.1962
2009	74.37	33.696	0.995	0.686	55.1997
2010	74.42	33.6477	0.995	0.6855	55.2758
2011	74.43	33.6645	0.995	0.6856	55.2637
2012	74.33	33.7959	0.995	0.6880	55.4445

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

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:

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

C^d – carbon content in fuel (%)
Mc – molecule weight for C – 12011 (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 3.18).

Table 3.18 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/1000m^3	Amount of methane in sludge gas (%)	Default carbon content in working mass of methane (C^d) %	NCV of methane (Q_z^d) TJ/1000m^3	Oxidation factor (p)	Natural gas density (ρ) t/1000m^3	Emission factor with oxidation factor (EF CO_2) kg/GJ
41.92582%	22.0	56.00%	74.867543%	35.88	0.995	0.6687	50.870474

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 and N_2O emission factors used in estimation of emission were taken from IPCC 1996, Chapter 1, Table 1-7 and Table 1-8, accordingly. CH_4 and N_2O emission factors for biodiesel, sludge gas and other biogas were taken from IPCC 2006, Chapter 2, Table 2.2. Emission factors for NO_x, NMVOC and CO were taken from EMEP/EEA 2013, 1.A.1 Energy industries, Table 3-2 (coal, coke), Table 3-3 (peat, peat briquettes), Table 3-4 (natural gas, LPG, sludge gas), Table 3-5 (RFO), Table 3-6 (liquid fuels, including biodiesel). Emission factors used for 2014 Submission are listed in Table 3.19 below.

Table 3.19 CH_4, N_2O, NO_x, CO, NMVOC emission factors used in 1.A.1. Energy Industries (Gg/PJ)

	CH_4	N_2O	NO_x	NMVOC	CO
Diesel oil	0.003	0.0006	0.065	0.0008	0.016
RFO	0.003	0.0006	0.142	0.0023	0.015
LPG	0.003	0.0006	0.089	0.0026	0.039
Jet fuel	0.003	0.0006	0.065	0.0008	0.016
Other kerosene	0.003	0.0006	0.065	0.0008	0.016
Other liquid	0.003	0.0006	0.065	0.0008	0.016
Petroleum coke	0.003	0.0006	0.065	0.0008	0.016
Waste oils	0.003	0.0006	0.065	0.0008	0.016
Shale oil	0.003	0.0006	0.065	0.0008	0.016
Coal	0.001	0.0014	0.209	0.001	0.009
Coke	0.001	0.0014	0.209	0.001	0.009
Peat briquettes	0.030	0.0040	0.247	0.001	0.009
Peat	0.030	0.0040	0.247	0.001	0.009
Natural gas	0.001	0.0001	0.089	0.0026	0.039
Wood	0.030	0.0040	0.081	0.007	0.090
CH_4 from Sludge Gas	0.001	0.0001	0.089	0.003	0.039
Other Biogass	0.001	0.0001	0.089	0.003	0.039
Biodiesel	0.003	0.0006	0.065	0.0008	0.016

Activity data

Mainly emissions from fuel combustion are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2012 sent to EUROSTAT. In the EUROSTAT tables fuel consumption mainly is in natural units (kt, millions m^3) therefore net calorific values provided by CSB are used to calculate fuel consumption into terajoules, except for natural gas where NCVs are taken from the natural gas company as noted previously. Data on fuel consumption in 1.A.1 sector are presented in A.3.1.

The CSB data collection system is based on detailed compulsory survey 2-EK (annual). Form 2-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.

Approximately 5000 respondents – all enterprises of the local governments regardless their number of employed and other enterprises employing 80 and more persons – were surveyed. Enterprises and organizations employing less than 80 persons were surveyed by the random sampling and afterwards the acquired results were extrapolated. 2–EK represents the basic tool for creating energy balances at a country level.

In Figure 3.8 there can be seen fuel consumption by fuel types in 1990-2012. The largest amounts of fuel types consumed are gaseous fuels in the whole time series and liquid fuels in the beginning of 1990-ties. The amounts of biomass consumed are slightly increasing, while the amounts of solid fuels are decreasing.

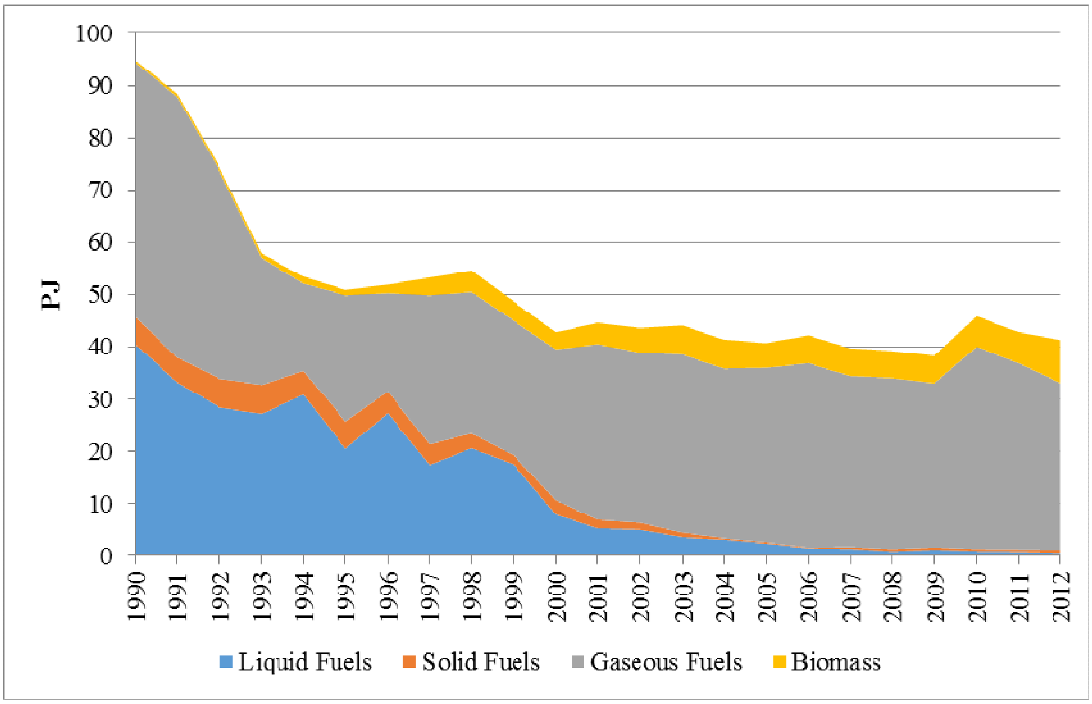


Figure 3.8 Fuel consumption in 1.A.1 Energy Industries in 1990-2012 (PJ)

The biggest decrease in time period 1990–2012 for the two sub-sectors of 1.A.1 Energy industries sector was for liquid fuel due to significant decrease of fuel consumption in 1.A.1.a subsector by 98.36%. It is explained with fuel switching processes when liquid fuels were switched to other more low-cost fuels. Also stronger legislation contributed fuel switch to the type of fuels with lower level of emissions. It also explains why consumption of solid fuels decreased. However, in the latest years consumption of solid fuels have increased that is explained with the increase of coal consumption in 1.A.1.a subsector by 400% in 2006-2012. The increase of solid fuel consumption was promoted by increase of oil price in world when coal combustion became cheaper than combustion of residual fuel oil and diesel oil.

Consumption of biomass fuel has increased by 1787.17% in 1990–2012. Solid biomass has lower costs therefore liquid and solid fuels replaced with biomass and natural gas.

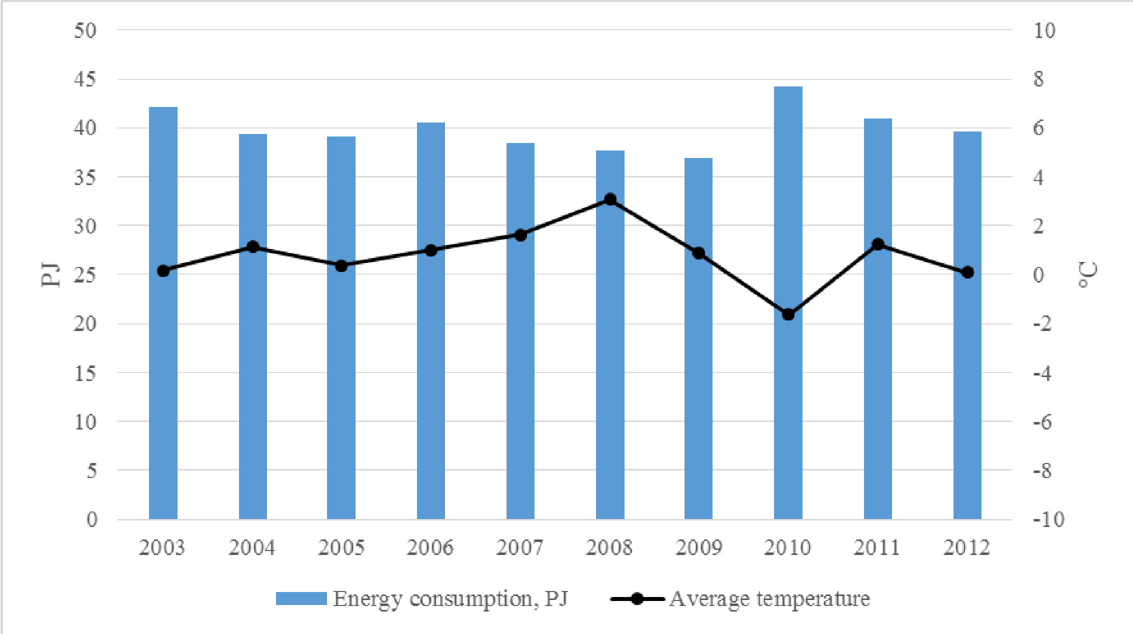


Figure 3.9 Fuel consumption in 1.A.1.a and average temperature in Latvia (2003-2012)

As it can be seen in Figure 3.9, the fuel consumption in 1.A.1.a sector is related with the average temperature in heating season (assumed that October-April are average months of heating season) with an exception of years 2006 where the correlation is not observed which can be explained with a decrease of central heating supply consumers when they switched to individual heating supply. Years 2006-2008 had quite high average temperature therefore the fuel consumption for combined heat plants and heat plants for heat production decreased as there wasn't any need of high heat production amount but in 2009-2010 the average temperature was lower and the use of fuel consumption increased. However in year 2011 the fuel consumption decreased because of a relatively warm winter, and in year 2012 the consumption of fuel continued to decrease despite the fall of average temperature.

3.2.4.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in 1.A.1 sector is ±2% in 2012. CSB gives approximately 2% statistical sample error for statistical data. According to CSB, as data are obtained using information given by respondents, this number is a variation coefficient which characterizes selection of respondents. Total variation coefficient for energy balance is within 2-3%.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. Also, according to IPCC 2000, pg. 2.41, there is more uncertainty for biomass and traditional fuels, that was a reason for higher uncertainty than for other fuel types. 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 approximately by the wastewater treatment plant that's why final uncertainty of combusted sludge gas is assumed as 20%. Taking into account uncertainties of solid biomass and biogas consumption total biomass fuel consumption uncertainty 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 for liquid fuels was assigned as quite low about 10%. The same level of uncertainty was assigned for solid fuels. CO_2 emission factor for natural gas was assumed rather low as 5% because plant specific fuel data is used to estimate emission factor.

CH_4 and N_2O emission factor used in estimation of emissions was taken from IPCC 1996 so uncertainty was assigned as 50% according to 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 exceeded 10% level. All issues given in Table 3.20 below were double checked and large fluctuations were explained.

Table 3.20 IEF changes higher than 10% for 1.A.1 sector

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.1.a	Solid Fuels/CH4	kg/TJ	2008	2.25	2009	1.60	-28.72%	Large fluctuation of CH_4 IEF is explained with changes of solid fuels structure. In 1990-2003 significant amounts of peat and peat briquettes were used in the sector, and peat consumption dominated in the solid fuels consumption in the sector. Starting from 2004, peat consumption reduced, while coal consumption increased by three times in 2006-2007.
1.A.1.a	Solid Fuels/CH4	kg/TJ	2007	2.61	2008	2.25	-13.90%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2006	5.66	2007	2.61	-53.83%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2004	7.48	2005	6.21	-16.92%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2003	22.95	2004	7.48	-67.43%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	2000	25.41	2001	22.42	-11.79%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1999	22.42	2000	25.41	13.36%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1995	20.10	1996	23.17	15.29%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1993	16.56	1994	19.03	14.95%	
1.A.1.a	Solid Fuels/CH_4	kg/TJ	1990	11.85	1991	15.36	29.68%	
1.A.1.a	Solid Fuels/N_2O	kg/TJ	2006	1.82	2007	1.54	-15.04%	
1.A.1.a	Solid Fuels/N_2O	kg/TJ	2003	3.37	2004	1.98	-41.20%	
1.A.1.a	Solid Fuels/N_2O	kg/TJ	1990	2.37	1991	2.69	13.29%	
1.A.1.a	Waste oils/CO_2	t/TJ	2002	72.59	2003	103.96	43.21%	In 2003 the structure of waste oils changed therefore average NCV in 2003 was lower (more light waste oils were used).
1.A.1.a	CH_4	kg/TJ	2011	26.44	2012	22.91	-13.36%	In 2012, the amounts of other biogas increased significantly, therefore total IEF for biomass decreased (wood which is the main biomass product consumed in 1.A.1.a has higher IEF than biogas).
1.A.1.a	N_2O	kg/TJ	2011	3.52	2012	3.05	-13.51%	
1.A.1.a	CH_4	kg/TJ	2011	1.68	2012	1.00	-40.42%	

3.2.4.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier 1 method from IPCC 2000 GPG. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.

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.
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. The reasons of data changes are explained.
    - After the data input in emission estimation database, the 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 verified by CSB energy experts by checking the data input reported in the NIR.
    - The emissions for indirect GHG in the database are cross-checked with emissions reported within LRTAP convention to ascertain if these are equal.
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 2%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.
4. Estimated emissions verification:

- 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 illogical 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.
- Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 2%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

Additional QA/QC checks for Tier 2 methodology

Country specific CO_2 emission factors

Mainly Tier 2 methodology is reported as used in the CO_2 emission estimation, 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.

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.

Plant specific CO_2 emission factors

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

3.2.4.5 Source-specific recalculations

Activity data were updated by CSB for wood consumption. Energy consumption less than 1 kt was taken from Energy balance available on CSB on-line database. Slight changes in natural gas GCV that influenced the amounts of gas consumed. Landfill gas previously reported in 1.A.1.a was allocated to 1.A.4.a sector. Changed emission factor for biodiesel (previously reported as other liquid biofuels). Other liquid fuels were split into waste oils petroleum coke and other liquid fuels therefore the consumption changed divided by fuel types.

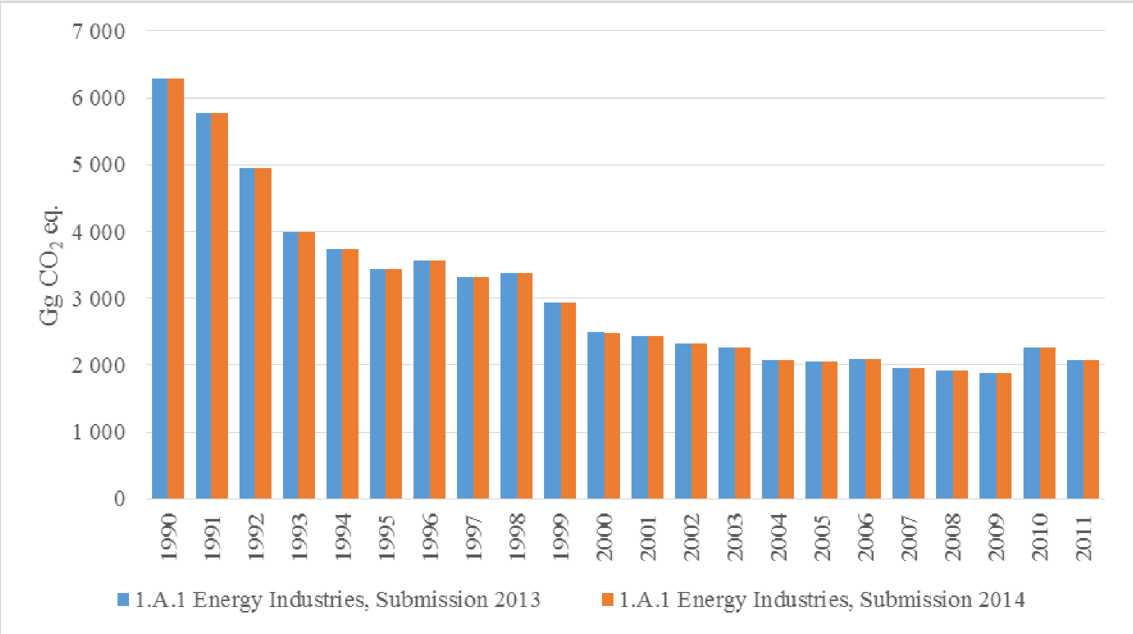


Figure 3.10 Comparison of GHG emissions in CRF 1.A.1 Energy Industries sector for Submission 2013 and Submission 2014 (Gg CO_2 eq.)

As it can be seen in Figure 3.10, the difference for Submission 2013 (submitted on September, 2013) and Submission 2014 in reported GHG emissions is quite small for all years in time series 1990-2012, fluctuating from -0.13% in 2000 to 0.10% in 2009.

3.2.4.6 Source-specific planned improvements

The summarized necessary improvements are:

- Implement the country specific emission factors obtained in research of CH_4 emissions from solid biomass combustion in the Submission 2015.
- Use of EU ETS data.

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

3.2.5.1 Source category description

CRF 1.A.2 Manufacturing industries and construction sector include emissions from fuel combustion in combustion installations for industrial production including emissions from off–road. CRF 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 CRF 1.A.2 according to IPCC 1996.

Starting from Submission 2014 the CRF subsector 1.A.2.f was split into several smaller subsectors. Under CRF 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
- Other non-specified (Industry)

Table 3.21 Emissions from 1.A.2 CRF Manufacturing industries and construction in 1990–2012 (Gg)

	CO_2	CH_4	N_2O	Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
1990	3742.90	0.26	0.026	3756.44	16.73	19.07	3.09	23.16
1991	2804.05	0.19	0.018	2813.64	11.49	6.85	1.64	14.07
1992	2368.39	0.17	0.016	2376.82	9.77	6.64	1.48	13.00
1993	2097.88	0.18	0.021	2108.12	9.78	7.74	1.75	14.38
1994	1899.68	0.17	0.022	1909.85	9.35	6.26	1.62	15.54
1995	1863.11	0.17	0.022	1873.31	9.41	4.24	1.51	14.88
1996	1826.91	0.18	0.023	1837.59	9.20	5.76	1.71	14.42
1997	1780.98	0.17	0.023	1791.62	9.04	5.02	1.64	13.94
1998	1559.86	0.18	0.022	1570.64	7.58	5.03	1.70	10.79
1999	1411.70	0.17	0.022	1422.03	6.76	4.19	1.59	8.78
2000	1151.91	0.16	0.017	1160.61	4.79	3.52	1.37	4.36
2001	1069.05	0.20	0.021	1079.81	3.78	4.07	1.73	2.33
2002	1125.04	0.19	0.020	1135.25	3.67	4.53	1.71	1.80
2003	1141.92	0.19	0.019	1151.78	3.72	3.67	1.59	1.39
2004	1149.56	0.23	0.025	1162.16	3.73	5.20	2.10	0.87
2005	1164.87	0.26	0.028	1179.07	3.51	6.28	2.36	1.11
2006	1212.20	0.29	0.032	1228.31	3.93	7.18	2.65	1.23
2007	1215.33	0.26	0.029	1229.71	3.79	7.10	2.37	1.25
2008	1100.28	0.27	0.030	1115.39	3.39	7.30	2.45	0.96
2009	883.12	0.33	0.040	902.39	3.24	7.51	3.09	0.65
2010	1073.80	0.41	0.049	1097.52	3.85	9.03	3.58	0.95

	CO_2	CH_4	N_2O	Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
2011	874.12	0.46	0.058	901.64	3.19	9.64	3.99	0.88
2012	928.11	0.52	0.066	959.40	3.52	10.67	4.50	0.75

Emissions from 1.A.2 were slightly increasing in 2001-2007 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 (Table 3.21). 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 caused a decrease of total emissions. Also increase of solid biomass consumption influenced a drop in CO_2 emissions. Large crisis of national economy caused by global financial crisis in 2008-2009 influenced quite significant decrease of GHG emissions by 19.10%. The crisis and development of EU ETS influenced increase of biomass consumption for 2008-2009 in 1.A.2 sector when almost all other fuels have decreased. Due to this significant increase of biomass consumption GHG emissions increased in 2009-2010. In year 2011 the GHG emissions have reduced by 17.85% mostly because of significant decrease of liquid fuels and natural gas in 1.A.2.a sector, but in year 2012 the GHG emissions have increased by 6.41% due to larger amounts of liquid and gaseous fuels consumed.

Also indirect GHG emissions from 1.A.2 sector were estimated. In this sector almost all indirect emissions have decreased: NOx emissions have decreased by 78.97%, CO emissions have decreased by 44.06%, and SO_2 emissions have a decrease by 96.74% in 1990–2012. However, NMVOC emissions have an increasing trend and since 1990 have increased by 45.58% due to very high emission factors for biomass comparing with other fuels. The decrease in emissions is explained with fuel switching to natural gas and biomass from what sulphur dioxide emissions aren't emitted, and there are less NOx and CO emissions from these fuels comparing with solid and liquid biomass.

3.2.5.2 Methodological issues

Methods

IPCC GPG 2000 Tier 2 method was used to estimate CO_2 emissions from fuel combustion as country specific parameters were used to estimate CO_2 emission factor. However, there are no country-specific emission factors due to lack of information for biodiesel and anthracite, and IPCC 2006 EF was used instead. IPCC GPG 1996 Tier 1 Sectoral approach was used to calculate CH_4 and N_2O emissions from the 1.A.1 sector.

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;
- Data from only natural gas supplier company of natural gas physical characteristics;
- IPCC 1996;
- IPCC 2006;
- EMEP/EEA 2013.

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.

There are also emission factors which are taken from other countries’ inventories as there are no country specific emission factors in Latvia available – for petroleum coke EF from Lithuanian inventory was taken (94.06 Gg/PJ). Emission factor for oil shale was taken from Estonian inventory (102.1 Gg/PJ). For emissions estimation from anthracite, default EF from IPCC 2006, Chapter 2, Table 2.3 was used (98.3 Gg/PJ).

<u>Liquid biofuels</u>

Liquid biofuels – biodiesel CO_2 emission factor (70.8 Gg/PJ) is taken from IPCC 2006, Chapter 2, Table 2.3 as there is no information available of used biofuels characteristics to estimate country or plant specific CO_2 emission factor.

<u>Used tires</u>

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 1999–2012 is taken from GHG emission reports that plant submitted under ETS (Table 3.22). 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, Chapter 2, Table 2.3.

Table 3.22 CO_2 emission factor for used tires (Gg/PJ)

	1999-2004	2005-2007	2008-2009	2010-2012
Used tires	82.7556	79.4	85	60.916

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

<u>Municipal waste</u>

CO_2 emission factor of municipal wastes combusted in cement production plants is taken from plant’s annual GHG report within EU ETS for 2008-2012 (Table 3.23). 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. EFs for CH_4 and N_2O emissions estimations are taken from IPCC 2006, Chapter 2, Table 2.3 - 0.03 Gg/PJ and 0.004 Gg/PJ, accordingly.

Table 3.23 CO_2 emission factor for municipal wastes (Gg/PJ)

	2008	2009	2010			2011			2012		
Municipal wastes - Plant 1	85.19	82.81									
Municipal wastes - Plant 2		120.95	82.69	117.6	155.97	113.22	81.13	135.3	95.24	81.13	130.35

SO_2 emission factors

SO_x 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.

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 3.1).

Other emission factors

List of other emission factors can be seen in Table 3.24.

The default CH_4 and N_2O emission factors are taken from IPCC 1996, Tables 1-7 and 1-8, accordingly, with an exception of anthracite and industrial and municipal wastes which are taken from IPCC 2006 and oil shale which have been taken from Estonian inventory as country specific.

Gasoline emission factors are used for emission estimation from off-roads (IPCC 1996, Chapter 1, Table 1-49 (4-stroke)).

Table 3.24 CH_4, N_2O, NO_x, NMVOC, CO emission factors (Gg/PJ)

	CH_4	N_2O	NO_x	NMVOC	CO
Gasoline	0.050	0.0020	0.210	1.000	27.000
Diesel oil	0.002	0.0006	0.513	0.03	0.07
RFO	0.002	0.0006	0.513	0.03	0.07
LPG	0.002	0.0006	0.074	0.023	0.029
Jet fuel	0.002	0.0006	0.513	0.03	0.07
Other kerosene	0.002	0.0006	0.513	0.03	0.07
Other liquid	0.002	0.0006	0.513	0.03	0.07
Petroleum coke	0.002	0.0006	0.513	0.03	0.07
Waste oils	0.002	0.0006	0.513	0.03	0.07
Shale oil	0.002	0.0006	0.513	0.03	0.07
Coal	0.010	0.0014	0.173	0.089	0.931
Coke	0.010	0.0014	0.173	0.089	0.931
Anthracite	0.001	0.0015	0.173	0.089	0.931
Oil shale	0.010	0.001	0.110	0.050	0.087
Peat briquettes	0.030	0.0040	0.173	0.089	0.931
Peat	0.030	0.0040	0.173	0.089	0.931
Natural gas	0.005	0.0001	0.074	0.023	0.029
Wood	0.030	0.0040	0.091	0.300	0.570

NO_x, CO and NMVOC emission factors used in estimation of emission were taken from EMEP/EEA 2013, Chapter 5, Table 3-1, with an exception of oil shale which has been taken from Estonian inventory as country specific EF. For industrial wastes and municipal wastes NO_x, CO and NMVOC emission factors are taken from EMEP/EEA 2013, Chapter 5.C.1.b, Table 3-1 and Chapter 5.C.1.a, Table 3-1 (Table 3.25).

Table 3.25 Indirect GHG emission factors for industrial wastes 1999-2012 (Gg/PJ)

	NOx	NMVOC	SOx	CO
	kg/Mg			
Municipal waste	1.071	0.0059	0.087	0.041
Industrial waste	0.87	7.4	0.0047	0.07

Activity data

Emissions from CRF 1.A.2 sector are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2012 sent to EUROSTAT. The data collection system for 1.A.2 sector is the same as for 1.A.1 sector. Data on fuel consumption in 1.A.2 sector are presented in ANNEX A.3.1.

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

Only gasoline combustion is reported as off-roads in 1.A.2 sector. It is sure that diesel oil is also consumed as off-roads but for now it is not possible for CSB and LEGMC to divide the consumption between fuel combusted stationary and filled in technological vehicles. Due to that all diesel oil reported in the sector is estimated as combusted stationary.

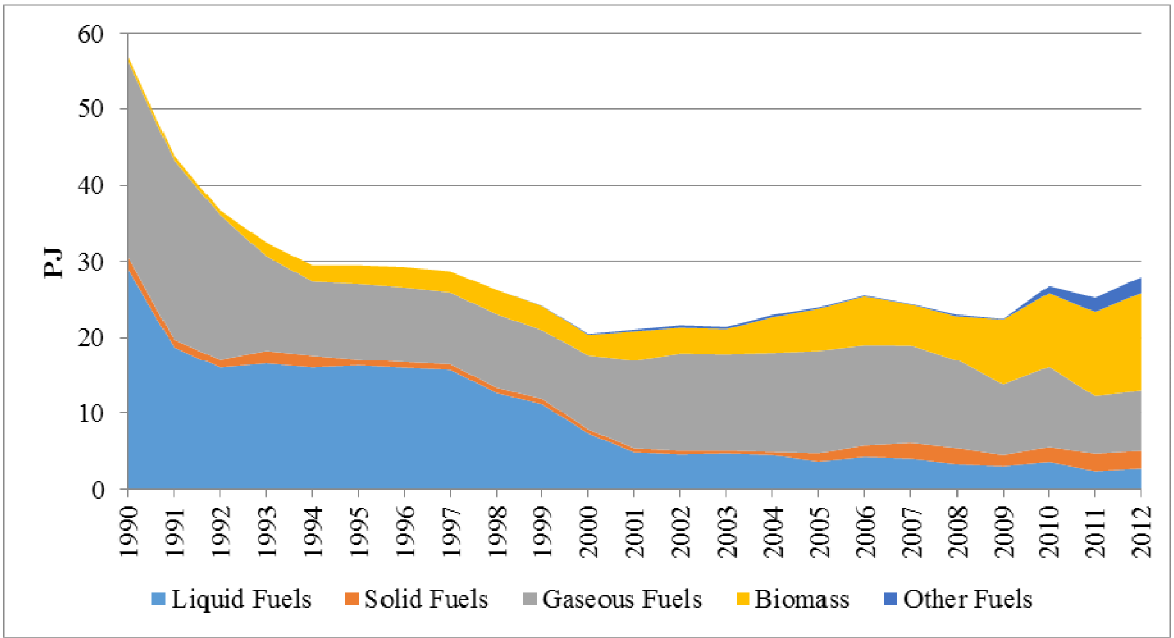


Figure 3.11 Fuel consumption in CRF 1.A.2 Manufacturing industries and construction in 1990-2012

All fuel types with an exception of biomass fuels have decreased in 1990-2012 (Figure 3.11) when liquid fuels had the biggest decrease in time period by 90.50%. It is explained with fuel switching processes when liquid fuels were switched to other lower costing 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.

The consumption of solid fuels (mainly coal) have been decreasing in 1990-2003 with an exception of 1993-1994, mainly due to increased use of coal in Construction and Textiles and Leather sectors. Solid fuels consumption rapidly were growing by 436.97% since 2003 until 2008 and decreased in 2009 by 29.71% due to crisis in national economy. However, starting from 2009, the consumption of solid fuels has grown by 55.77% until year 2012. The increase of solid fuel consumption was promoted by the increase of oil price overall the world when coal combustion was cheaper than combustion of residual fuel oil and diesel oil. The increase in Latvia is also explained with the development of mineral production sector – cement production – where coal are consumed.

Consumption of biomass fuel has increased very significantly – by 1994.17% in 1990–2012 with some fluctuations in 2000-2008. Lower costs of solid and liquid biomass free and large availability of the fuel in-country as well as development of EU ETS were the main reason for liquid and solid fuels replacement with biomass and natural gas.

Consumption of used tires (information collected from „CEMEX", the only company which combusts used tires) and municipal wastes in Mineral production (information taken from „CEMEX", the only company which combusts municipal waste for energy purposes) reported as Other Fuels had increased in 1999-2012 by 5534.94% (2.032 PJ) and continue to increase year by year. Comparing with 2011, the consumption of wastes has increased by 11.42% in 2012. The increase was influenced by a sharp increase of cement production that was caused by increasing demand of construction materials and sharp development of construction sector.

3.2.5.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in 1.A.2 sector is ±2% in 2012. CSB gives approximately 2% statistical sample error for statistical data. According to CSB, as data are obtained using information given by respondents, this number is a variation coefficient which characterizes selection of respondents. Total variation coefficient for energy balance is within 2-3%. 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. Also, according to IPCC 2000, pg. 2.41, there is more uncertainty for biomass and traditional fuels, that was a reason for higher uncertainty than for other fuel types.

Uncertainty of other fuels consumption – municipal and industrial wastes used in mineral production is assumed also low – 2% as the activity data is obtained from only one producer within EU ETS therefore the data is verified by accredited verifier and Regional Environmental Board.

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 for liquid fuels was assigned as quite low about 10%. The same uncertainty level was assigned for solid fuels. However, for combustion of solid fuels in 1.A.2.a Iron and Steel sector uncertainty of CO_2 emission factor was assigned higher to 20% because CO_2 emission factor of anthracite was taken from IPCC 2006. 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 factors for other fuels and mineral production sector is assumed as 5% as were determined in accredited laboratory of cement production company.

CH_4 and N_2O emission factor used in estimation of emissions was taken from IPCC 1996 so uncertainty was assigned as 50% according to 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 exceeded 10% level. All issues given in Table 3.26 below were double checked and large fluctuations were explained.

Table 3.26 IEF changes higher than 10% for 1.A.2 sector

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.2.a	Liquid Fuels/CO_2	t/TJ	2005	97.98	2006	72.59	-25.91%	In 2005 the consumption of other liquid fuels (CO_2 IEF 79.59 t/TJ) decreased and waste oils (CO_2 IEF 103.96 t/TJ) were used instead therefore in 2005 there is a sudden increase in IEF. In 2006 it decreased due to use of other liquid fuels instead of waste oils.
1.A.2.a	Liquid Fuels/CO_2	t/TJ	2004	72.59	2005	97.98	34.98%	
1.A.2.a	CH_4	kg/TJ	2011	10.00	2012	7.87	-21.29%	In 2012, anthracite (IEF 1 kg/TJ) was used as a fuel therefore total IEF decreased.
1.A.2.c	Liquid Fuels/CH_4	kg/TJ	2010	3.49	2011	2.00	-42.63%	In 2010, gasoline was used as a fuel (considered as offroad) therefore liquid fuel IEF changed.
1.A.2.c	Liquid Fuels/CH_4	kg/TJ	2009	2.00	2010	3.49	74.29%	
1.A.2.e	Solid Fuels/CH_4	kg/TJ	2009	10.00	2010	11.08	10.82%	Changes in IEF are explained with appearance of peat briquettes (higher IEF for CH_4 and N_2O) in 1997-1999 and in 2010.
1.A.2.e	Solid Fuels/CH_4	kg/TJ	1999	11.30	2000	10.00	-11.48%	
1.A.2.e	Solid Fuels/CH_4	kg/TJ	1996	10.00	1997	11.16	11.58%	
1.A.2.e	Solid Fuels/N_2O	kg/TJ	2009	1.40	2010	1.54	10.05%	
1.A.2.e	Solid Fuels/N_2O	kg/TJ	1999	1.57	2000	1.40	-10.74%	
1.A.2.e	Solid Fuels/N_2O	kg/TJ	1996	1.40	1997	1.55	10.76%	
1.A.2.e	Waste oils/CO_2	t/TJ	2002	72.59	2003	103.96	43.21%	In 2003 the structure of waste oils changed therefore average NCV in 2003 was lower (more light waste oils were used).
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2010	3.57	2011	3.17	-11.23%	CH_4 emissions from liquid fuels in this sector are influenced with the amount of gasoline consumption in off-roads as gasoline fuel only has different CH_4 EF comparing to other liquid fuel types. Therefore part of gasoline fuel in total liquid fuel
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2008	4.44	2009	3.41	-23.19%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2007	3.84	2008	4.44	15.65%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2004	3.62	2005	4.11	13.50%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2003	2.83	2004	3.62	27.75%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2002	4.11	2003	2.83	-31.04%	

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2001	3.08	2002	4.11	33.31%	consumption influences average IEF of liquid fuels in the sector.
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	2000	2.65	2001	3.08	16.11%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1999	2.37	2000	2.65	12.04%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1998	2.70	1999	2.37	-12.34%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1996	3.00	1997	2.69	-10.39%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1995	2.33	1996	3.00	28.64%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1994	2.86	1995	2.33	-18.26%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1993	3.78	1994	2.86	-24.43%	
1.A.2.f	Liquid Fuels/CH_4	kg/TJ	1990	5.38	1991	3.35	-37.71%	
1.A.2.f	Liquid Fuels/CO_2	t/TJ	2002	75.63	2003	84.29	11.46%	In 2003, petroleum coke as a fuel was started to use. As there is no country-specific CO_2 EF for such fuel, one from Lithuania was taken, therefore IEF for liquid fuels in this sector has increased.
1.A.2.f	Other Fuels/CO_2	t/TJ	2009	55.62	2010	35.79	-35.65%	Changes in CO_2 EF are due to different structure in municipal waste (biomass fraction, NCV) that influenced the CO_2 EF.
1.A.2.f	Other Fuels/CO_2	t/TJ	2007	79.40	2008	58.12	-26.80%	
1.A.2.f	Solid Fuels/CH_4	kg/TJ	2004	12.27	2005	10.00	-18.47%	Changes of all emissions IEF are explained with the appearance of peat and peat briquettes consumption - peat is consumed in 1997-1998, and in 2004, while peat briquettes are combusted in the sector only in 1995-1996.
1.A.2.f	Solid Fuels/CH_4	kg/TJ	2003	10.00	2004	12.27	22.66%	
1.A.2.f	Solid Fuels/CH_4	kg/TJ	1994	10.00	1995	11.03	10.32%	
1.A.2.f	Solid Fuels/CH_4	kg/TJ	1990	10.00	1991	11.46	14.55%	
1.A.2.f	Solid Fuels/N_2O	kg/TJ	2004	1.69	2005	1.40	-17.38%	
1.A.2.f	Solid Fuels/N_2O	kg/TJ	2003	1.40	2004	1.69	21.04%	
1.A.2.f	Solid Fuels/N_2O	kg/TJ	1990	1.40	1991	1.59	13.51%	

3.2.5.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier 1 method from IPCC 2000 GPG. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.

There are several steps for activity data verification:

2. 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.
3. 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. The reasons of data changes are explained.
   - After the data input in emission estimation database, the 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 verified by CSB energy experts by checking the data input reported in the NIR.
- The emissions for indirect GHG in the database are cross-checked with emissions reported within LRTAP convention to ascertain if these are equal.

5. Estimated emissions verification:

- 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 illogical 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.
- Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 2%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

Additional QA/QC checks for Tier 2 methodology

Country specific CO_2 emission factors

Mainly Tier 2 methodology is reported as used in the CO_2 emission estimation, 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.

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.

3.2.5.5 Source-specific recalculations

Other liquid fuels were split into waste oils, petroleum coke and other liquid fuels, therefore changed their NCVs in the whole time series and CO_2 emission factor as well as CO_2 emissions. Natural gas - slight changes in NCV from 37.359 to 37.358 which slightly affected the consumption of gas used in all subsectors (1.A.1, 1.A.2, 1.A.4), CO_2 EF and CO_2 emissions. Fuel type "other liquid biofuels" was changed to "biodiesel" and CO_2 EF was changed to biodiesel's EF. Slight changes in 1.A.2.a-1.A.2.e sectors generally due to addition of Energy balance data (less than 1 kt) for several fuels, such as diesel oil and coal (mainly in 2010, 2011). Completely changed structure of 1.A.2.f sector after in country review with a suggestion from Energy expert to split 1.A.2.f sector into smaller subsectors in order to improve the reporting transparency. In 1.A.2.f sector activity data changes for LPG, coal, peat, diesel oil due to addition of Energy balance data. Corrections of activity data for industrial wastes, where information was precised by the company which consumes the specific fuel type. Emissions from indirect gases were recalculated as well due to updates in guidebook (EMEP/EEA 2013). Consumed amounts of oil shale in 1990 were added. Emissions from indirect gases were recalculated as well due to updates in guidebook (EMEP/EEA 2013).

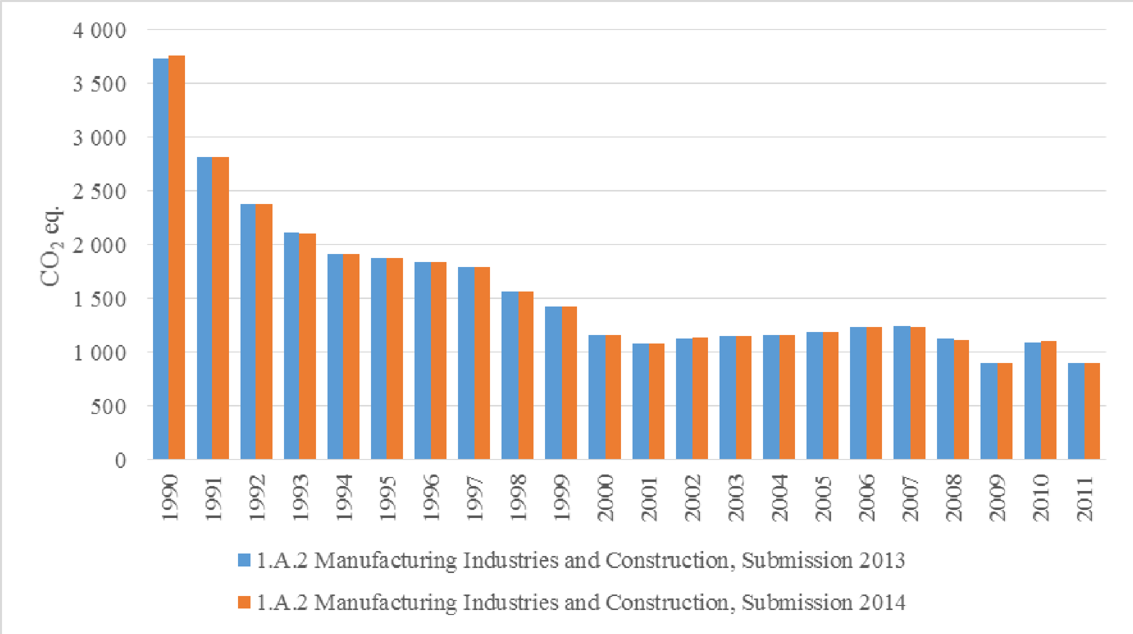


Figure 3.12 Comparison of GHG emissions in CRF 1.A.2 Manufacturing Industries and Construction sector for Submission 2013 and Submission 2014 (Gg CO_2 eq.)

As it can be seen in Figure 3.12, the difference for Submission 2013 (submitted on September, 2013) and Submission 2014 in reported GHG emissions is quite small for all years in time series 1990-2012, fluctuating from -1.05% in 2008 to 1.32% in 2002 with average diference 0.03%.

3.2.5.6 Source-specific planned improvements

The summarized necessary improvements are:

- Implement the country specific emission factors obtained in research of CH_4 emissions from solid biomass combustion in the Submission 2015.
- Use of EU ETS data.

3.2.6 Transport (CRF 1.A.3)

3.2.6.1 Source category description

This section describes GHG emissions resulting from transport fuel combustion. In 2012, this source category was responsible for more than 27% of total GHG emissions in Latvia, reaching 2794 Gg.

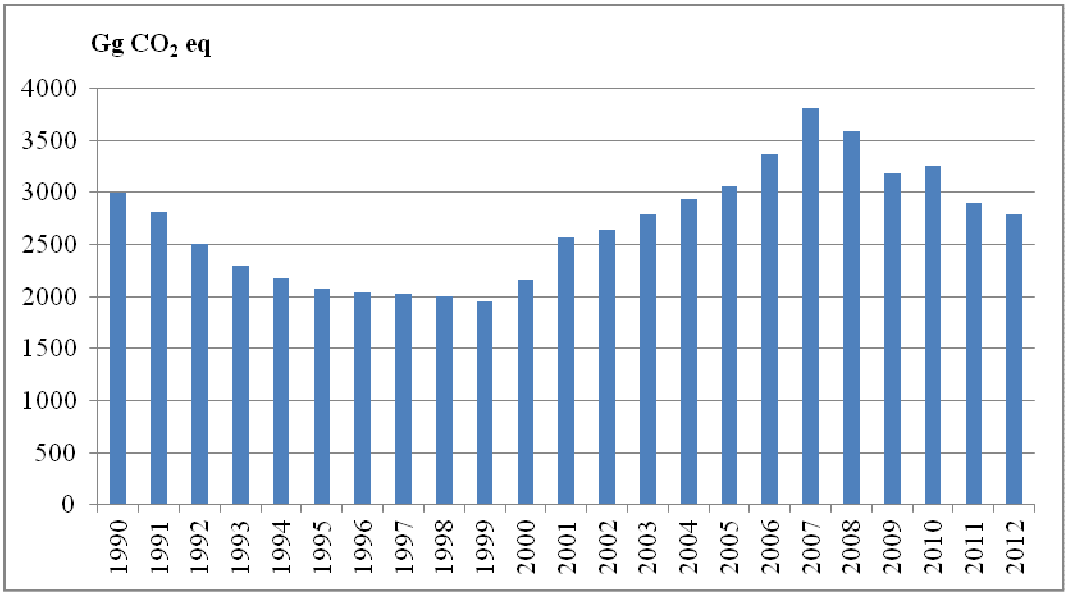


Figure 3.13 GHG emissions development in transport 1990 – 2012

The road transport constitutes a convincing majority of the total GHG emissions in the transport sector. In 2012, it gave 89.4 % of total emissions but the next largest emission source is a railroad – 9.99 % (see Figure 3.14).

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 3.15).

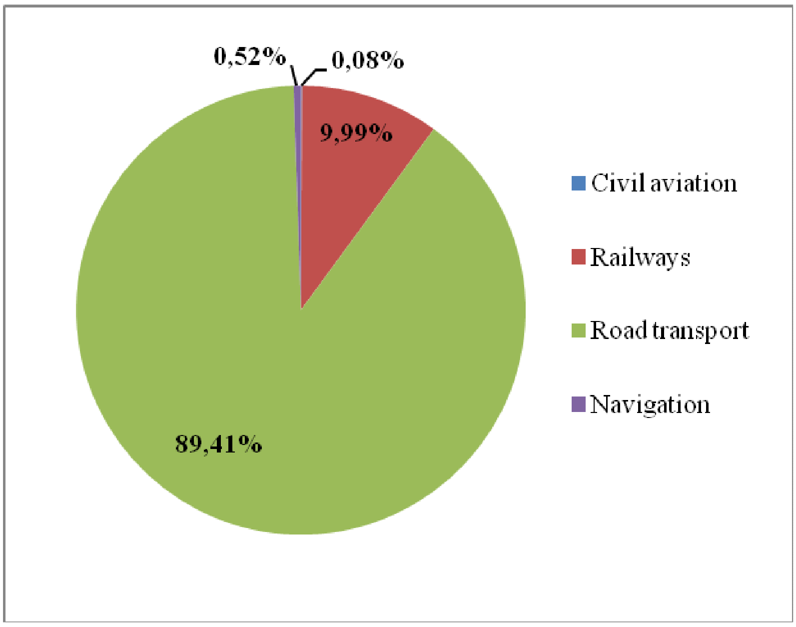


Figure 3.14 GHG emissions in transport by sub-sectors in 2012

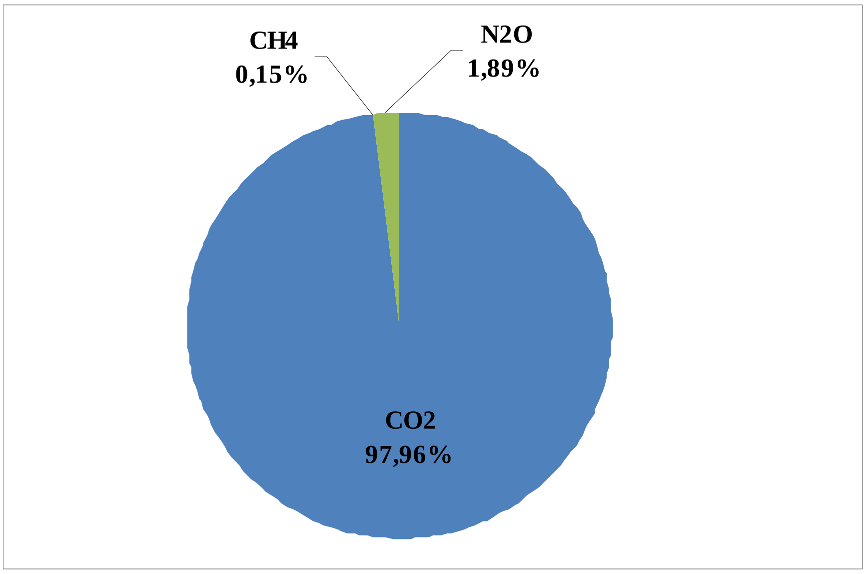


Figure 3.15 GHG emissions in transport sector by gases in 2012

One of the critical factors influencing CO_2 emission is the amount and type of the consumed fuel. In 2012, total fuel consumption in the transport sector, compared to 2011 level, has decreased by 4 %. In different subsectors various changes have taken place in 2012. In domestic civil aviation the fuel consumption has increased 3 times, whereas in the road transport it has decreased by 4.5 %. In the railway the fuel consumption has increased by 5.7 %, but in domestic navigation it has decreased by 19%.

In total, road transport consumes about 91%, railway – about 8.9% and domestic civil aviation and domestic navigation – the remaining share of fuel.

Diesel oil is the major fuel type in the transport sector and it constitutes 67.7 %, and is followed by gasoline – 25.3 %, but LPG constitutes 4.8% and biofuels (biodiesel and bioethanol) 2.1% of the total fuel consumption in the transport sector. A share of biofuels has decreased from 2.3 in year 2011 up to 2.1% in year 2012. Biofuel mainly is used in road transport but small portion is consumed in railway as well.

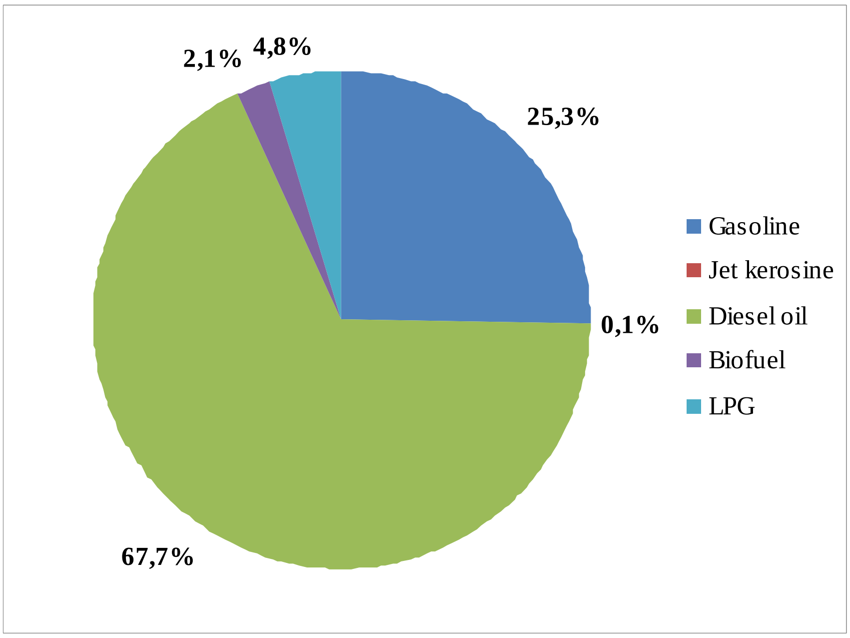


Figure 3.16 Fuel consumption in transport by fuel type (2012)

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

In Latvia, civil aviation, excluding international flights, is really narrow. Therefore the fuel consumption and thus also the volume of GHG emissions is comparably small, constituting mere 0.08% of GHG emissions from transport sector in year 2012 (Figure 3.14).

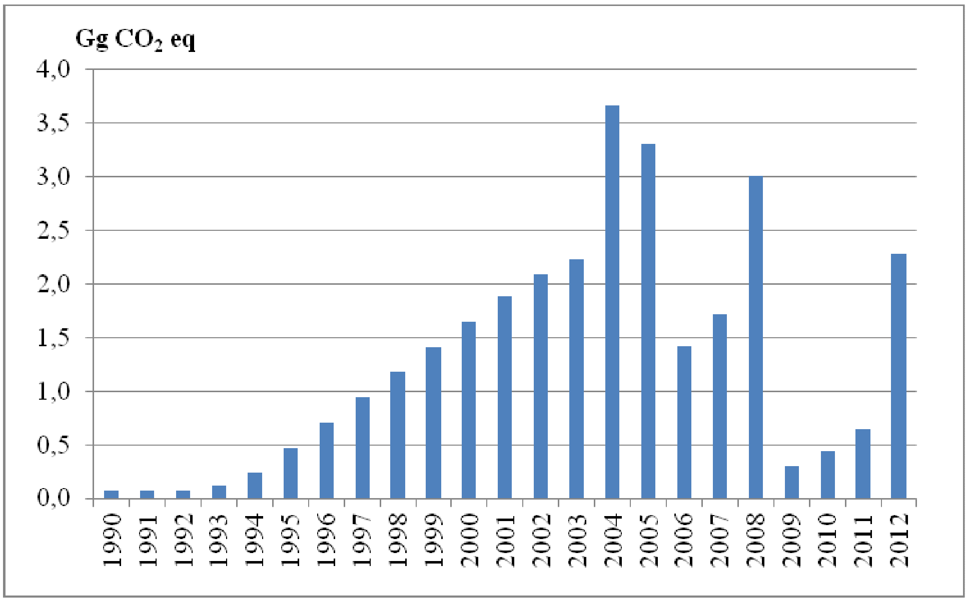


Figure 3.17 GHG emissions in civil aviation (Gg CO_2 eq)

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 very dependent on the strategy of local state owned airline company; the number of flights, fuel consumption and emission amount are quite unsteady over the years. As it can be seen, after the state owned (99.8% of shares) local airline company had aborted domestic commercial flights in year 2009, fuel consumption had decreased dramatically in 2009. Today the main activities in civil navigation relates with private flights.

Methods

When calculating emissions from civil aviation, two approaches have been applied. Taking into consideration the different properties of aviation gasoline and jet kerosene, IPCC 1996 Tier 1 method has been applied when estimating emissions from aviation gasoline, and IPCC 1996 Tier 2– when calculating emissions from jet kerosene. Using Tier 2 approach, emissions for LTO (landing/take off) and cruise are calculated individually. Separate emission factors are provided for LTO and Cruise activities. Prior to the emission calculation, representative aircraft type was chosen, for which the fuel consumption and emission data exist in the EMEP database (EMEP/EEA emission inventory guidebook — 2009 http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009).

1. Total Emissions = LTO Emissions + Cruise Emissions

*2. LTO Emissions = Number of LTOs * Emission Factor of LTOs*

*3. LTO Fuel Consumption = Number of LTOs * Fuel Consumption per LTO*

*4. Cruise Emissions = (Total Fuel Consumption – LTO Fuel Consumption) * EF Cruise*

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 the data for fuel consumption is used from the study ("Evaluation of fuel consumption for domestic aviation and navigation", FEI, 2004). For 2004 onwards, the air flight statistics is provided by the Riga and Liepaja airports.

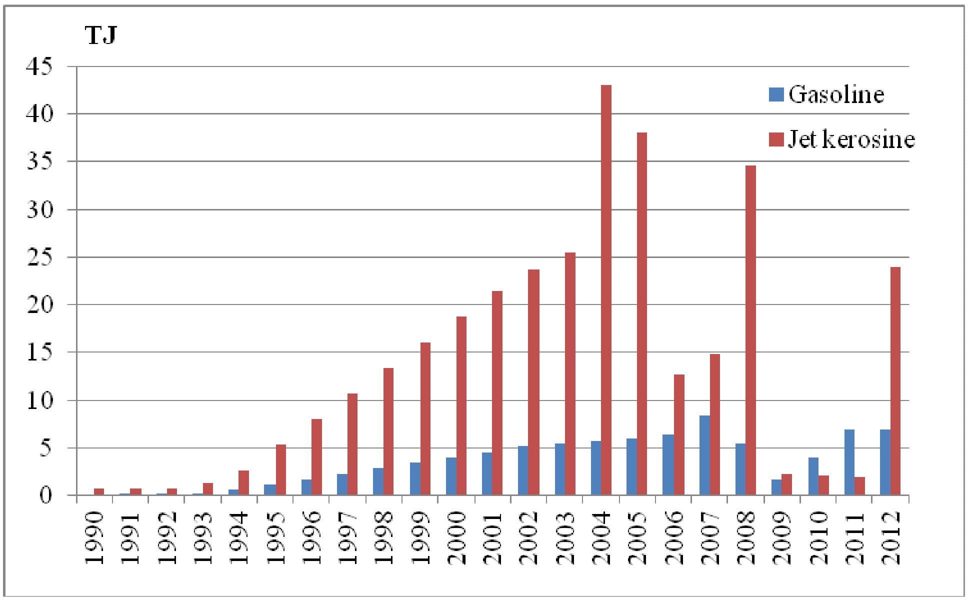


Figure 3.18 Fuel consumption in domestic civil aviation (TJ)

Table 3.27 Fuel consumption in domestic civil aviation (TJ)

	Jet kerosene (TJ)	Aviation gasoline (TJ)
1990	0,8	0,2
1991	0,8	0,2
1992	0,8	0,2
1993	1,3	0,3

	Jet kerosene (TJ)	Aviation gasoline (TJ)
1994	2,7	0,6
1995	5,4	1,1
1996	8,0	1,7
1997	10,7	2,3
1998	13,4	2,8
1999	16,1	3,4
2000	18,8	4,0
2001	21,4	4,6
2002	23,7	5,1
2003	25,5	5,4
2004	43,0	5,7
2005	38,0	6,0
2006	12,8	6,4
2007	14,8	8,4
2008	34,5	5,4
2009	2,3	1,7
2010	2,1	4,0
2011	2,0	7,0
2012	24,0	7,0

Emission factors

Default EFs of LTO and cruise (jet kerosene) for civil aviation is used (EMEP/EEA emission inventory guidebook – 2009).

Table 3.28 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

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

The road transport constituted 89.4 % of GHG emissions in the transport sector in 2012. After the rapid growth in the period 2000 – 2007, emissions in 2009 have sharply decreased. The main reason was a sharp decreasing of fuel consumption in the road transport in 2009. It decreased by 12.8 %, compared to 2008 level. The major reason for this tendency was recession of the national economy and decrease of transport activities – decrease of passenger km by passenger cars and ton km by freight transport. The road transport is widely used in the local transportation and also for providing cross-border transportation. The freight road transport approximately constitutes 46% (2012) of the total freight in the country. It is in a place decreasing of this share by approximately 1% point, compare with year 2011. In the freight road transport the inland freight constitutes approximately 90% of gross – timber products, food products, household goods and building materials are dominant. Fuel consumption in road transport has decreased by 4.5% in year 2012 compare with 2011. In different fuels various changes have taken place in 2012 compare with 2011. Gasoline consumption has decreased by 15% and diesel consumption has decreased by 2 %, whereas biofuel consumption has decreased by 12%. The main feature in 2012 was a sharp increase of LPG consumption, by 57%.

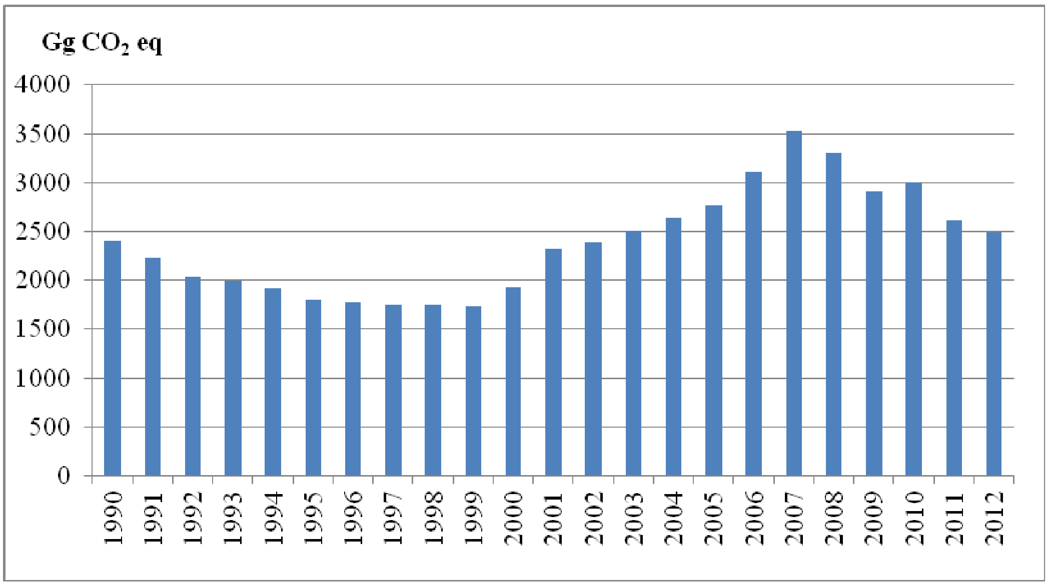


Figure 3.19 GHG emissions in road transport (Gg CO_2 eq)

In time period 1990 – 2012, essential changes have taken place in the structure of GHG emissions created by the road transport (see Table 3.29). In 2012, the gasoline consumption emissions created by passenger cars were less than 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.

Table 3.29 GHG emissions in road transport by vehicle types (Gg CO_2 eq)

	Passenger Cars		**LDV**		**HDV**	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
1990	1108,02	42,51	158,00	54,20	380,33	439,82
1991	1003,70	39,63	160,16	59,87	341,08	419,10
1992	1027,65	27,75	139,62	37,30	260,18	347,75
1993	1023,25	34,47	136,35	41,87	226,47	348,27
1994	975,50	33,34	139,49	43,29	189,31	345,09
1995	903,58	35,26	89,42	38,46	184,28	352,23
1996	860,73	43,58	101,23	35,88	187,39	344,02
1997	814,66	74,32	83,24	41,93	160,66	364,73
1998	799,59	120,24	69,90	49,14	153,73	384,39
1999	768,00	124,25	66,18	50,88	141,15	436,24
2000	810,55	118,00	45,25	76,95	116,95	567,99
2001	894,75	249,99	41,03	100,71	92,19	699,25
2002	899,13	282,12	34,89	116,04	75,86	717,67
2003	914,98	355,60	30,30	120,80	67,62	741,36
2004	941,06	443,88	26,78	129,25	54,08	778,00
2005	934,22	515,47	22,84	128,74	46,28	852,01
2006	1048,59	614,85	22,17	146,27	42,70	955,77
2007	1160,51	759,75	21,19	178,07	38,84	1090,49
2008	1061,64	760,75	18,74	178,06	31,41	989,19
2009	941,70	804,79	35,83	242,55	20,39	805,10

	Passenger Cars		LDV		HDV	
2010	855,09	950,10	32,05	242,11	17,67	823,30
2011	790,05	706,98	30,39	220,00	15,63	768,39
2012	667,59	682,82	17,01	236,05	13,15	758,73
Trend 2012/1990(%)	-39,75	1506,29	-89,23	335,55	-96,54	72,51

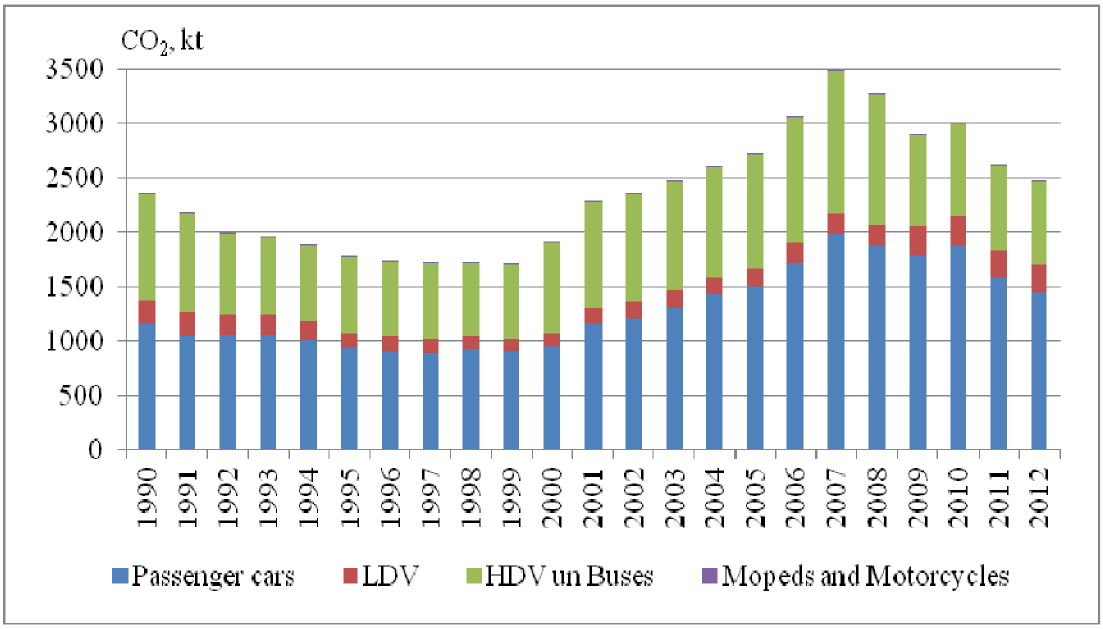


Figure 3.20 CO_2 emissions in road transport by vehicle types (Gg)

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 3.20, the most important emissions source for the road transport is passenger cars and HDV vehicles followed by LDV, buses and motorcycles. Share of CO_2 emissions from passenger cars was 58%, HDV and buses 31% and LDV 10.4% in year 2012.

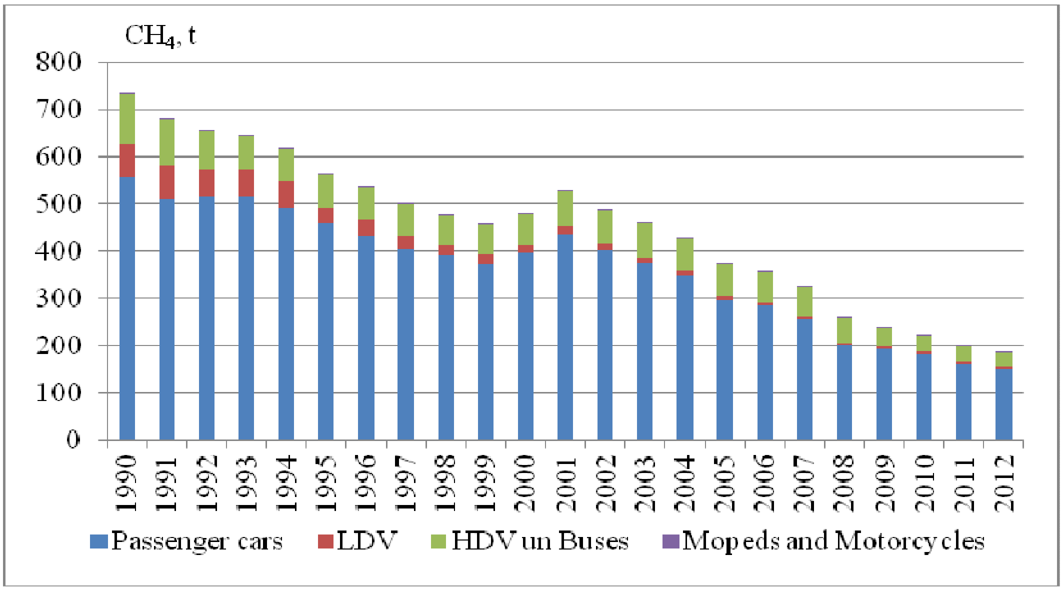


Figure 3.21 CH_4 emissions in road transport by vehicle types

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 and additionally in years 2009 - 2012 with decreasing of gasoline consumption by passenger cars.

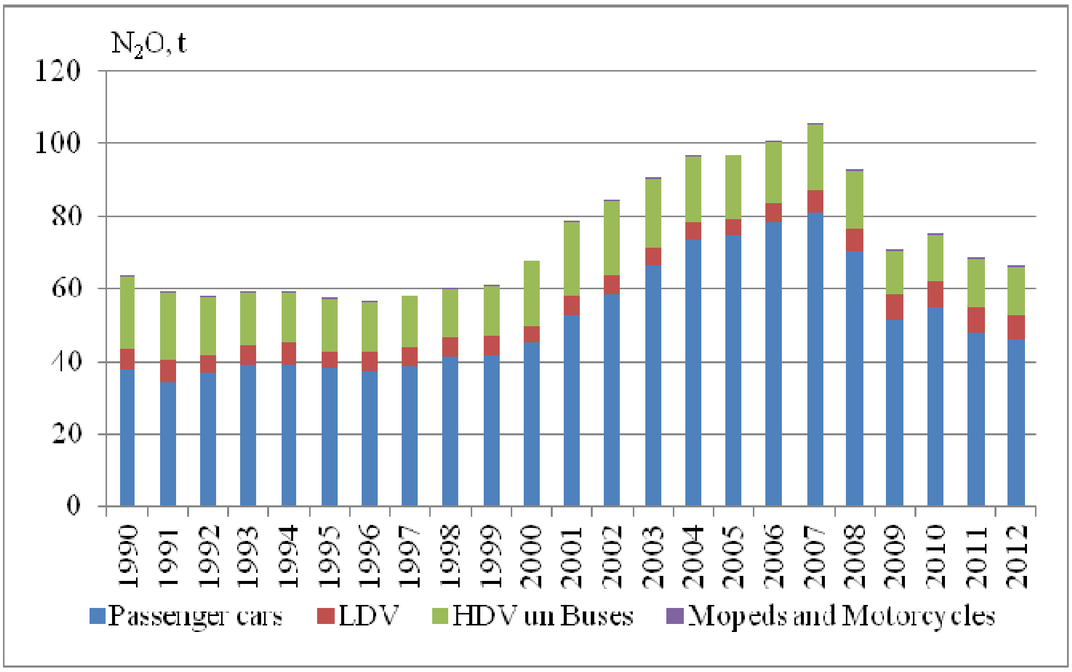


Figure 3.22 N_2O emissions in road transport by vehicle types

Taking into account that N_2O emission rates are largely dependent from implemented combustion and emission control technologies, different factor interaction characterises the trend of N_2O changes.

To analyze the trend of N_2O emission at first the significance of different emission sources should be clearly identified. The passenger cars contribute 63.5%, the freight transport -36% of total N_2O emission in Latvia road transport. Thus the N_20 emission trend is mainly determined by the change in the technologies and fuel used by passenger cars.

Regarding total N_20 emission created by the fleet of Latvia passenger cars, gasoline fuelled passenger cars contribute slightly above 43%, the rest is emitted by diesel fuelled passenger cars. Important, in the period after year 2005 the average N_2O emission factor (t/TJ) for gasoline fuelled passenger cars has tendency to decrease due to change in the relative share of EURO 3 and EURO 4 cars. The N_20 emission factor (g/km) of gasoline fuelled passenger cars of the EURO 1 and EURO 2 classes is more then twice higher compared to the factor of gasoline fuelled passenger cars of the EURO 3 and EURO 4 classes. The mileage share in 2012, calculated by summing the shares of EURO3 and EURO4 gasoline passenger cars, has increased almost twice – from 29.5% to 56.4% of the total gasoline passenger cars mileage , compared to year 2005.

At the same time, one can see the opposite trend in the group of diesel passenger cars. The N_2O emission factor (g/km) of EURO3 and EURO4 diesel passenger cars is per about 60% higher than the emission factor for EURO1 and EURO2 diesel passenger cars. Thus, due to the significant rise of the mileage share of EURO3 and EURO4 cars – from 24% (year 2005) up to 54% (year 2012) of the total diesel passenger cars mileage, the average N_2O emission factor (t/TJ) for diesel passenger cars has also slightly increased.

Methods

For road transport, the detailed methodology is used to make annual estimates of the Latvian emissions, as described in the EMEP/EEA emission inventory guidebook – 2009. 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 are taken from the COPERT IV model.

To calculate CO_2 emissions from lubrication oil using in car's engines in road transport it is calculated amount of oil, which the oil film developed on the inner cylinder walls. This oil film further is exposed to combustion and is burned along with the fuel. A calculation of lubricant oil consumption for engine operation has been performed using a typical oil consumption factors for different vehicle types, fuel used and vehicle age (see Table 3-28 EMEP Emission inventory Guidebook 2009; updated 2012). Based on this calculated lubricant oil consumption and using default EF (IPCC guidelines 1996) CO_2 emissions for lubricant oil burning for engine operation has been calculated.

Activity data

As a basis for model input information, CSB data have been used considering the fuel consumption, LR Road Traffic Safety Directorate (RTSD) collected and published data have been used considering stock of road transport in Latvia. Total mileage data for passenger cars, light duty trucks, heavy duty trucks and buses produced by the RTSD is used for the years 1996-2012.

Table 3.30 Activity data and sources used for emission calculation in road transport

Activity data	Source of activity data	Remarks
Fuel consumption	Calculated consumption by COPERT IV model	Calibrated with national statistics. Deviation less than 0,15%
Number of cars	Road safety Directorate	For calculation it is used number of cars with permission to participate in traffic

Activity data	Source of activity data	Remarks
Number of cars by fuel and vehicle type	Road Traffic Safety Directorate and expert calculation	Based on available data cars are grouped by fuel type, engine power, age and vehicle categories according to emission control system
distance travelled by cars by fuel and vehicle type	Road Traffic Safety Directorate and expert calculation	Based on an average data by cars classes it is modelled by fuel type, engine power, age and vehicle categories
Emission factors	National specific for CO_2 emissions, COPERT emission factors for CH_4 and N_2O	CO_2 emission factors is based on carbon content in fuel. 1990 – 2008 EF gasoline is 68.6; 2009-onwards EF gasoline is 71.18

General information about activity data is presented in Figure 3.24 (number of cars and them split by sub-classes and layers). Before emission calculation COPERT IV model was calibrated to be consistent with actual fuel consumption (energy statistics). Deviation between fuel consumption in COPERT model and statistics is less than 0,1%. Thus we can say that all emission calculation is based on fuel consumption amount.

Table 3.31 Fuel consumption in road transport (TJ)

	Gasoline, TJ	Diesel oil TJ	LPG, TJ	Natural gas, TJ	Biofuel (biodiesel and bioathanol), TJ
1990	24217	8326	592	339	-
1991	22191	8116	501	195	-
1992	21266	6587	228	172	-
1993	20651	6798	273	93	-
1994	19640	6798	91	75	-
1995	17994	6884	91	37	-
1996	17596	6796	91	37	-
1997	16193	7859	91	37	-
1998	15222	8710	137	37	-
1999	14683	9091	273	37	-
2000	14505	11471	865	75	-
2001	15251	15930	866	112	-
2002	14950	17168	865	75	-
2003	14950	18609	956	75	-
2004	15038	20222	1047	75	-
2005	14729	22180	1093	75	107
2006	16311	25240	1184	75	57
2007	17854	29485	1093	74	71
2008	16267	28255	956	37	81
2009	13587	25154	865	4	173
2010	12311	27449	1002	-	1102
2011	11432	22945	1184	-	844
2012	9697	22465	1866	-	742

As seen in Figure 3.23, the fuel consumption has essentially changed in the time period 1990 – 2012. 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. Consumption of gasoline had decreased in 2012 by 15 % compare with year 2011. Whereas the diesel fuel consumption starting from 1997 has increased all the time till 2007. While it decreased in 2008 and 2009. Diesel fuel consumption has decreased in 2012 by 2 % compare with year 2011. It was in place substantial LPG consumption increasing in year 2011 and 2012 in road transport.

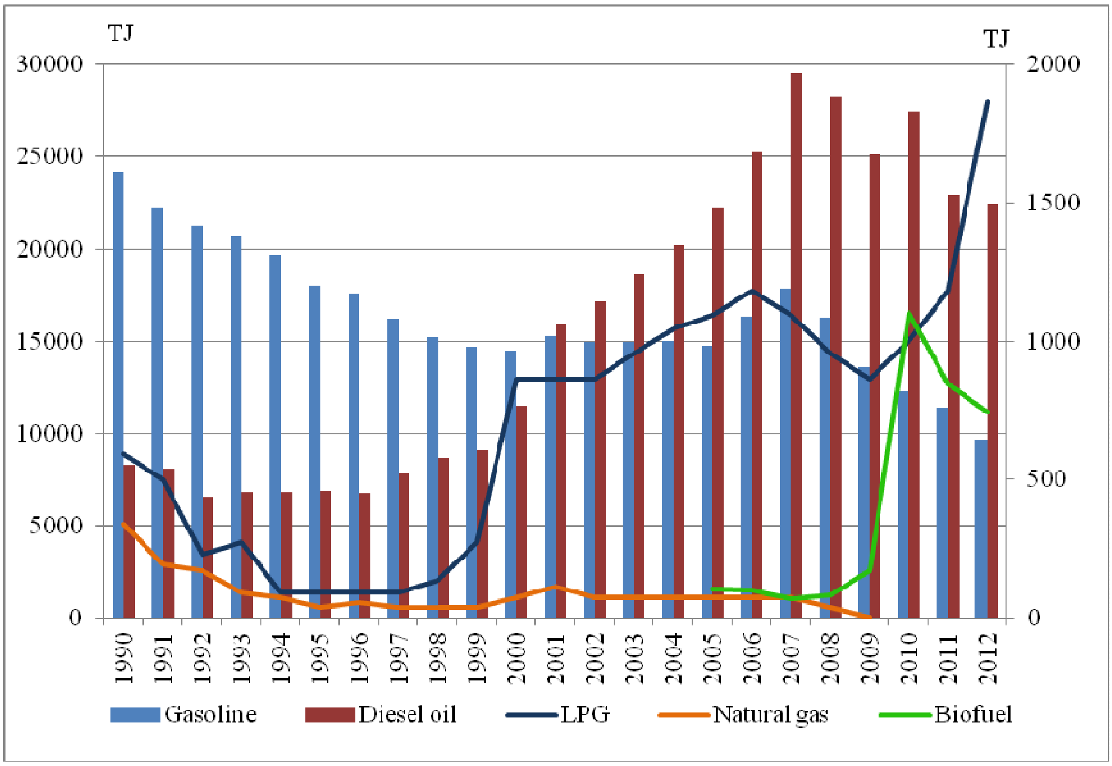
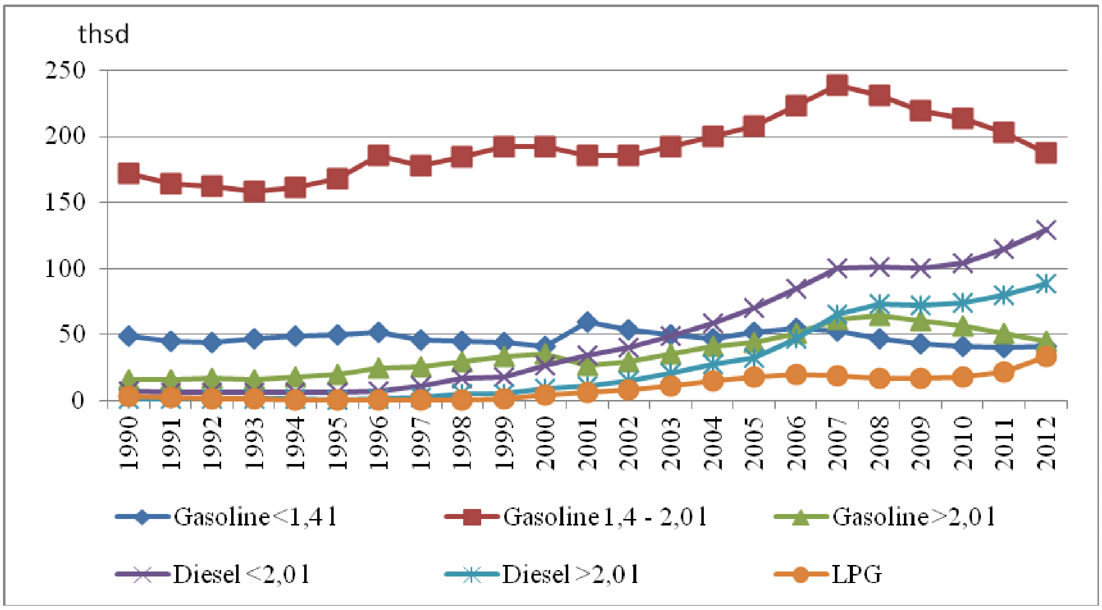


Figure 3.23 Development of Fuel consumption in road transport (TJ)[13]

The vehicle numbers per passenger cars sub-class and layers are shown in Figure 3.24.



[13] LPG, natural gas and biofuel on right axes

Figure 3.24 Distribution of passenger cars fleet by sub-classes

Analysing the development of the passenger car fleet in the time period 1990 – 2012, 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 and its constitute approximately 8% in year 2012;
- As of 2000, the number of cars with diesel engines, both, < 2.0l and > 2.0l, grow rapidly and its share is 42.7% from the toral number of passenger cars in 2012;
- As of 2005, in the car fleet with a gasoline engine, the number of EIRO 3 and EIRO 4 cars grow rapidly. In 2012 a share of EIRO 3 and EIRO 4 and EIRO 5 cars constitute 33%;
- As of 2005, in the car fleet with a diesel engine, the number of EIRO 3 and EIRO 4 cars grow rapidly. In 2012 a share of EIRO 3 and EIRO 4 and EIRO 5 cars constitute 46%;.

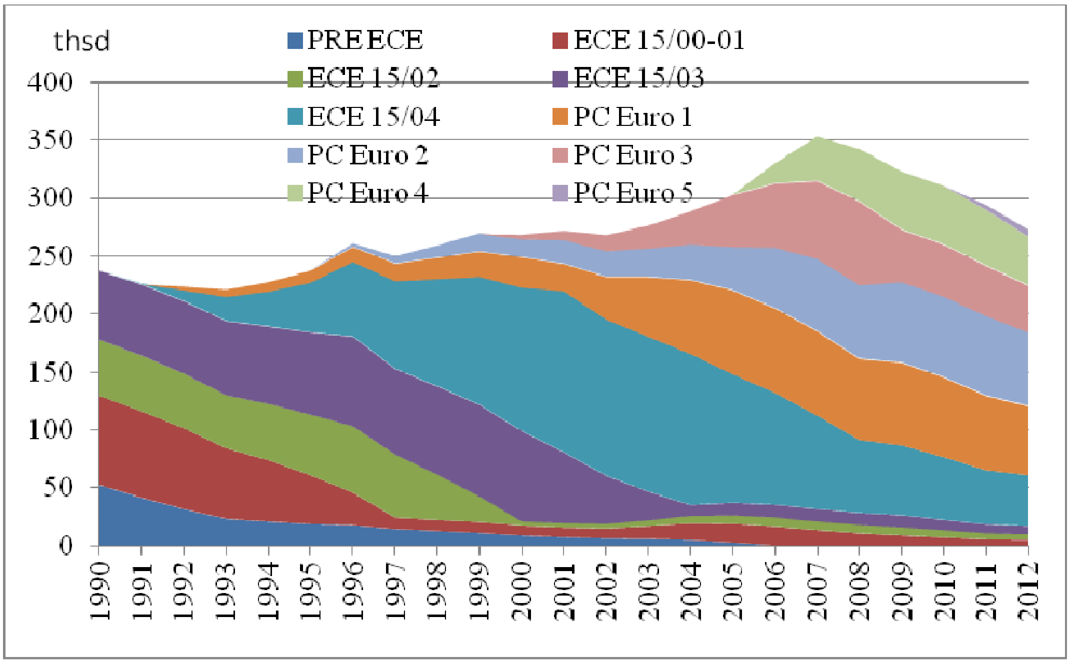


Figure 3.25 Distribution of gasoline passenger cars fleet by layers

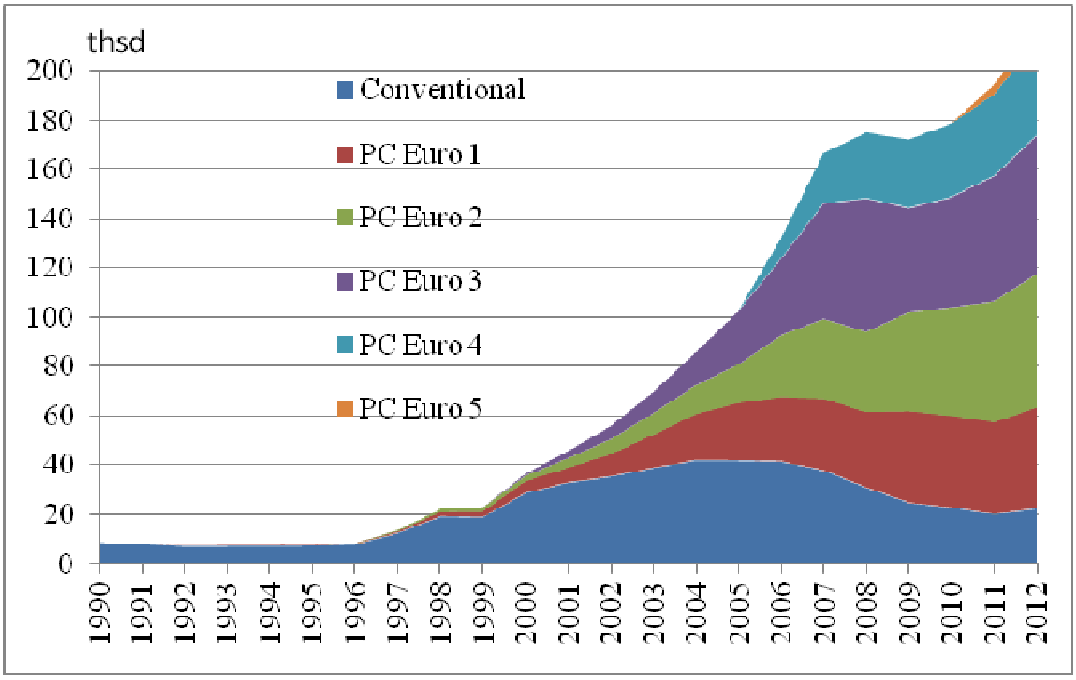


Figure 3.26 Distribution of diesel oil passenger cars fleet by layers

- Analysing 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. In 2012 a share of diesel cars is 91.5% ;
- As of 2002, the number of EURO 3 and EIRO 4 cars rapidly increases. In 2012 a share of EIRO 3 and EIRO 4 and eURO 5 cars constitute 48.5%;

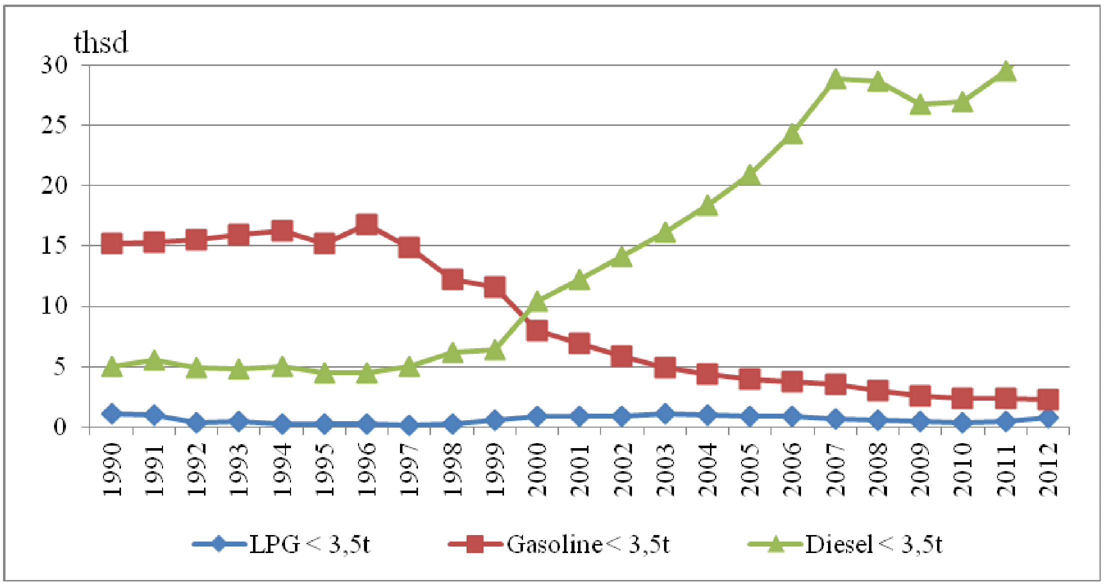


Figure 3.27 Distribution of light duty vehicles fleet by sub-classes

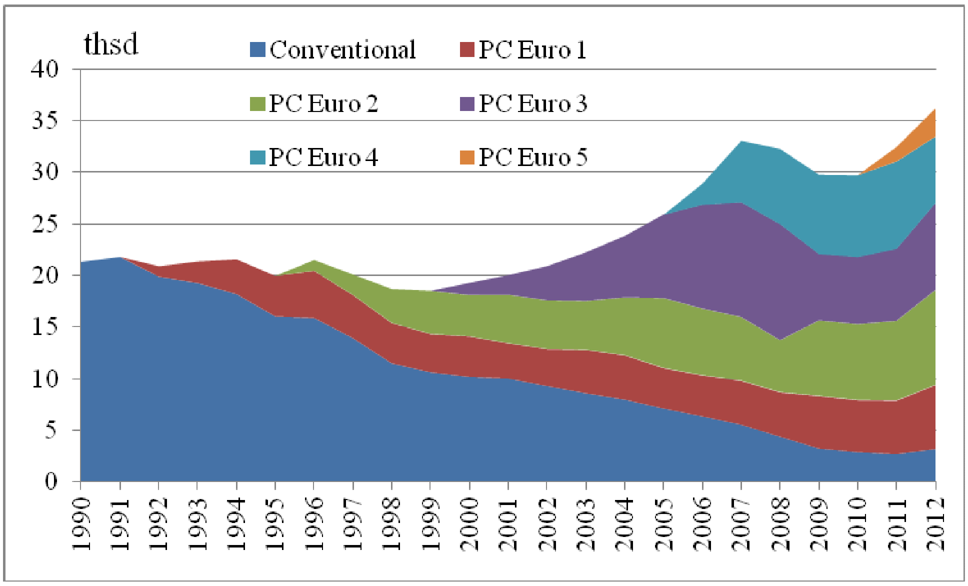


Figure 3.28 Distribution of light duty vehicles fleet by layers

The vehicle numbers per HDV sub-classes and layers are presented in Figure 3.29 and Figure 3.30. Analysing 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. A share of gasoline cars has decreased from 33% to 5 % corresponding years 2000 and 2012;
- 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. In 2012 a share of EIRO 3 and EIRO 4 and EURO 5 cars constitute 45.6%.

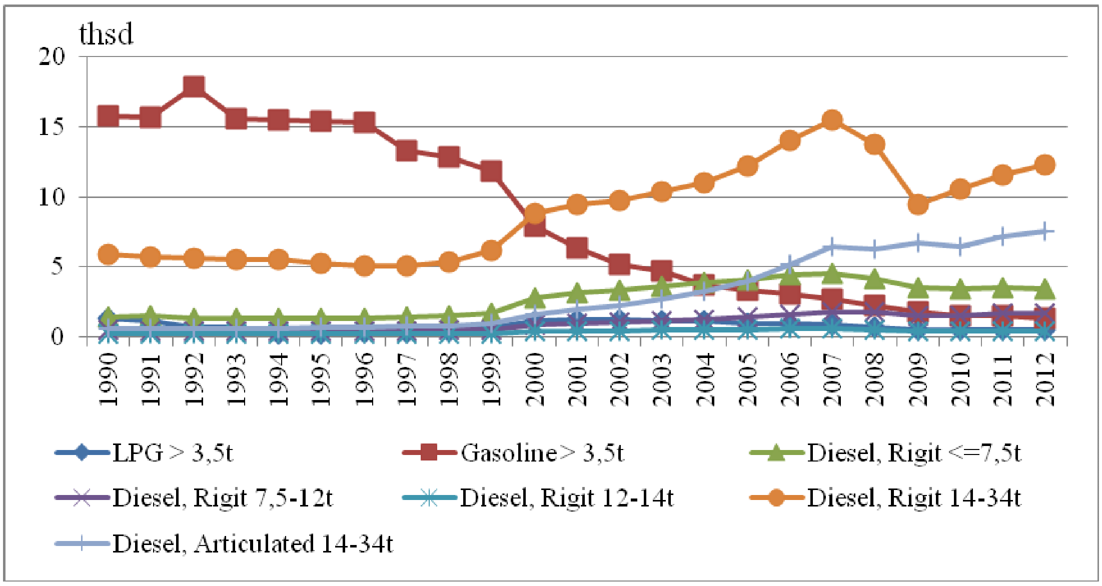


Figure 3.29 Distribution of heavy duty vehicles fleet by sub-classes

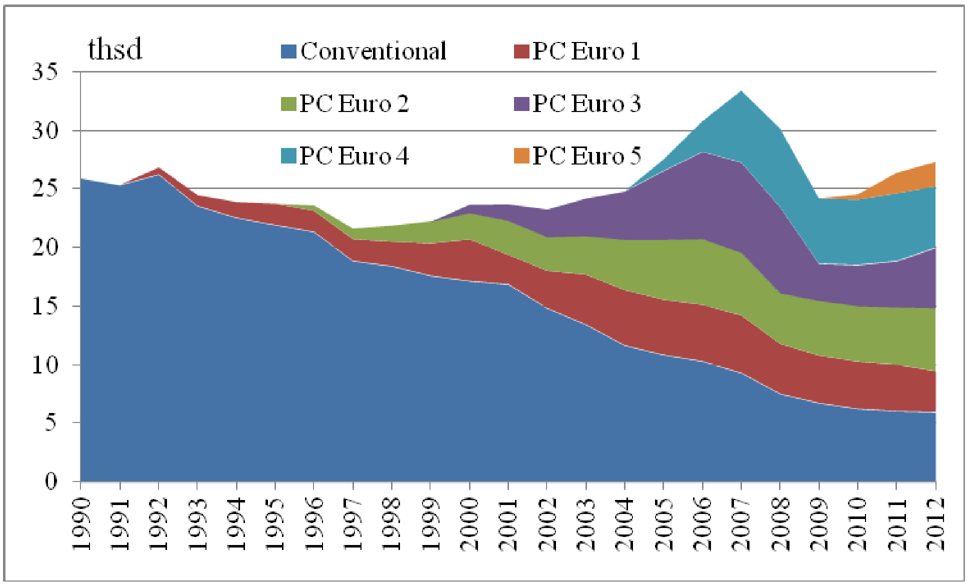


Figure 3.30 Distribution of heavy duty vehicles fleet by layers

Emission factors

CO_2 emissions in COPERT IV model were calculated, using country-specific CO_2 emission factor that are calculated based on the information available on the C and H content in fuel. Country specific EF for CO_2 emission calculation (gasoline, diesel oil) in road transport are used:

- 1990 – 2011 EF diesel oil 74.0 kg/GJ ("Guidance Manual for CO_2 emission estimations" (2004) see Annex 2 of NIR);
- 1990 – 2008 EF gasoline is 68.6 kg/GJ ("Guidance Manual for CO_2 emission estimations" (2004) see Annex 2 of NIR);

Taking into account recommendations of ERT about necessity to investigate EF for gasoline (due to big difference in comparison with other countries'), Ministry of Environment and Regional development funded research "Research on carbon content in transport fuels" in year 2012. The research on C content in fuels carried out in 2012 quantified C and H content in gasoline. For gasoline the C content is 86.3%, further it is calculated NCV for gasoline (43.97 MJ/kg) and estimated CO_2 emission factor in accordance Requirements from the IPCC 1996 Guidelines. Based on the results of this research, CO_2 EF of gasoline has been calculated - 71.18 kg/GJ. Considering that quantification of C and H content in gasoline has been performed for fuel with a requirement for gasoline quality which is in force from 01.01.2009, the updated CO_2 EF is implemented for emissions calculation 2009-2012. Rest of emission factors comes from the COPERT IV model.

3.2.6.4 Railway (CRF 1.A.3.C)

In 2012, the fuel consumption in railway constituted 9.9 % of GHG emissions from the total GHG emissions in transport. Freight transport has a dominant role in railway. The railway transport accomplishes approximately 50% (2012) of freight transport in Latvia and the transit transport traffic is dominant. In 2009 and 2010, transported freight along the railway and therefore the diesel consumption has a slightly decreased, compared to 2008 level. Fuel consumption has increased by approximately 6.7% in 2012 compare with year 2011. Railway transport includes railway transport operated by diesel locomotives.

Railway related fuel consumption is key sources for CO_2 emissions (Figure 3.31).

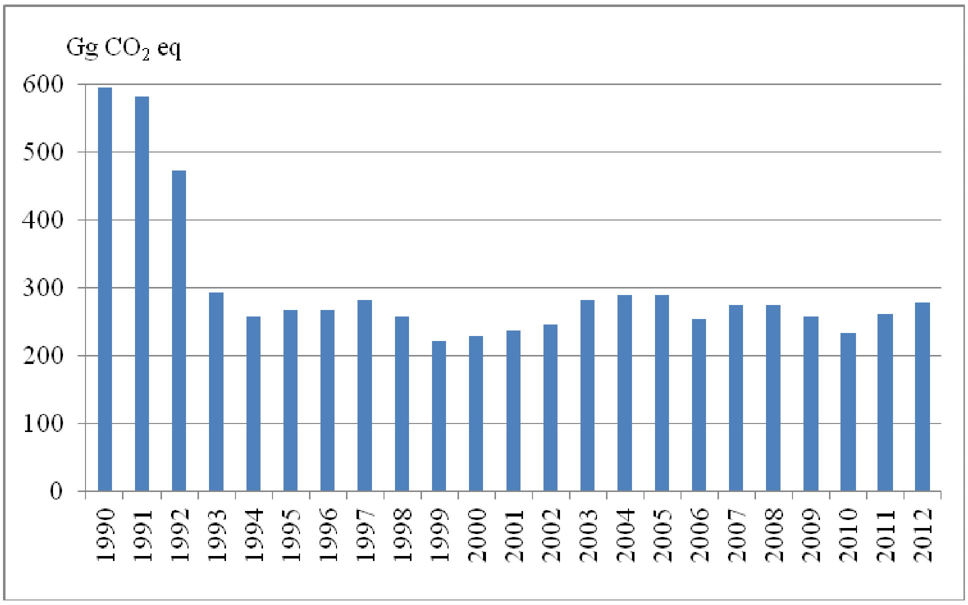


Figure 3.31 Development of GHG emissions in railway (Gg CO_2 eq)

<u>Methodological issues</u>

Methods

When calculating emissions from railway, IPCC 1996 Tier 1 method 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 3.32 and

Table **3.32**.

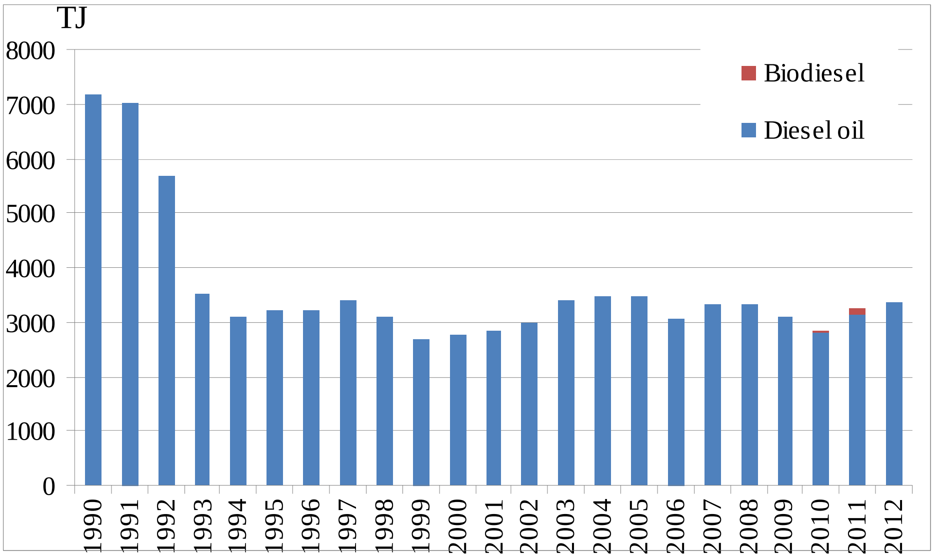


Figure 3.32 Development of fuel consumption in railway (TJ)

Table 3.32 Fuel consumption in railway (TJ)

	Diesel oil	Biodiesel
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	-
2009	3102	-
2010	2804	35
2011	3144	91
2012	3357	63

Emission factors

Country specific EF for CO_2 emissions is used ("Guidance Manual for CO_2 emission estimations" (2004) see Annex 2 of NIR). Rest of emission factors comes from Revised IPCC Guidelines (1996) and EMEP/Corinair 2009 (Table 3.33).

Table 3.33 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	74	0.00423	0.02918	0.93198	0.251823	0.10943	0,02353 (2003-2004) 0,09414 (1990-2007) 0.04707 (2008-2012)

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

In 2012, fuel consumption in navigation was responsible for 0.5 % of GHG emissions from total GHG emissions in transport.

Although Latvia has several ports, domestic navigation that providing transport of freight or passengers among local ports is not developed. Major activities in ports deal with international freight transport. In domestic navigation, the emissions are calculated for miscellaneous vesels (tugs, barges, towboats, icebreakers), recreational crafts and personal boats (Figure 3.33).

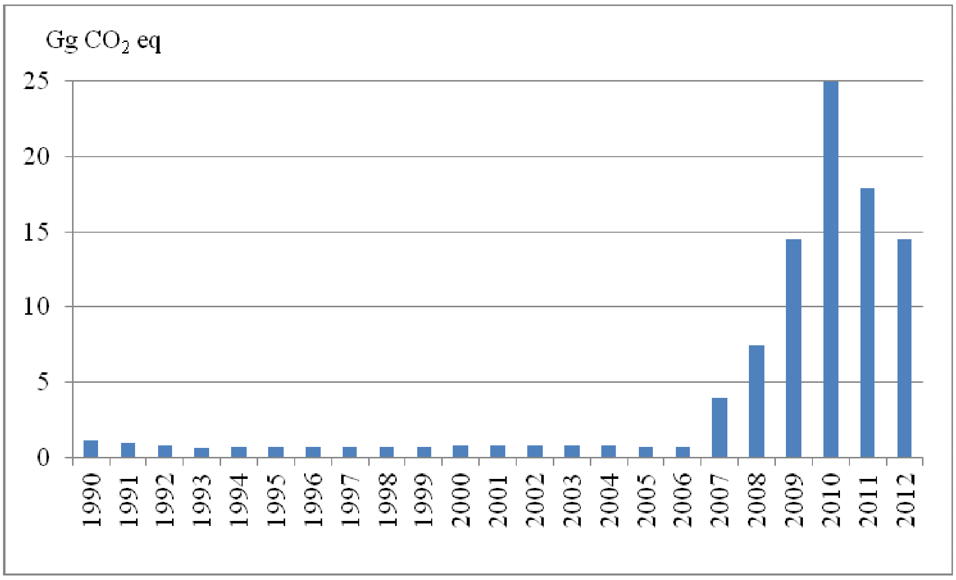


Figure 3.33 GHG emission development in domestic navigation (Gg CO_2 eq)

Fuel consumption and CO_2 emissions trend in domestic navigation mainly depends from international (import, export) cargo activities in ports (cargo turnover and number of vessels served in ports). During the period 2006-2012 international cargo turnover in ports has increased by approximately 19% points and number of served vessels by approximately 10% points. This increasing trend of activity partly explains fuel consumption increasing. Other additional factor which makes impact to fuel consumption in domestic navigation is weather conditions. This we can definitely see for year 2010 and 2011 when air temperature was low and sea was covered by ice. An ice breaker operated many months to ensure operation of ports in year 2010 and 2011. This has made an impact to fuel consumption in years 2010 and 2011.

Before GHG emission calculation is performed CSB is asked to check and further confirm fuel consumption in sector if fluctuation is more than 20% points compare to the previous year.

Methodological issues

Methods

When calculating emissions from navigation, IPCC 1996 Tier 1 method has been applied.

Activity data

The data about diesel oil consumption and gasoline consumption in domestic navigation are derived from the CSB. CSB have started to collect data about diesel oil consumption and gasoline consumption in domestic navigation respectively from year 2006 and 2010. For the time period 1990 – 2005 and 1990 – 2009 correspondingly for diesel oil and gasoline consumption it is used data evaluation method from the study ("Evaluation of fuel consumption for domestic aviation and navigation", FEI, 2004). Development of fuel consumption in domestic navigation is presented in Figure 3.34 and Table 3.34.

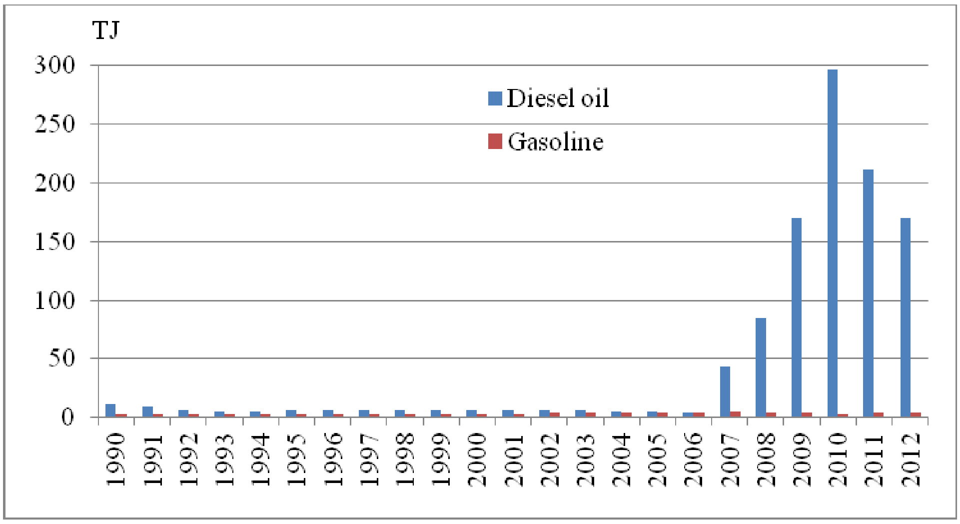


Figure 3.34 Development of gasoline and diesel oil fuel consumption in domestic navigation

Table 3.34 Fuel consumption in domestic navigation (TJ)

	Diesel oil	Gasoline
1990	11	2
1991	10	3
1992	7	3
1993	5	3
1994	6	3
1995	6	3
1996	6	3
1997	6	3
1998	6	3
1999	6	3
2000	6	3
2001	6	3
2002	6	4
2003	6	4
2004	6	4
2005	5	4
2006	4	4
2007	43	5
2008	70	5
2009	161	4
2010	297	3
2011	211	3
2012	170	3

Emission factors

Default EFs for navigation is used (Revised IPCC Guidelines (1996) and EMEP/Corinair 2009, Table 3.35).

Table 3.35 Emission factors used in the calculation of emissions from navigation

	CO_2, t/TJ	CH_4, t/TJ	N_2O, t/TJ
Gasoline	72.7	0.0473	0.000296
Diesel oil	74.0	0.004	0.003

3.2.6.6 Uncertainties and time series consistency

Uncertainty in activity data of fuel consumption in transport is ±2% in 2012. 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 10%. CH_4 and N_2O emission factor used in estimation of emissions was taken from EMEP/CORINAIR (2009) so uncertainty was assigned 50 %.

To ensure time series consistency any recalculation related with model version updating is realized for all time period. Linear interpolation has been implemented only for cases when activity data fluctuation does not take place.

Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG 2000. Latvia's national inventory QA/QC plan is ruled in national legislation and approved by Cabinet of Ministers.

3.2.6.7 Source-specific QA/QC and verification

For transport emission's calculation following QA/QC checks are performed for all parts of national inventory.

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.
2. Activity data checked at the institution responsible for the emission estimation and reporting:
    - Before GHG emission calculation is performed CSB is asked to check and further confirm fuel consumption in sectors if fluctuation in current year is more than 20% points compare to the previous year.
    - Before the data is processed in emission estimation models activity data is a verified using diagram that is the best way to reflect all the illogical data fluctuations.

Estimated emissions verification:

1. All estimations of the emissions done for a transport sector are checked on the logical mistakes by checking the time series, emission factors and emissions consistency to display all significant and illogic changes in the emissions.
2. Emissions are checked using time series consistency check for the IEF estimated in CRF Reported. For road transport a checking is done on less aggregated level than CRF Reported. Non CO_2 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.

Additional QA/QC checks for Tier2 methodology

For emission calculation in road transport additional QA/QC check approach has implemented. QC activities are realised with emission data and activity data QC.
It is assessed that implemented default EF from COPERT IV model are applicable to national circumstances because model comprises all necessary technologies. Country specific EFs for CO_2 are calculated based on IPCC Guidelines methodology. Activity data (fuel consumption, total number of vehicles) provider CSB has the internal QA/QC procedures based on mathematical model and analysis to avoid logic mistakes. To ensure QA procedure expert from Road traffic and safety Directorate is asked to make peer review about the main assumption implemented in emission calculation.

3.2.6.8 Source specific recalculations

The following recalculations and improvements of the emission inventories have been made in the transport sector since the emission reporting in 2013. (Table 3.36)

Table 3.36 Recalculations for Sub-category CRF 1.A.3 Transport

Sub-category	Recalculation	Improvements
Road transport (CRF A.3.b)	All emissions for year 2009-2011 have been recalculated	Recalculations have been done due to improvement of activity data. Improvements comprise more precise split of passenger cars, LDV and HDV by subgroups (depending on engine volume) and layers (EURO classes) and mileage. It is recalculated emissions of road transport for year 2009 and 2011. Recalculation affected direct and non direct emissions
Road transport (CRF A.3.b)	CO_2 emissions for 2011 have been recalculated	Recalculations have been done due to corrected fuel consumption data (year 2011) by CSB.

Table 3.37 Impact of recalculations to GHG emissions in road transport, current submission versus 2013 year submission, %

	2009	2010	2011
CO_2 emissions	0	0	-7.8
CH_4 emissions	5.8	5.4	2.7
N_2O emissions	8.0	12.3	-1.0

3.2.6.9 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 3.38).

Table 3.38 Planned improvements for Sub-category A.3. Transport

Sub-category	Planned improvements
Railway (CRF 1.A.3.C)	Based on the results of carried out study in year 2013 (prepared formats for activity data collection from national railway administration and calculation sheets for emission calculation) to implementation Tier 2 method for CH_4 and N_2O emission calculation in year 2015.

3.2.7 Other sources (CRF 1.A.4)

3.2.7.1 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 produced.

Table 3.39 Emissions from 1.A.4 Other Sectors in 1990–2012 (Gg)

	CO_2	CH_4	N_2O	Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
1990	5503.71	11.19	0.202	5801.20	21.40	161.04	22.63	36.49
1991	5634.46	12.71	0.216	5968.33	23.83	156.41	23.20	36.08
1992	3992.90	11.49	0.204	4297.51	18.40	139.37	20.99	29.12
1993	3316.73	12.14	0.206	3635.53	16.26	146.54	22.11	23.36
1994	2298.12	12.03	0.201	2613.11	12.44	144.12	21.84	17.85
1995	1545.46	12.55	0.211	1874.37	10.34	140.09	22.38	9.47
1996	1559.94	12.91	0.209	1895.81	10.09	147.66	23.35	9.66
1997	1324.74	12.22	0.188	1639.57	8.65	138.83	22.06	7.22
1998	1141.23	11.36	0.171	1432.66	7.37	132.61	20.97	5.31
1999	1128.49	11.15	0.181	1418.63	8.22	128.42	20.52	3.91
2000	1037.04	10.47	0.171	1309.88	7.63	125.13	19.72	2.85
2001	1187.27	11.55	0.190	1488.56	8.53	137.82	21.60	3.25
2002	1159.07	11.30	0.177	1451.42	7.85	133.12	21.06	2.59
2003	1264.65	11.86	0.198	1575.06	9.01	140.45	22.22	2.11
2004	1323.52	12.21	0.198	1641.24	9.02	141.84	22.65	1.87
2005	1296.02	12.24	0.192	1612.69	8.57	144.28	22.86	1.74
2006	1360.91	11.88	0.183	1667.21	8.60	140.29	22.23	1.47
2007	1367.32	11.88	0.177	1671.67	8.17	137.64	22.00	1.19
2008	1289.00	10.99	0.162	1569.90	7.40	134.11	20.93	0.82
2009	1276.48	12.09	0.174	1584.18	7.54	148.02	23.06	0.81
2010	1441.35	11.32	0.166	1730.53	7.76	137.88	21.50	1.21
2011	1342.74	9.64	0.145	1590.13	7.22	120.57	18.61	1.11

	CO_2	CH_4	N_2O	Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
2012	1267.19	10.37	0.150	1531.55	7.11	124.90	19.65	0.56

Total GHG emissions from 1.A.4 Other Sectors have decreased in 1.A.4 sector by 73.60% in 1990-2012. However, the emissions increased in 2000 – 2012 by 16.92%. It can be explained with development of 1.A.4.a Commercial / Institutional sector. In 2010-2011 there is a decrease of GHG emissions by 8.11% which is explained with warm winter therefore the amount of biomass and natural gas used for heating decreased. In year 2012 the emissions continue to decrease, and compared with previous year have decreased by 3.68%. There can also be seen a trend that if the average temperature comparing with previous year has increased, CO_2 emissions are less and vice versa. At the same time there can be seen a trend that residential households replace central heating system (especially in years 2006-2007) with individual combustion facilities thereby the emissions in 1.A.4.b Residential sector increased.

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 3.39). Increase of CO_2 emissions in 2000–2007 is explained with development of national economy and well-being of population. CO_2 emissions are also affected by increase of individual heating supply consumers in 1.A.4.b Residential sector. Starting from year 2008 the emissions fluctuate which can mainly be explained with average temperatures and global crisis. Comparing with year 2011, CO_2 emissions have decreased by 5.63% in 2012.

However, there can be seen an increase in CH_4 and N_2O emissions in 2011-2012 by 7.63% and 3.41%, respectively. It can be explained with an increased use of biomass by 9.07% comparing with previous year, instead of fossil fuels.

Also indirect GHG emissions from Other Sectors were estimated. SO_2 had biggest decrease by 98.46% in 1990–2012. It is explained with fuel switching to natural gas and biomass from what sulphur dioxide emissions aren't emitted.

3.2.7.2 Methodological issues

Methods

IPCC GPG 2000 Tier 2 method was used to estimate CO_2 emissions from fuel combustion as country specific parameters were used to estimate CO_2 emission factor. However, there are no country-specific emission factors due to lack of information for biodiesel, and IPCC 2006 EFs was used instead. For CO_2 emission estimation from charcoal, IPCC 1996 default EF was used.

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;
- Data from only natural gas supplier company of natural gas physical characteristics;
- IPCC 1996;
- IPCC 2006;
- EMEP/EEA 2013.

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.

In 2008-2010 straws also are combusted in the sector. CO_2 emission factor from IPCC 2006 – 100 Gg/PJ (as for other solid biomass) is used for emission estimation as no data is available to calculate country specific emission factor.

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 NCVs for biogas collected in landfills are known.

As landfills were not 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:

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

where :

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 landfill gas same equation as for natural gas was used.

Table 3.40 Characteristics of methane obtained from landfil gas and estimated CO_2 emission factors

Carbon content in working mass of landfil gas (C^d) %	NCV of landfil gas (Q_z^d) TJ/1000m^3	Amount of methane in landfil gas (%)	Default carbon content in working mass of methane (C^d) %	NCV of methane (Q_z^d) TJ/1000m^3	Oxidation factor (p)	Natural gas density (ρ) t/1000m^3	Emission factor with oxidation factor (EF CO_2) kg/GJ
41.92582%	22.0	56.00%	74.867543%	35.88	0.995	0.6687	50.870474

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

List of other emission factors can be seen in Table 3.41

The default CH_4 and N_2O emission factors are taken from IPCC 1996 with an exception of biodiesel and straws for which emission factors are taken from IPCC 2006, Chapter 2, Table 2.4 and 2.5.

SO_2 emission factors for fuel combustion are presented in Annex 3.1.

Table 3.41 CH_4, N_2O, NO_x, NMVOC, CO emission factors (Gg/PJ)

	CH_4	N_2O	NO_x		NMVOC		CO	
			1.A.4.a, 1.A.4.c	1.A.4.b	1.A.4.a, 1.A.4.c	1.A.4.b	1.A.4.a, 1.A.4.c	1.A.4.b
Diesel oil	0.010	0.0006	0.513	0.051	0.03	0.001	0.066	0.057
RFO	0.010	0.0006	0.513	0.051	0.03	0.001	0.066	0.057
LPG	0.010	0.0006	0.074	0.051	0.023	0.001	0.029	0.026
Jet fuel	0.010	0.0006	0.513	0.051	0.03	0.001	0.066	0.057
Other kerosene	0.010	0.0006	0.513	0.051	0.03	0.001	0.066	0.057
Other liquid	0.010	0.0006	0.513	0.051	0.03	0.001	0.066	0.057
Waste oils	0.010	0.0006	0.513	0.051	0.03	0.03	0.066	0.057
Shale oil	0.010	0.0006	0.513	0.051	0.03	0.001	0.066	0.057
Coal	0.010	0.0014	0.173	0.110	0.089	0.484	0.931	4.600
Coke	0.010	0.0014	0.173	0.110	0.089	0.484	0.931	4.600

	CH_4	N_2O	NO_x		NMVOC		CO	
			1.A.4.a, 1.A.4.c	1.A.4.b	1.A.4.a, 1.A.4.c	1.A.4.b	1.A.4.a, 1.A.4.c	1.A.4.b
Peat briquettes	0.300	0.0040	0.173	0.110	0.089	0.484	0.931	4.600
Peat	0.300	0.0040	0.173	0.110	0.089	0.484	0.931	4.600
Natural gas	0.005	0.0001	0.074	0.051	0.023	0.002	0.029	0.026
Wood	0.300	0.0040	0.091	0.080	0.300	0.600	0.570	4.000
CH_4 from Landfil Gas	0.001	0.0001	0.074		0.023		0.029	
Straws	0.300	0.0040	0.091	0.080	0.300	0.600	0.570	4.000
Biodiesel	0.003	0.0006	0.513		0.03		0.07	
Charcoal	0.200	0.0010	0.0800		0.600		4.000	

Gasoline GHG emission factors are used for emission estimation from off-roads (IPCC 1996, Chapter 1, Table 1-49 (4-stroke)). For indirect GHG emissions EFs from EMEP/EEA 2013 were used. Also diesel oil consumed in Fisheries sector was assumed as off-road and the emission factors were taken from IPCC 1996, Chapter 1, Table 1-49 (inland waterways). Emission factors for gasoline and diesel oil are presented in Table 3.42.

Table 3.42 CH_4, N_2O, NO_x, NMVOC, CO emission factors for gasoline (Gg/PJ)

Fuel	Sector	CH_4	N_2O	NO_x	NMVOC	CO
Gasoline	1.A.4.a	0.05	0.002	0.137	1.677	16.669
	1.A.4.b	0.12	0.002	0.137	1.677	16.669
	1.A.4.c	0.08	0.002	0.137	1.677	16.669
Diesel oil	1.A.4.c Fisheries	0.004	0.03	1.847	0.066	0.174

Activity data

Emissions from 1.A.4 sector are calculated using fuel consumption data from the CSB prepared within Annual questionnaires for 1990-2012 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. 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.

Only gasoline combustion is reported as off-roads in 1.A.4 sector. It is sure that diesel oil is also consumed as off-roads but for now it is not possible for CSB and LEGMC to divide the consumption between fuel combusted stationary and filled in technological vehicles. Due to that all diesel oil reported in the sector is estimated as combusted stationary.

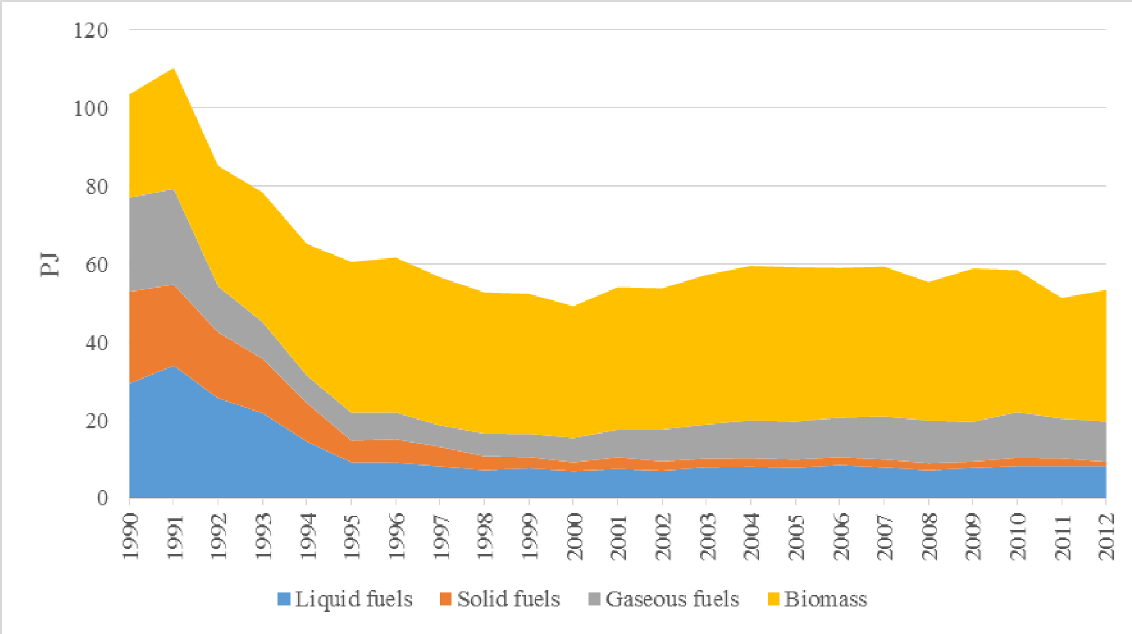


Figure 3.35 Fuel consumption in CRF 1.A.4 Other sectors in 1990-2012 (PJ)

The biggest decrease in 1990-2012 was for solid fuel consumption – 95.73% and liquid fuels consumption – 71.79% (Figure 3.35). It is explained with fuel switching processes when solid and liquid fuels were replaced with cheaper fuels. Also stronger legislation contributed fuel switching to the type of fuels with a lower level of emissions.

Since 1990 biomass as a fuel dominates in Other Sectors. The biggest part of solid biomass consumption goes to Residential sector where biomass is the main fuel in small capacity burning installations. Consumption of biomass fuel has increased substantially by 27.53% in 1990–2012 in Other Sectors.

Since 1997 gaseous fuel consumption is constantly increasing until 2007. These are types of fuels with lower costs 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. In the latest years fluctuations of gaseous fuel are observed. The consumption of gaseous fuel decreased by 12.50% in 2010-2011, and increased by 1.49% in 2011-2012.

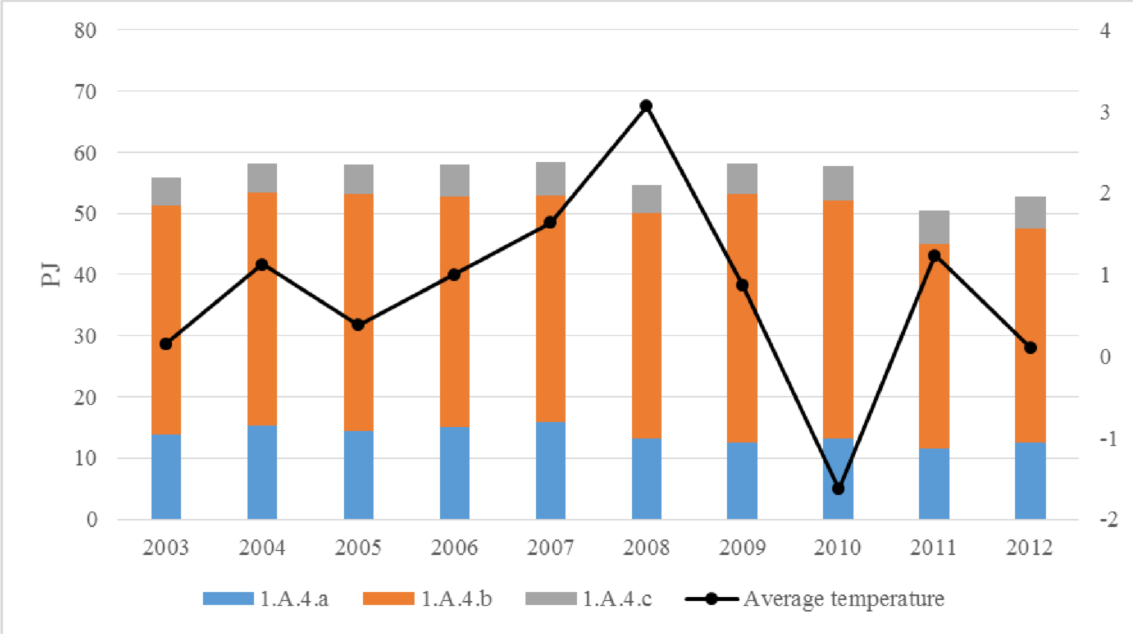


Figure 3.36 Fuel consumption in 1.A.4 Other sectors for stationary combustion and average temperature in Latvia (2000-2012)

As it can be seen in Figure 3.36, the fuel consumption in 1.A.4 sector is related with the average temperature in heating season (assumed that October-April are average months of heating season) with an exception of years 2005-2007 which can be explained with a decrease of central heating supply consumers when they switched to individual heating supply. Years 2007-2008 had quite high average temperature therefore the amounts of fuel consumed decreased. In years 2009-2010 the average temperature decreased significantly, but the fuel consumption was less than expected due to negative effect of financial crisis. In year 2011 the average temperature increased rapidly if compared with year 2010, and the amounts of fuel consumed decreased by 12.65%. However, in year 2012 the temperature decreased again and fuel consumption increased by 4.52% - less than expected due to extensive heat isolation of residential buildings as well as increase of fuel price that made people to think of fuel economy.

3.2.7.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in 1.A.4 sector is ±2% in 2012. CSB gives approximately 2% statistical sample error for statistical data. According to CSB, as data are obtained using information given by respondents, this number is a variation coefficient which characterizes selection of respondents. Total variation coefficient for energy balance is within 2-3%. 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. Also, according to IPCC 2000, pg. 2.41, there is more uncertainty for biomass and traditional fuels, that was a reason for higher uncertainty than for other fuel types. 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%. Taking into account uncertainties of solid biomass and biogas consumption total biomass fuel consumption uncertainty 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 for liquid fuels 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. CO_2 emission factor for natural gas was assumed rather low as 5% because plant specific fuel data is used to estimate emission factor.

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. As fuel consumption in 1.A.4.b Residential sector is obtained only every 5 years using questionnaire and data are extrapolated until the next survey, therefore the uncertainty of all fuel consumption in residential sector is assumed 50%.

Taking into account uncertainties of solid biomass and biogas emission factors total biomass emission factor uncertainty is assumed as 50%.

CH_4 and N_2O emission factor used in estimation of emissions was taken from IPCC 1996 so uncertainty was assigned as 50% according to 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 exceeded 10% level. All issues given in Table 3.43 below were double checked and large fluctuations were explained.

Table 3.43 IEF changes higher than 10% for 1.A.4 sector

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	2010	11.14	2011	12.61	13.27%	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 EF.
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	1995	10.00	1996	11.13	11.27%	
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	1994	11.51	1995	10.00	-13.11%	
1.A.4.a	Liquid Fuels/CH_4	kg/TJ	1993	10.16	1994	11.51	13.28%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2009	16.20	2010	10.57	-34.79%	Changes in 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	2008	19.52	2009	16.20	-16.99%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2007	25.64	2008	19.52	-23.88%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2006	20.21	2007	25.64	26.87%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2005	15.45	2006	20.21	30.80%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2004	10.00	2005	15.45	54.53%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2003	12.16	2004	10.00	-17.79%	

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2002	10.00	2003	12.16	21.63%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2001	12.89	2002	10.00	-22.44%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	2000	15.63	2001	12.89	-17.50%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1999	12.18	2000	15.63	28.36%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1998	18.29	1999	12.18	-33.43%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1997	26.35	1998	18.29	-30.60%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1996	30.58	1997	26.35	-13.81%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1995	20.79	1996	30.58	47.06%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1994	30.43	1995	20.79	-31.68%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1993	20.26	1994	30.43	50.23%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1992	25.65	1993	20.26	-21.01%	
1.A.4.a	Solid Fuels/CH_4	kg/TJ	1991	22.57	1992	25.65	13.64%	
1.A.4.a	Waste oils/CO_2	t/TJ	2002	72.59	2003	103.96	43.21%	In 2003 the structure of waste oils changed therefore average NCV in 2003 was lower (more light waste oils were used).
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	2008	30.83	2009	24.34	-21.07%	CH_4 and N_2O 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 and N_2O EF comparing with other liquid fuels types. Therefore part of gasoline fuel in total liquid fuel influence average IEF of liquid fuels in the sector.
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	2005	25.34	2006	27.90	10.14%	
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	2004	20.05	2005	25.34	26.35%	
1.A.4.b	Liquid Fuels/CH_4	kg/TJ	1999	10.00	2000	20.06	100.59%	
1.A.4.b	Liquid Fuels/N_2O	kg/TJ	1999	0.60	2000	0.73	21.34%	
1.A.4.b	Solid Fuels/N_2O	kg/TJ	1998	1.91	1999	1.58	-17.29%	Changes in N_2O IEF are explained with appearance and fluctuations of peat and pet briquettes consumption.
1.A.4.b	Solid Fuels/N_2O	kg/TJ	1997	1.65	1998	1.91	16.02%	
1.A.4.b	Solid Fuels/N_2O	kg/TJ	1994	1.48	1995	1.72	15.81%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2009	3.02	2010	3.40	12.41%	Changes in N_2O IEF are explained with diesel fuel used for offroads (fishing boats) in Fishing sector, for which N_2O EF is different than for diesel used in stationary combustion in Agriculture/Forestry sector.
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2008	3.66	2009	3.02	-17.41%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2006	5.36	2007	3.93	-26.71%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2005	6.90	2006	5.36	-22.32%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2004	8.26	2005	6.90	-16.43%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2003	9.67	2004	8.26	-14.62%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2002	7.58	2003	9.67	27.53%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2001	9.62	2002	7.58	-21.18%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2000	8.59	2001	9.62	12.06%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1998	5.24	1999	8.69	65.68%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1997	6.75	1998	5.24	-22.38%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1996	9.23	1997	6.75	-26.82%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1995	11.03	1996	9.23	-16.35%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1994	9.93	1995	11.03	11.11%	

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1993	7.71	1994	9.93	28.73%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1992	6.68	1993	7.71	15.41%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1991	4.97	1992	6.68	34.56%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	1990	6.68	1991	4.97	-25.68%	
1.A.4.c	Gas/Diesel Oil/N_2O	kg/TJ	2011	3.59	2012	2.72	-24.28%	

3.2.7.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier 1 method from IPCC 2000 GPG. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.

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.
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. The reasons of data changes are explained.
    - After the data input in emission estimation database, the 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 verified by CSB energy experts by checking the data input reported in the NIR.
    - The emissions for indirect GHG in the database are cross-checked with emissions reported within LRTAP convention to ascertain if these are equal.
    - Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 2%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.
3. Estimated emissions verification:

- 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 illogical 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.

Additional QA/QC checks for Tier 2 methodology

Country specific CO_2 emission factors

Mainly Tier 2 methodology is reported as used in the CO_2 emission estimation, 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.

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.

Plant specific CO_2 emission factors and Tier 2 CO_2 emission estimation methodology

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

3.2.7.5 Source-specific recalculations

Other liquid fuels were split into waste oils and other liquid fuels, therefore changed their NCVs in the whole time series and CO_2 emission factor as well as CO_2 emissions. Natural gas - slight changes in NCV from 37,359 to 37,358 which slightly affected the consumption of gas used in all subsectors (1.A.1, 1.A.2, 1.A.4), CO_2 EF and CO_2 emissions. Input mistake in coal consumption (1.A.4.a; 2001), straw consumption and CO_2 emissions (1.A.4.a; 2006-2010), wood consumption (2008). Corrected activity data provided by CSB for coal (2011). Data from Energy balance (less than 1 kt) added for LPG, RFO (2010, 2011). The consumption of jet fuel was allocated from 1.A.5.b sector (1.A.4.c) for years 1995-2000. Charcoal - changed EF to IPCC 1996. Fuel type "other liquid biofuels" was changed to "biodiesel" and CO_2 EF was changed to biodiesel's EF. Changed EF for diesel used for fishing from stationary to mobile offroad (boats) after QA/QC procedures while comparing data for UNFCCC and CLRTAP submissions.

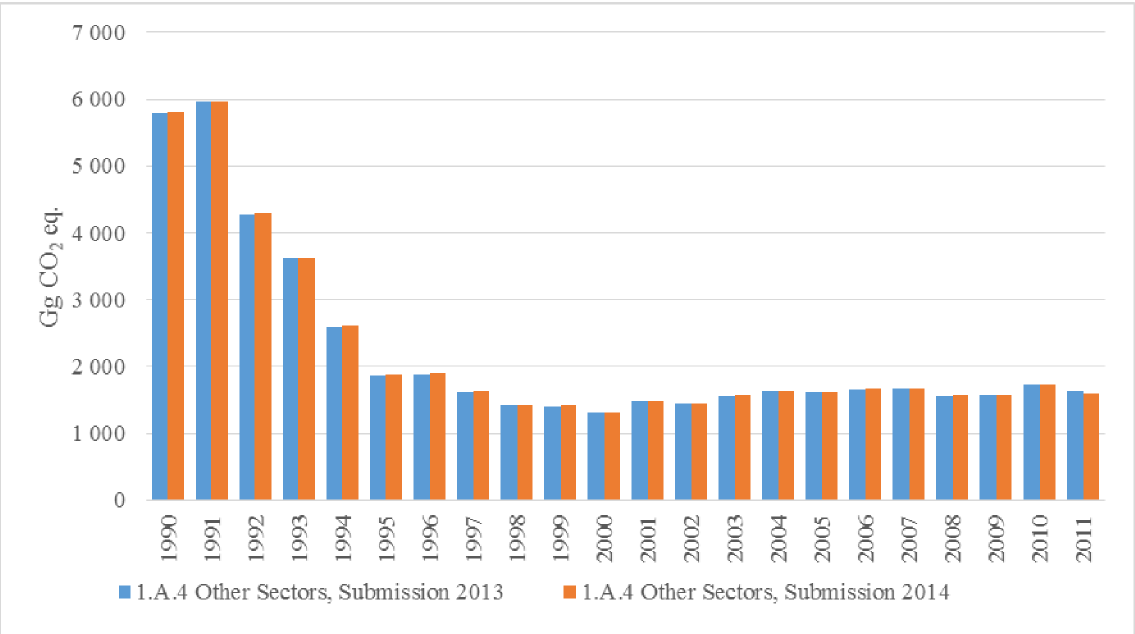


Figure 3.37 Comparison of GHG emissions in CRF 1.A.4 Other Sectors for Submission 2013 and Submission 2014 (Gg CO_2 eq.)

As it can be seen in Figure 3.37, the difference for Submission 2013 (submitted on September, 2013) and Submission 2014 in reported GHG emissions is quite small for all years in time series 1990-2012, fluctuating from -2.22% in 2011 to 1.25% in 1999 with average diference 0.43%.

3.2.7.6 Source-specific planned improvements

It is planned to investigate amounts of fuel used for fishing (off-road purposes) with collaboration with CSB.

More detailed activity data by technology types for Residential sector is planned to be obtained as Residential sector is a key source.

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

3.2.8.1 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 1996 (Table 3.44).

Table 3.44 Emissions from 1.A.5 Other sources in 1990–2012 (Gg)

	CO_2	CH_4	N_2O	Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
1990	NO	NO	NO	NO	NO	NO	NO	NO
1991	NO	NO	NO	NO	NO	NO	NO	NO
1992	NO	NO	NO	NO	NO	NO	NO	NO
1993	NO	NO	NO	NO	NO	NO	NO	NO
1994	NO	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO	NO
1996	0.19	0.0002	0.000002	0.20	0.0002	0.0743	0.0012	0.00006
1997	0.10	0.0001	0.000001	0.10	0.0001	0.0372	0.0006	0.00003
1998	0.19	0.0002	0.000002	0.20	0.0002	0.0743	0.0012	0.00006
1999	0.15	0.0001	0.000002	0.16	0.0002	0.0588	0.0009	0.00005
2000	0.14	0.0001	0.000002	0.14	0.0002	0.0528	0.0008	0.00004
2001	0.17	0.0001	0.000002	0.17	0.0002	0.0648	0.0010	0.00005
2002	6.89	0.0004	0.002238	7.59	0.1430	0.0571	0.0059	0.00193
2003	6.17	0.0004	0.001938	6.78	0.1244	0.0721	0.0055	0.00174
2004	9.63	0.0006	0.003331	10.68	0.2101	0.0994	0.0089	0.00268
2005	7.63	0.0005	0.002316	8.36	0.1497	0.0812	0.0065	0.00216
2006	7.53	0.0007	0.002199	8.22	0.1425	0.1716	0.0077	0.00214

	CO_2	CH_4	N_2O	Aggregate GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6)	NO_x	CO	NMVOC	SO_2
	Gg			Gg CO_2 eq.	Gg			
2007	2.86	0.0002	0.000429	2.99	0.0334	0.0318	0.0018	0.00086
2008	3.42	0.0004	0.000624	3.63	0.0447	0.1537	0.0041	0.00102
2009	5.35	0.0003	0.001472	5.81	0.0973	0.0419	0.0041	0.00153
2010	7.87	0.0004	0.002601	8.69	0.1660	0.0236	0.0062	0.00220
2011	7.22	0.0004	0.002408	7.98	0.1534	0.0161	0.0056	0.00202
2012	7.33	0.0004	0.002360	8.07	0.1514	0.0162	0.0056	0.08072

Emissions from this sector aren't influenced by the changes in national economy or in the economy of Latvia's trade partners but still the emissions are decreasing since 2004. However, in the previous years there has been an increase of fuel consumption, according to data given by CSB.

3.2.8.2 Methodological issues

Methods

IPCC 1996 Tier1 Sectoral approach was used to calculate GHG emissions from the 1.A.5.b Other Mobile source sector. IPCC GPG 2000 Tier 2 method was used to estimate CO_2 emissions from diesel 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

Default emission factors for direct GHGs from Military aircrafts are taken from IPCC 1996 (Table 3.45).

Indirect GHGs emission factors of aviation gasoline and diesel oil were taken from EMEP/EEA 2013, emission factors of jet fuel were taken from IPCC 1996. Country specific emission factors were used to calculate sulphur dioxide (SO_2) emissions.

Table 3.45 CO_2, CH_4, N_2O, NO_x, NMVOC, CO emission factors (Gg/PJ)

	CO_2	CH_4	N_2O	NO_x	NMVOC	CO
Aviation gasoline	72.1	0.060	0.0009	0.091	0.432	27.291
Diesel oil	74	0.004	0.030	1.847	0.066	0.174

	CO_2	CH_4	N_2O	NO_x	NMVOC	CO
Jet fuel	72.8	0.002		0.290	0.018	0.120

Activity data

Emissions from 1.A.5 sector are calculated using fuel consumption data from the CSB informations sent directly to LEGMC due to small amounts of fuel consumed which does not show up on EUROSTAT tables with an exception of few years. Amounts of fuel consumed in 1.A.5. sector can be seen in Annex 3.

3.2.8.3 Uncertainties and time series consistency

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.5.b is ±2% in 2012 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.

Emission factors used for emission estimation were taken from IPCC Guidelines so uncertainty was assigned as very high about 50% according to 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 exceeded 10% level. All issues given in Table 3.46 below were double checked and large fluctuations were explained.

Table 3.46 IEF changes higher than 10% for 1.A.5 sector

Sector	GHG	Unit	Year	First Year	Year	Second Year	Difference	Explanation
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2009	4.24	2010	3.74	-11.7%	All changes in IEFs are explained with structure of liquid fuels and their part of total liquid fuels amount
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2008	9.55	2009	4.24	-55.6%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2007	4.16	2008	9.55	129.7%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2006	5.60	2007	4.16	-25.7%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2005	4.81	2006	5.60	16.3%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2004	4.13	2005	4.81	16.4%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2003	4.87	2004	4.13	-15.2%	
1.A.5.b	Liquid Fuels/CH_4	kg/TJ	2001	60.00	2002	4.62	-92.3%	
1.A.5.b	Liquid Fuels/CO_2	t/TJ	2006	61.69	2007	72.76	17.9%	
1.A.5.b	Liquid Fuels/CO_2	t/TJ	2005	73.49	2006	61.69	-16.1%	
1.A.5.b	Liquid Fuels/CO_2	t/TJ	2004	61.36	2005	73.49	19.8%	
1.A.5.b	Liquid Fuels/CO_2	t/TJ	2003	71.26	2004	61.36	-13.9%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2009	20.20	2010	24.33	20.5%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2008	13.28	2009	20.20	52.1%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2007	10.94	2008	13.28	21.4%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2006	18.02	2007	10.94	-39.3%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2005	22.30	2006	18.02	-19.2%	
1.A.5.b	Liquid Fuels/N_2O	kg/TJ	2001	0.90	2002	24.31	2601.5%	

3.2.8.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier 1 method from IPCC 2000 GPG. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.

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.
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. The reasons of data changes are explained.
- After the data input in emission estimation database, the 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 verified by CSB energy experts by checking the data input reported in the NIR.
- The emissions for indirect GHG in the database are cross-checked with emissions reported within LRTAP convention to ascertain if these are equal.
- Activity data used in Sectoral Approach estimation methodology is compared to the activity data used in Reference Approach estimations. All significant differences (more than 2%) are double-checked. Difference has to be explained and agreed with CSB. This verification step is done for total fuel combustion sector.

3. Estimated emissions verification:
4. 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 illogical changes in the activity data and emissions.
5. 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.

Additional QA/QC checks for Tier 2 methodology

Country specific CO_2 emission factors

Mainly Tier 2 methodology is reported as used in the CO_2 emission estimation, 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.

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.

3.2.8.5 Source-specific recalculations

Emission factors changed to IPCC 1996, except CO_2 EF for diesel fuel. Precised activity data in cooperation with CSB. Consumption of jet fuel allocated to 1.A.4.c sector. Emissions from indirect gases were recalculated as well due to updates in guidebook (EMEP/EEA 2013).

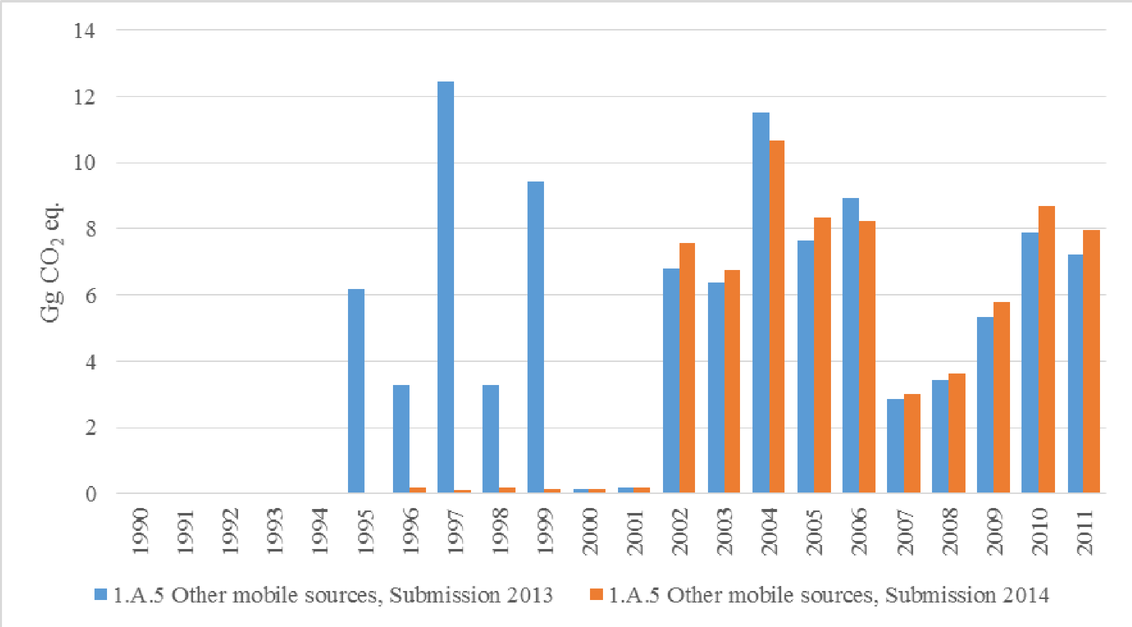


Figure 3.38 Comparison of GHG emissions in CRF 1.A.5 Other mobile sources for Submission 2013 and Submission 2014 (Gg CO_2 eq.)

As it can be seen in Figure 3.38, the difference for Submission 2013 (submitted on September, 2013) and Submission 2014 in reported GHG emissions is very large for years 1995-1999 due to fuel allocation to 1.A.4.c sector. However, in years 2002-2011 there is on average 4.60% difference due to precised activity data and changes in emission factors.

3.2.8.6 Source-specific planned improvements

No improvements currently are planned to be carried out.

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

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

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 light liquid fuels are reported (Table 3.47).

Table 3.47 Reported fugitive emissions in Latvia in 2012

Source	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1.B.1 Solid Fuels	NO	NO	NO	NO	NO	NO	NO

Source	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1.B.1.a Coal Mining and Handling	NO	NO	NO	NO	NO	NO	NO
1.A.1.b Solied 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	√	√	NO	NO	NO	√	NO
1.B.2.a Oil	NO	NO	NO	NO	NO	√	NO
1.B.2.b Natural Gas	√	√	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

It is possible to get data from hard coal transportation via railways but it is assumed that no GHG emissions are generated during this activity. 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 CH_4 emissions from peat bog manufacturing but according to IPCC these emissions have to be reported in LULUCF sector.

There are no coal mines in Latvia and therefore no fugitive emissions from mining processes.

3.3.1.1 Source category description

CRF sector 1.B.2 Oil and Natural Gas includes NMVOC emissions from refined oil products storage and distribution.

There are no oil refineries in Latvia; therefore NMVOC emissions from gasoline distribution 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 3.48 Fugitive NMVOC emissions from oil products 1990–2012 (Gg)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2.979	2.533	2.411	2.342	2.239	2.019	1.994	1.833	1.715	1.656	1.324

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1.387	1.351	1.324	1.407	0.861	0.642	0.257	0.262	0.221	0.301	0.472	0.405

For 2002–2012 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 (Table 3.48) in 2004-2005 by 39% is explained with the strong legislation rules set in the country for operation with liquid fuels. In the latest years fugitive NMVOC emissions have an increasing trend, but in year 2012 the emissions have decreased by 14%.

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 2002–2012 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 3.49).

Table 3.49 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 3.50). Activity data for 2002–2012 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 Environmental Boards. Mostly these emissions are obtained by using measurement or estimated using mass balance method.

Table 3.50 Activity data used for NMVOC emission calculation in 1990–2001 (PJ)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
26.75	22.75	21.65	21.03	20.11	18.13	17.91	16.46	15.4	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 2002-2012 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 2002-2012 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.

3.3.1.4 Source-specific QA/QC and verification

Quality control procedures according to the IPCC GPG 2000 Tier 1 method for Energy sector were performed. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.

NMVOC emissions reported for 2002-2012 are taken from national database "2-Air". The data input by companies' is verified and approved by Regional Environmental Boards.

Data reported in this inventory are compared with data reported under LRTAP convention.

3.3.1.5 Source-specific recalculations

NMVOC emissions from database „2-AIR" were revised and the inventory was updated.

3.3.1.6 Source-specific planned improvements

Investigate the oil flow in the country.

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.

In 2013 data from natural gas company with activity data and recalculated emissions' data using methodology developed in Russia (translated copy available) were received, therefore in Submission 2014 there are changes in methodology (Tier 1 to Tier 2) and activity data are finally available to ensure the reporting transparency.

Table 3.51 Fugitive CH_4, CO_2 and NMVOC emissions from natural gas 1990-2012 (Gg)

	CO_2	CH_4	NMVOC
1990	0.0107	9.214	2.759
1991	0.0103	8.875	2.658
1992	0.0094	8.091	2.423
1993	0.0090	7.738	2.317
1994	0.0088	7.562	2.264
1995	0.0085	7.364	2.205
1996	0.0082	7.096	2.125
1997	0.0077	6.623	1.983
1998	0.0074	6.354	1.903
1999	0.0070	6.058	1.814

	CO_2	CH_4	NMVOC
2000	0.0065	5.606	1.679
2001	0.0065	5.590	1.674
2002	0.0068	5.853	1.753
2003	0.0052	4.474	1.340
2004	0.0051	4.362	1.306
2005	0.0057	4.893	1.465
2006	0.0041	3.514	1.052
2007	0.0042	3.589	1.075
2008	0.0045	3.849	1.153
2009	0.0042	3.602	1.079
2010	0.0039	3.355	1.005
2011	0.0021	1.796	0.538
2012	0.0031	2.661	0.797

The emissions in whole time series are less than in previous submission, and also NMVOC emissions have been reported. Generally the emissions have a decreasing trend in 1990-2012 with a few years where the emissions are increased due to repair works and modernisation of existing pipeline system.

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 1990–2012. Consequently company "Latvijas Gāze" calculates emissions by itself, using data of natural gas density and other physical parameters, and measures the content of methane and other chemical compounds in natural gas.

LEGMC has methodological material, which describes how the amounts of natural gas leaked are calculated. The methodology is translated in English and a brief essence of methods will be available on next year's submission.

Activity data

CH_4 emissions are obtained from the holding company "Latvijas Gāze" and the activity data (millions m^3) are provided in Table 3.52 below. In CRF reporter the amounts of gas leaked have been calculated into TJ due to no possibility to enter data in m^3. Data are calculated into TJ using country specific natural gas NCVs provided in methodology for CO_2 calculation in previous chapters (see Table 3.17)

Table 3.52 Amounts of natural gas leaked in 1990-2012

Year	Natural gas, millions m^3
1990	0.2848
1991	0.2743
1992	0.2501
1993	0.2392

Year	Natural gas, millions m^3
1994	0.2337
1995	0.2276
1996	0.2193
1997	0.2047
1998	0.1964
1999	0.1873
2000	0.1733
2001	0.1681
2002	0.1755
2003	0.1370
2004	0.1356
2005	0.1532
2006	0.1099
2007	0.1128
2008	0.1158
2009	0.1094
2010	0.1054
2011	0.0634
2012	0.0819

3.3.2.3 Uncertainties and time series consistency

The level of uncertainty was determined by the representative of only natural gas distributig company „Latvijas Gāze". The uncertainty of CH_4, CO_2 and NMVOC emissions from natural gas leakages in gas distribution and transmission systems, as well as in gas storage facility is assigned as quite low – 10%, as emissions were measured and estimated by only enterprise operated with natural gas in Latvia – "Latvijas Gāze" by methodology developed for enterprise. However, for other leakage (CRF 1.B.2.B.5) the uncertainty for the emissions is assumed as 35%, therefore total uncertainty for 1.B.2.b Natural gas sector is assumed as 25%. The same uncertainty is applied to CO_2 and CH_4 emissions as these are calculated directly from the amounts leaked.

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

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 and CO_2 emissions according to methodology prepared especially of the organization that is internationally verified and approved by the Environment State Bureau. 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.

3.3.2.5 Source-specific recalculations

There have been recalculated all CH_4 and CO_2 emissions in 1.B.2.b sector, and NMVOC emissions for the first time have been calculated.

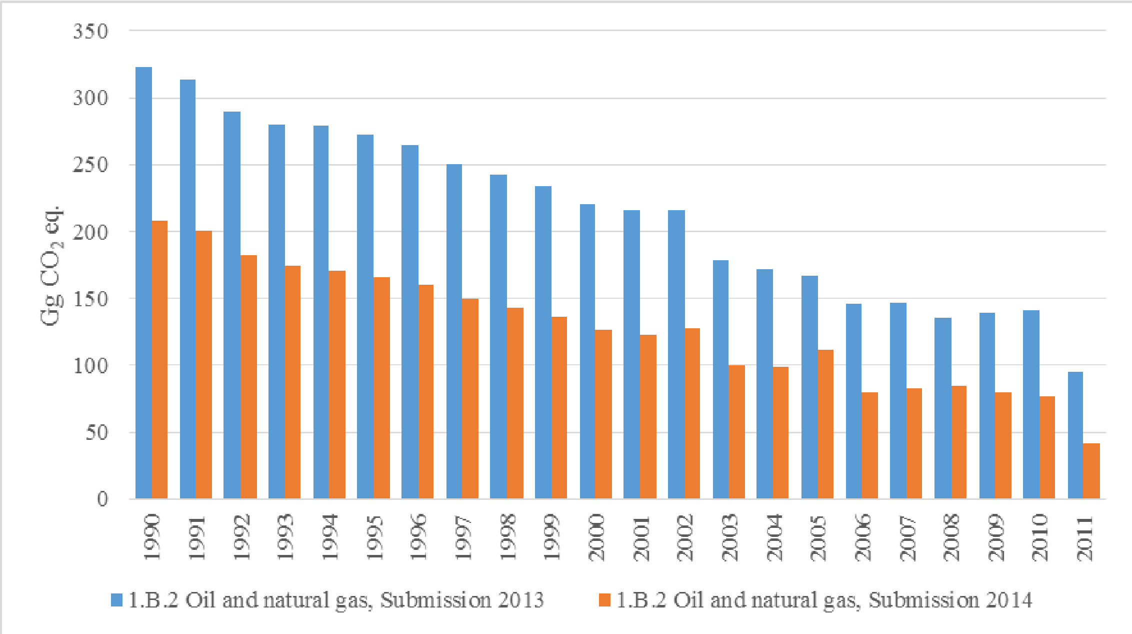


Figure 3.39 Comparison of GHG emissions in CRF 1.B.2 Oil and Natural gas sources for Submission 2013 and Submission 2014 (Gg CO_2 eq.)

As it can be seen in Figure 3.39, the difference for Submission 2013 (submitted on September, 2013) and Submission 2014 in reported GHG emissions is very large for all time series due to method change (Tier 1 to Tier 2) and recalculations of CO_2 and CH_4, as well as NMVOC emissions from gas leakages.

3.3.2.6 Source-specific planned improvements

No improvements currently are planned to be made.

3.4 REFERENCES

- Metodiskie norādījumi CO_2 emisiju noteikšanai, izstrādāti, ievērojot ANO Vispārējās konvencijas "Par klimata pārmaiņām", Klimata pārmaiņu starpvaldību padomes (IPCC) rekomendācijas un Latvijā pielietotā kurināmā fizikālās īpašības. Riga, 2004.
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  http://data.csb.gov.lv/Menu.aspx?selection=vide__Ikgad%C4%93jie%20statistikas%20dati__Ener%C4%A3%C4%93tika&tablelist=true&px_tableid=EN0070.px&px_path=vide__Ikgad%C4%93jie%20statistikas%20dati__Ener%C4%A3%C4%93tika&px_language=en&px_db=vide&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0
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- Average temperature data. Weather in Latvia by selected cities and towns, CSB, 2013 http://data.csb.gov.lv/Selection.aspx?px_tableid=GZ070.px&px_path=visp__Ikgad%

C4%93jie%20statistikas%20dati__%C4%A2eografisk%C4%81s%20zi%C5%86as&px_language=en&px_db=visp&rxid=562c2205-ba57-4130-b63a-6991f49ab6fe

4. INDUSTRIAL PROCESSES (CRF 2)

4.1 OVERVIEW OF SECTOR

4.1.1 Quantitative overview

Sources of emissions from Industrial Processes are Table 1.1.

- Mineral products (CRF 2.A):
  - cement production (clinker production) – CRF 2.A.1;
  - lime production (as non-marketed lime for steel production in Iron & Steel production plant) – CRF 2.A.2;
  - limestone and dolomite use – CRF 2.A.3
    - in glass production,
    - in steel production,
    - in lime production.
    - in sugar production;
  - soda ash use in glass production – CRF 2.A.4,
  - asphalt roofing – CRF 2.A.5;
  - road paving with asphalt – CRF 2.A.6;
  - other – use of mineral products in glass and ceramics production – CRF 2.A.7:
    - raw materials use in glass production – potash, fluorspar and whiterite;
    - NMVOCs and indirect CO_2 from glass fibre production,
    - use of raw materials in bricks production,
    - use of raw materials in tiles production;
- Metal production (CRF 2.C):
  - CO_2 emissions from use of crude iron as raw material,
  - CH_4 and indirect GHG 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 Reported emissions from Industrial Processes in Latvia in 2012

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	√									√		√	√
2. Lime Production	√												
3. Limestone and Dolomite Use	√												

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. Soda Ash Production and Use	NO												
5. Asphalt Roofing	√										√	√	
6. Road Paving with Asphalt	√									NE	NE	√	NE
7. Other													
Production of Glass (Use of fluorspar)	√	NE	NE							NE	NE	NE	NE
Production of Glass (Use of potash)	NO	NO	NO							NO	NO	NO	NO
Production of Glass (Use of whiterite)	NO	NO	NO							NO	NO	NO	NO
Production of Glass Fibre	√	NE	NE							NE	NE	√	NE
Production of Bricks	√	NE/NO	NE/NO							NE/NO	NE/NO	NE/NO	NE/NO
Production of Tiles	√	NE	NE							NE	NE	NE	NE
B. Chemical Industry													
1. Ammonia Production	NO	NO	NO							NO	NO	NO	NO
2. Nitric Acid Production			NO							NO			
3. Adipic Acid Production	NO		NO							NO	NO	NO	
4. Carbide Production	NO	NO								NO	NO	NO	NO
5. Other													
Carbon Black		NO											
Ethylene	NO	NO	NO										
Dichloroethylene		NO											
Styrene		NO											
Methanol		NO											
C. Metal Production													
1. Iron and Steel Production	√	NO	NA							√	√	√	√
2. Ferroalloys Production	NO	NO	NO							NO	NO	NO	NO
3. Aluminium Production	NO	NO	NO				NO			NO	NO	NO	NO
4. SF_6 Used in Aluminium and Magnesium Foundries									NO				
5. Other													
Other non-specified	NO	NO	NO							NO	NO	NO	NO
D. Other Production													
1. Pulp and Paper										NO	NO	NO	NO
2. Food and Drink(2)	NA											√	
E. Production of Halocarbons and SF_6													
1. By-product Emissions													
Production of HCFC-22					NO								
Other					NO		NO		NO				
2. Fugitive Emissions					NO		NO		NO				
3. Other													
Other non-specified					NO		NO		NO				
F. Consumption of Halocarbons and SF_6													
1 Refrigeration and Air Conditioning Equipment				√	√	NO	NO	NO	NO				
2. Foam Blowing				√	√	NO	NO	NO	NO				
3. Fire Extinguishers				√	√	NO	NO	NO	NO				
4. Aerosols/ Metered Dose Inhalers				√	√	NO	NO	NO	NO				
5. Solvents				NO	NO	NO	NO	NO	NO				
6. Other applications using ODS(3) substitutes				NO	NO	NO	NO	NO	NO				
7. Semiconductor Manufacture				NO	NO	NO	NO	NO	NO				

Source	Emissions												
	CO_2	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
8. Electrical Equipment				NO	NO	NO	NO	√	√				
9. Other *(as specified in table 2(II)*													
Production of shoes				√	√	NO	NO	NO	NO				
G. Other													
Other non-specified	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

4.1.2 Description

Industrial processes GHG emissions contribute 6.8% of the total anthropogenic GHG emissions in Latvia in 2012. The most important emission source of the Industrial Processes in 2012 is CO_2 emissions from Mineral products and HFCs emissions from Consumption of halocarbons and SF_6.

Table 4.2 Greenhouse gas emission trend in 1990–2012 (Gg CO_2 eq)

	TOTAL	2.A Mineral Products	2.C Metal Production		HFCs		SF_6	
		CO_2	CO_2	CH_4	Actual	Potential	Actual	Potential
1990	597.41	584.53	12.83	0.06	IE,NA,NE,NO	NE,NO	NA,NE,NO	NE,NO
1991	535.60	526.85	8.71	0.04	IE,NA,NE,NO	NE,NO	NA,NE,NO	NE,NO
1992	256.57	250.81	5.73	0.03	IE,NA,NE,NO	NE,NO	NA,NE,NO	NE,NO
1993	81.47	74.43	7.01	0.03	IE,NA,NE,NO	NE,NO	NA,NE,NO	NE,NO
1994	142.02	135.44	6.55	0.03	IE,NA,NE,NO	NE,NO	NA,NE,NO	NE,NO
1995	155.83	150.48	4.43	0.03	0.638	0.473	0.251	0.634
1996	168.23	163.59	3.49	0.03	0.833	0.498	0.287	0.670
1997	174.70	164.22	8.00	0.05	1.924	0.558	0.508	0.891
1998	176.42	164.30	8.50	0.05	2.856	0.948	0.710	1.092
1999	210.23	198.22	7.71	0.05	3.271	1.287	0.977	1.360
2000	161.54	146.67	8.43	0.05	5.112	2.320	1.275	1.657
2001	186.40	168.75	8.04	0.05	7.576	32.199	1.977	2.359
2002	200.16	179.27	7.60	0.05	9.854	32.770	3.382	3.764
2003	220.90	188.56	12.16	0.06	15.702	65.510	4.413	4.796
2004	235.94	199.54	12.92	0.06	18.062	125.300	5.370	5.752
2005	237.09	188.78	12.36	0.06	28.362	132.945	7.530	7.913
2006	300.93	218.61	12.57	0.06	62.567	161.714	7.124	7.595
2007	341.12	219.34	14.57	0.06	98.558	131.955	8.596	9.062
2008	306.97	215.27	8.73	0.06	72.83	194.094	10.076	10.601
2009	304.17	206.68	9.56	0.05	74.35	199.867	13.529	14.077

	TOTAL	2.A Mineral Products	2.C Metal Production		HFCs		SF_6	
		CO_2	CO_2	CH_4	Actual	Potential	Actual	Potential
2010	564.84	469.07	11.28	0.06	72.182	321.454	12.25	12.781
2011	657.31	569.36	0.48	0.02	75.011	185.819	12.454	12.973
2012	687.51	588.21	1.87	0.09	83.650	192.032	13.688	14.222

Data on 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, Table 4.2) 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 different 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 52.6% in 2000-2007. It is explained with sharp development of Latvian industry when construction activities increased and industrial production of building materials also increased.

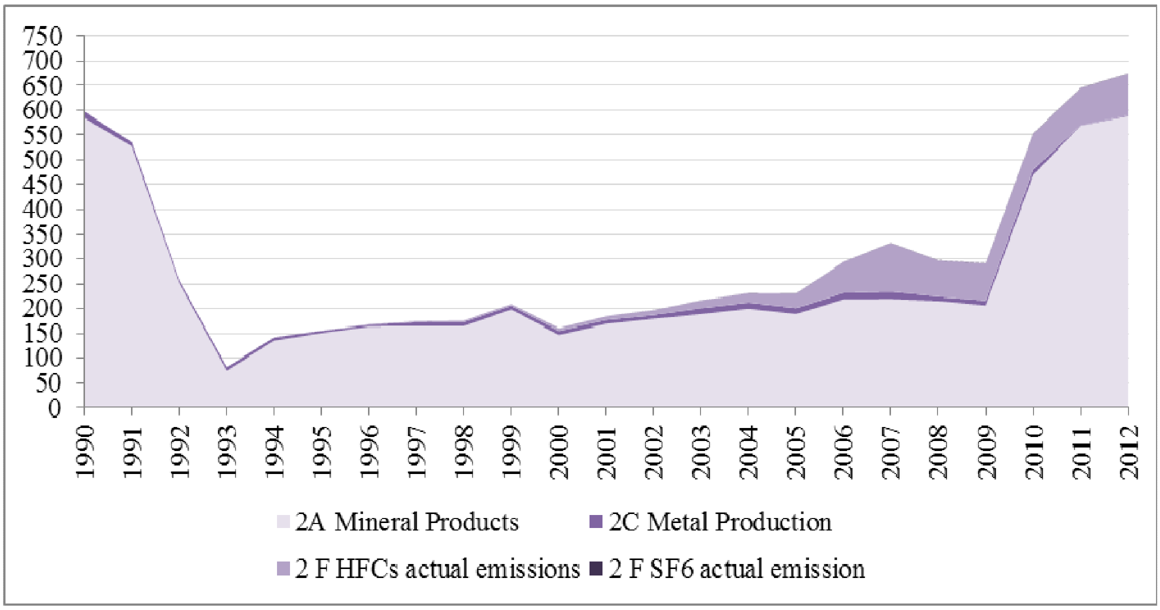

Figure 4.1 GHG emissions from Industrial Processes in 1990–2012 (Gg CO_2 eq.)

Still at the end of 2008 and in 2009 the global financial crisis caused a crisis in Latvia's national economy when the industrial production has decreased quite significantly. The decrease mainly is explained with the decrease of population welfare when lot of people lost their jobs, benefits and pensions were decreased and taxes were increased therefore the purchase capacity of population decreased remarkably. Due to that the building and construction sector development decreased as well as companies also were charged with higher taxes. Starting with 2010 there is an overall increase of activity and emissions from Industrial production.

Only HFCs and SF_6 emissions increased in latest years as biggest F-gases sectors – commercial refrigerators and mobile air conditioning equipment, are not directly linked with development of national economy. Refrigerating equipments are used in manufacturing industry and trading that are developing even during economical crisis. Mobile air conditioning equipments are installed in all newer cars and need to be refilled.

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. At the moment the most important for non-energy CO_2 emission sources from Industrial Processes sector are cement, road paving with asphalt process, limestone use in glass and metal production and lime 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 4.3. Also radical decrease of CO_2 emissions from 1999 to 2000 are influenced by economical crisis in neighbourhood Russian Federation with whom Latvia had strong foreign trade linkage.

Table 4.3 Emissions from 2.A Mineral Products in 1990–2012 (Gg)

	CO_2								NOx	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	584.526	366.123	8.205	141.005	NO	0.0030	0.0015	69.189	0.9025	0.00007	0.1565	3.4094
1991	526.844	327.136	8.205	111.369	NO	0.0030	0.0005	80.133	0.8338	0.00002	0.1444	3.1498
1992	250.805	149.177	8.205	55.305	NO	0.0002	0.0001	38.118	0.3753	0.00000	0.0651	1.4178
1993	74.428	16.736	8.205	39.206	0.4821	0.0045	0.0022	9.792	0.0415	0.00011	0.0114	0.1568
1994	135.437	81.109	8.205	37.054	0.9147	0.0096	0.0047	8.140	0.2025	0.00024	0.0407	0.7650
1995	150.479	95.418	8.205	35.212	0.6428	0.0089	0.0044	10.989	0.2372	0.00022	0.0465	0.8960
1996	163.592	107.701	9.401	34.374	0.968	0.0164	0.0081	11.125	0.2673	0.00041	0.0575	1.0099
1997	164.223	109.553	12.169	29.910	1.0027	0.0171	0.0084	11.562	0.2723	0.00043	0.0612	1.0286
1998	164.302	106.502	10.965	31.326	0.9926	0.0172	0.0085	14.491	0.2641	0.00043	0.0610	0.9978
1999	198.215	140.538	11.349	29.633	0.9401	0.0255	0.0126	15.717	0.3550	0.00064	0.0762	1.3412
2000	146.672	89.578	10.532	30.386	1.7431	0.0161	0.0179	14.399	0.2257	0.00040	0.0528	0.8526
2001	168.748	110.963	11.255	29.719	1.4978	0.0189	0.0209	15.273	0.2743	0.00047	0.0662	1.0364
2002	179.273	119.135	11.013	30.601	2.023	0.0213	0.0236	16.457	0.2984	0.00053	0.0724	1.1273
2003	188.563	131.530	11.215	29.323	1.7489	0.0238	0.0264	14.695	0.3255	0.00059	0.0782	1.2296
2004	199.538	139.034	14.320	28.995	1.5148	0.1392	0.1542	15.381	0.3510	0.00347	0.1669	1.3260

	CO_2								NOx	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				
2005	188.784	134.951	13.421	27.758	1.5535	0.0444	0.0492	11.007	0.3583	0.00111	0.1043	1.3535
2006	218.609	169.532	9.230	28.065	0.4656	0.0426	0.0471	11.226	0.4464	0.00106	0.1113	1.6863
2007	219.338	171.811	10.157	24.408	0.0374	0.0569	0.0630	12.804	0.4567	0.00142	0.1318	1.7254
2008	215.272	167.795	11.651	20.765	NO	0.0586	0.0649	14.938	0.4515	0.00146	0.1311	1.7058
2009	206.679	178.855	6.948	17.422	NO	0.0320	0.0354	3.387	0.7033	0.00080	0.0626	1.7390
2010	469.067	431.197	12.815	20.209	NO	0.0357	0.0396	4.772	0.4829	0.00089	0.0481	0.0705
2011	569.359	558.657	0.001	4.940	NO	0.0565	0.0625	5.642	0.9341	0.00141	0.0669	0.3737
2012	588.218	576.633	0.425	5.065	NO	0.0604	0.0669	5.967	1.4644	0.00151	0.0570	0.3214
Share of total 2012 emissions[22]	**5.93%**	**5.22%**	**0.00%**	**0.05%**	**0.00%**	**0.00%**	**0.61%**	**0.05%**	**0.01%**	**0.00%**	**0.21%**	**0.00%**

Due to Latvia's economical features since 2007–2008 the industry development was slowing down as the financing and real estate sectors started dominating in national economy. In 2009-2010 emissions from 2.A.1 Cement production increased as cement production plant switched the production technology and installations and increased its capacity by approximately 2.4 times. In 2012 there is increased production capacity 1.3 times comparing with 2010 when production plant switched totally from wet to dry process clinker production.

Under sector 2.A Mineral products there are included NMVOC emissions from road paving and asphalt roofing as well as NMVOC emissions from glass fibre production. Also SO_2 emissions from cement production are reported. NO_x and NMVOC 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 NMVOC emissions in 2.A.1 Cement Production sector.

Indirect CO_2 emissions were estimated from NMVOC emissions in 2.A.5, 2.A.6 sectors and from glass fibre production.

4.2.2 Cement Production (CRF 2.A.1)

4.2.2.1 Source category description

CO_2, NO_x, 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. Still in 2009 new production plant with dry process kiln production technology was erected and the old one where the wet process kiln technology was used was closed in the middle of the year. And as the old production plant was set to closing no active cement kiln dust recovery occurred and all cement kiln dust was collected and transported to landfill for storage. Therefore amount of cement kiln dust and CKD/clinker ratio increased sharply in 2009-2012 that affected CO_2 emissions (Figure 4.2).

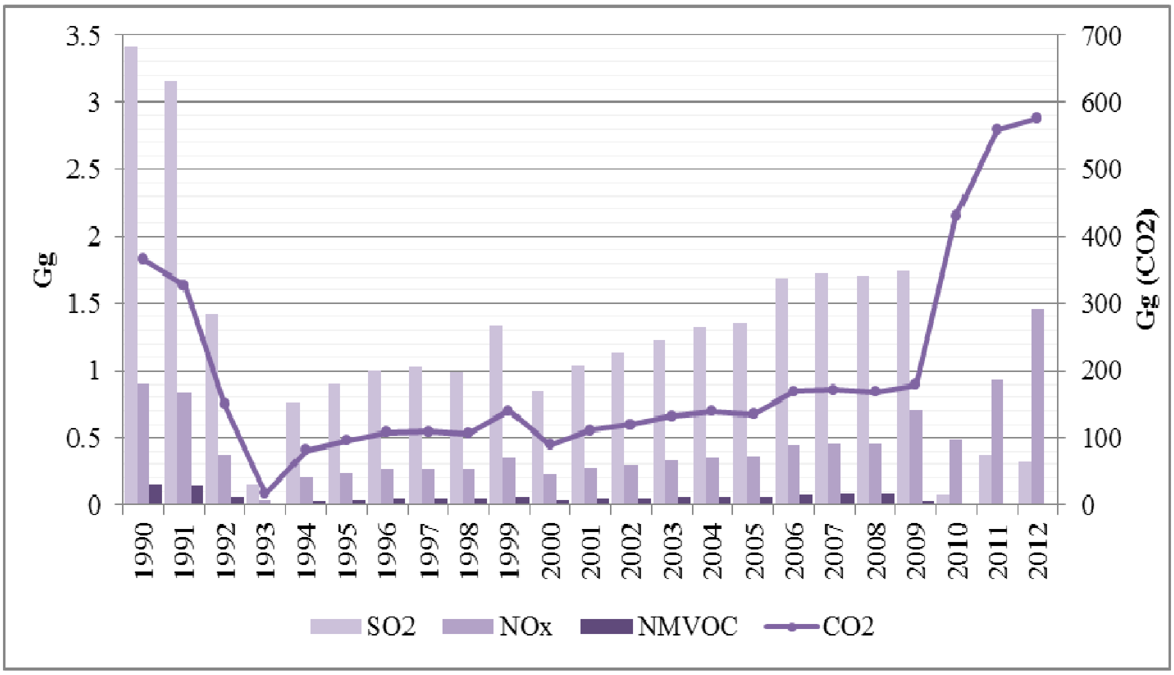

Figure 4.2 Emissions from Cement production in 1990–2012 (Gg)[14]

All emissions except NMVOC increased in 2008-2009 when CO_2 increased by 6.59%, SO_2 – by 1.95%. NOx emissions increased quite sharp by 55.76% that is explained with the emission factor of NOx for new production plant using dry process kiln that is 181.48% higher than in old production plant. NMVOC emissions decreased by 61.22% that is also explained with the emission factor for new production plant that is 95.65% lower than for the old production plant's wet kiln process technology.

Starting from 2010 fully dry process kiln is used in cement production. For 2009 both kiln processes- dry and wet was used in cement production. Previously (1990 – 2009 partly) only wet process kiln was used in cement production. Due to increasing activity for cement clinker production in 2010 there are obviously decreased amount of SO_x emissions. From year 2009 to 2010 SO_x emissions are decreased about 95.95% due to changing technology of cement clinker production from wet to dry process kiln. As resources there are used tyres and lube oil which consists sulphur compounds, all necessary for producing clinker. NO_x are decreased about 31.34% but these data are not representative due to new technology started to work with full capacity only in July on 2nd half of year 2010 and fully in 2011. In 2011 and 2012 there are increased emissions from 2.A.1 sector due to increasing of used activity data in cement production comparing with previous years accordingly about 31.17% and 3.09%.

4.2.2.2 Methodological issues

Methods

Tier2 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. For CO_2 emission factor as well as emission estimations IPCC GPG 2000 Tier2 method is used.

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

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

$$E_m = EF \times AD_{clinker} \times CKD_{CF}$$

where:

Em – CO_2 emissions from clinker production (Gg)

EF – clinker production EF (Gg/Gg)

$AD_{clinker}$ – clinker production activity data (Gg)

CKD_{CF} – cement kiln dust correction factor

Tier2 approach from EMEP/CORINAIR 2007 was used to calculate NOx, NMVOC, SO_2 emissions from cement production taking into account produced amount of clinker in wet and dry process kilns and technology based EFs.

Emission factors

CO_2 emission factor

CO_2 emission factor is calculated for all years in time series 1990–2012 according to CaO content in used limestone that is measured in laboratory of cement production facility (Table 4.4). LEGMC is able to use all laboratory measurements data from cement production plant even if it is not accredited and certified as requested in EU ETS MRG 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 factor is calculated using equation from IPCC GPG 2000:[16]

$$EF = 0.785 \times CaO_{\ content}$$

where:

EF – clinker production EF (Gg/Gg)

0.785 – molecular weight ration of CO_2 to CaO in the raw material ($CaCO_3$)

CaO – CaO content (weight fraction) in produced clinker (%)

Table 4.4 Average CaO content in clinker (%) and average CO_2 emission factor in 1990–2012 (t CO_2 / t clinker)

	Average CaO content (%)	CO_2 EF without CKD factor	CKD correction factor	CO_2 EF with CKD factor
1990	50.71	0.5071	1.080	0.548
1991	50.75	0.5075	1.044	0.530
1992	50.06	0.5006	1.072	0.537
1993	50.39	0.5039	1.080	0.544
1994	50.07	0.5007	1.080	0.541
1995	50.29	0.5029	1.080	0.543
1996	50.56	0.5056	1.076	0.544
1997	50.56	0.5056	1.074	0.543
1998	50.56	0.5056	1.077	0.544
1999	50.56	0.5056	1.057	0.534
2000	50.56	0.5056	1.060	0.536
2001	50.56	0.5056	1.080	0.546
2002	50.56	0.5056	1.066	0.539

[15] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p3.10
[16] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p3.12

	Average CaO content (%)	CO_2 EF without CKD factor	CKD correction factor	CO_2 EF with CKD factor
2003	50.56	0.5056	1.079	0.546
2004	50.56	0.5056	1.058	0.535
2005	50.56	0.5056	1.006	0.508
2006	50.83	0.5083	1.009	0.513
2007	50.29	0.5029	1.010	0.508
2008	50.02	0.5002	1.003	0.502
2009	51.24	0.5124	1.024	0.525
2010	51.21	0.5121	1.008	0.516
2011	50.51	0.5051	1.010	0.510
2012	50.48	0.5048	1.012	0.511

For year 1996–2005 average CaO content data of years 1995 and 2006 was used in emissions calculation since data for average CaO content in produced clinker for years 1996–2003 was not available in cement production plant. Also information from plant that average CaO content of years where data is available could be used was received.

For Submission 2014 the CaO content data for 2012 was requested to cement production plant. CO_2 emission factor for 2012 was used according to information on CaO content in produced clinker provided by plant.

Indirect GHG emission factors

As the EFs for NOx, NMVOC and SO_2 are not available in EMEP/EEA 2013[17] (marked as "Not Estimated") the EFs from EMEP/CORINAIR 2007[18] were used as these emissions are emitted in the production according to cement production plant. Till submission 2011 the EFs were divided for dry process kiln used (Table 4.5). Starting with 2010 there are reported NO_x and SO_2 emissions as plant-specific data that are detected automaticaly from dry process production plant. Only NMVOC emissions are estimated using provided EF mentioned below. Only NMVOC emissions are estimated using provided EF taken from EMEP/CORINAIR 2007 mentioned in Table 4.5.

Table 4.5 EFs for cement clinker production emission estimation (Gg/Gg)

	NOx	NMVOC	SO_2
wet process kiln	0.00135	0.00023	0.0051
dry process kiln	0.00245	0.00001	0.0051

Activity data

The produced clinker is not weighted in cement production plant but clinker production is estimated from final cement type by multiplying it with cement/clinker ration according to cement producer annual EU ETS GHG report (European Union Emission Trading System Greenhouse Gas Report that must be submitted by ETS operators annualy till 15th of March to State Environmental Service Regional Environmental Board for approval of verified emissions in previous year).

According to IPCC GPG 2000 it is not a good practice to estimate CO_2 emissions from final cement production data. According to IPCC GPG 2000 alternative of activity data if clinker

[17] http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009/part-b-sectoral-guidance-chapters/2-industrial-processes/2-a-mineral-industry/2-a-1-cement-production.pdf (pages 12-13)
[18] http://www.eea.europa.eu/publications/EMEPCORINAIR5/B3311vs2.4.pdf (pages 12-13)

production data is not available is to use cement clinker data and the estimate this amount back to clinker production data. In the cement production plant it is done for the EU ETS annual reporting by taking into account clinker and cement ratio for the particular types of cement produced. Activity data of clinker is plant- specific data reported from cement clinker plant. Final clinker data are known to using mass balance approach in two steps:

1) Used clinker = produced cement - all the additives;
2) Produced clinker = used clinker + clinker export – clinker import + clinker stock change.

CaO content is measured in the cement production companies and CO_2 EF for produced clinker is estimated according to IPCC GPG 2000 Chapter 3 equation 3.3[19]. As it stated by cement producer and verified by ISO accredited verifiers the cement kiln dust is weighted at the plant before the transportation outside the company for the storage.

Due to changing of technology there are produced 2.4 and 1.3 times more clinker in 2010 and 2011 as in previous years. It is explained with new dry process kiln technology and increasing of activity produced by clinker production plant. Full capacity of dry process cement clinker production has caused the increase of CO_2 from Industrial processes starting from 2010. Cement clinker are produced for internal use but mainly for export.

Table 4.6 CKD correction factor in 1990–2012

	Produced clinker (Gg)	Produced cement kiln dust (Gg)	CKD / clinker ratio (%)	Corrected CKD / clinker ratio (%)
1990	668.50	175.49	26.25	0.080
1991	617.60	27.00	4.37	0.044
1992	278.00	20.00	7.19	0.072
1993	30.75	5.00	16.26	0.080
1994	150.00	15.00	10.00	0.080
1995	175.69	15.00	8.54	0.080
1996	198.02	15.00	7.57	0.076
1997	201.69	15.00	7.44	0.074
1998	195.65	15.00	7.67	0.077
1999	262.97	15.00	5.70	0.057
2000	167.18	10.00	5.98	0.060
2001	203.22	18.18	8.94	0.080
2002	221.04	14.60	6.61	0.066
2003	241.10	19.05	7.90	0.079
2004	260.00	15.00	5.77	0.058
2005	265.40	1.53	0.58	0.006
2006	330.65	2.89	0.87	0.009
2007	338.31	3.35	0.99	0.010
2008	334.46	0.99	0.30	0.003
2009	340.99	8.08	2.37	0.024
2010	834.94	7.02	0.84	0.008
2011	1095.23	10.87	0.99	0.010
2012	1129.11	13.29	1.18	0.010

[19] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf page 3.12

As it can be seen in Table 4.6 the plant specific data resulted in a higher CKD ratio (26.25%) in 1990, while the CKD in 2008 is much lower (0.30%). 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.

According to cement production plant the CKD amount is weighted before it is sent to disposal site. The amount of weighted CKD as well as procedures of all data obtaining is verified by the accredited verifier within EU ETS. According to Verification Company all production facilities as well as data obtaining and storage was inspected at the production company personally by the lead verificator. All verification reports also are publicly available through LEGMC ETR web page (only in Latvian), internal verification documentation is confidential. The cement clinker is produced only from limestone and CKD amount changes due to production technology. For the last years CKD has decreased due to improvement of used technology.

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 Environmental Board 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.

Time series consistency was checked by verifying IEF changes and attention was paid to changes that increased 10% level. No specific issues were found.

4.2.2.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG 2000.

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 under each subsector source category description.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived.

Plant specific CO_2 emission factors and Tier 2 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 2000.

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 2000 and the Tier2 methodology was verified by ERT during three in-country reviews in 2007, 2009 and 2013 and accepted as correct.

There were involved external auditor for QA/QC as this is a key source category. All specific or significant uncertanties were corrected and missing information was reported. For example to compared data tabeles between CRF and NIR to avoid rounding issues.

4.2.2.5 Source-specific recalculations

No recalculation has been done for the sector.

4.2.2.6 Source-specific planned improvements

According to ERT recommendations during the incountry review week on September 2013, there are planned to make updates in this sector to improve time series consistency by undergoing capacity building projects so as to achieve better time series consistency in the emissions estimates for the next submission. It is planned to make these efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for next submission.

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 quicklime (CaO) data.

In iron & steel production facility lime necessary for steel smelting in open heart furnaces is produced only from limestone in vertical shaft kiln. The plant is reporting their non-marketed quicklime production data for 2005-2012 within ETS so the estimated emissions as well as used activity data and emission factors are taken from plant's annual GHG report within GHG (Table 4.7).

Table 4.7 CO_2 emission from lime production in steel production in 1990–2012 (Gg)

1990	8.205
1991	8.205
1992	8.205
1993	8.205
1994	8.205
1995	8.205
1996	9.401
1997	12.169
1998	10.965
1999	11.349
2000	10.532
2001	11.255
2002	11.013
2003	11.215
2004	14.320
2005	13.421
2006	9.230
2007	10.157
2008	11.651
2009	6.948
2010	12.815
2011	0.001
2012	0.425

As for most of Latvia's economy sectors the emissions in 2008-2009 have decreased significantly due to the economical crisis. In 2010, emissions have increased due to increasing activity data of produced lime that are used for glass and metal production. There are increased emissions from lime production due to overall increasing of activity in Industrial processes. In 2011, emissions of produced lime that are used for metal production are decreased due to changing technology of metal production as plant switched on steel production in EAF (Electric arc furnace) only and operation of this plant was partialy suspended due to reconstruction. In 2012 there are increased CO_2 emissions in this subsector 425 times but still its is small amount comparing with years before 2011.

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 quicklime data and default emission factor.

$$EM = EF \times AD$$

where:

EM – CO_2 emissions from quicklime production (Gg)

EF – default EF according to IPCC GPG 2000 (tCO_2/t lime) and MRG

AD – quicklime production data (Gg)

Emission factors

Default CO_2 emission factor from IPCC GPG 2000 was used by steel production plant as per tonne of high calcium quicklime – 0.785 tCO_2/t lime[20]. 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 4.8**Table 4.8).

Table 4.8 Amount of produced lime in steel production in 1990–2012 (Gg)

1990	10.452
1991	10.452
1992	10.452
1993	10.452
1994	10.452
1995	10.452
1996	11.976
1997	15.502
1998	13.968
1999	14.457
2000	13.416
2001	14.338
2002	14.029
2003	14.287
2004	18.242
2005	17.097
2006	11.758
2007	12.939
2008	14.842
2009	8.851
2010	16.325
2011	0.002
2012	0.541

For years 1995-2004 the iron production plant reported their activity data additionally after the information request letter. Due to lack of official data it was decided to use year's 1995 activity data for emission estimation for 1990-1995.

4.2.3.3 Uncertainties and time series consistency

Although according to IPCC GPG the uncertainty of non-marketed lime production data could reach 100% and more[21] it is assumed that the uncertainty of activity data for non-marketed lime production data is 2.A.2 sector is assumed as 2% as only one plant specific data verified by accredited verifier and approved by Regional Environmental Board is used.

[20] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf (page 3.20)
[21] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf (page 3.23)

As default emission factors for lime production from IPCC GPG 2000 as well as MRG are used the uncertainty is assumed 50% due to unavailability of the plant specific data of produced lime and due to the fact that this is default emission factor for quicklime production.

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 no specific issues.

4.2.3.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG 2000.

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 under each subsector source category description.

The QC form has been filled in for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is archived.

There were involved external auditor for QA/QC in 2013. No specific or significant uncertanties were found under this sector.

4.2.3.5 Source-specific recalculations

No recalculation has been done for the sector.

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 of EU 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. This IEF are taken from annual report and it is suggest as accurate one by verificator. This EF are elected according to changes in operator GHG permission.

Under CRF 2.A.3 and CRF 2.A.4 sectors following CO_2 emission sources are reported:

- limestone and dolomite use in two glass production plants and one glass fibre production plant;
- limestone and dolomite use in one iron & steel production plant;
- limestone use in one lime production plant;
- dolomite use in one lime production plant;
- limestone use in sugar production processes;
- soda ash use in one glass production plant.

It's feasible that the emissions in early 90ties are higher because iron & steel production plant is active since 19th century. 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. Therefore the data of use of raw materials in steel production plant is not available for the time period 1990-1993. For more precision of the inventory the data of year 1994 was used for the years in 1990-1993.

As it can be seen in Figure 4.3 the CO_2 emissions from dolomite use in lime production plant as well as dolomite and limestone use in steel production are continuously decreasing since the beginning of 90ties due to recession of overall national economy.

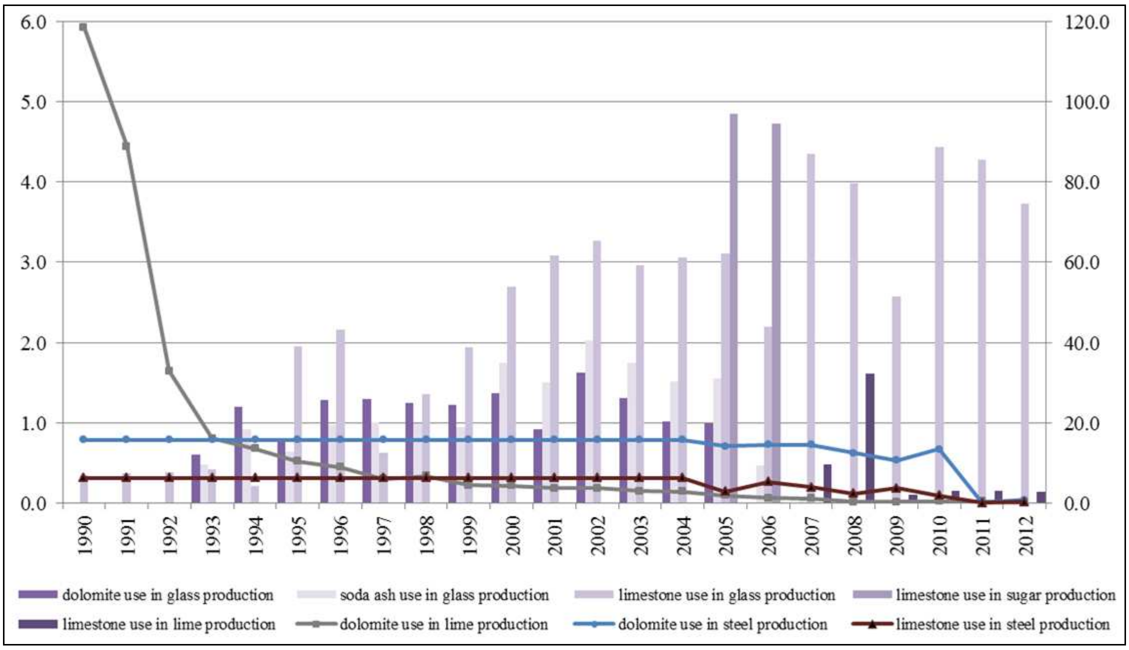

Figure 4.3 CO_2 emission from limestone, dolomite and soda ash use in 1990–2012 (Gg)[22]

The sharp decrease of limestone use in glass production plant in 1997 and accordingly the CO_2 emissions is explained with changes in plant's structure as since 1997 the plant is Joint Stock Company and overall changes in production technology Figure 4.3.

The economical crisis is obviously reflecting in CO_2 emissions from limestone, dolomite and soda ash use in mineral productions. Also the increase of taxes influences the ability of industrial producers to invest in future development. In 2010 there are increased CO_2

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

emissions from limestone, dolomite and soda ash use due to increasing activity in all industrial sector. It is explained with fact that Latvia is almost over economical crisis. In 2011 there are sharply decrease of CO_2 emissions in limestone and dolomite use in steel production due to changing technology of metal production as plant switched on steel production in EAF (Electric arc furnace) only and operation of this plant was partialy suspended due to reconstruction.

In latest two years there are trend to decrease CO_2 emissions from subsectors 2.A.3 and 2.A.4. due to reconstruction mentioned above.

4.2.4.2 Methodological issues

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

CO_2 emissions from Lime production in two direct lime production plants are calculated basing on data of carbonates – dolomite and limestone use. Purity factor from IPCC GPG 2000 is 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 activity data and default IPCC 1996 emission factors. Tier3 method is used in CO_2 emission from dolomite use in lime production processes estimation as plant specific activity data as well as plant specific CO_2 emission factors are used in estimation.

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 and sugar production also is taken from IPCC 1996 (Table 4.9).

Table 4.9 CO_2 emission factors for limestone, dolomite and soda ash use (t CO_2/t raw material)

	1990–2012
Limestone use in glass, steel, lime and sugar production	0.440
Dolomite use in glass and steel production	0.477
Soda use in glass production	0.415

Plant specific CO_2 emission factor for dolomite use in lime production

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 CO_2 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 $_{kg\ CO2}$ + 201.82 $_{kg\ CO2}$ – 108.41 $_{kg\ MgO}$ = 309.51 $_{kg\ CO2}$

0.3095 $_{t\ CO2}$ 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 $_{dolomite\ use\ in\ lime\ production}$ = 309.51 $_{kg\ CO2}$ × 94.76% = 0.29329167 t CO_2 / t dolomite.

Activity data

In this sector there are gathered activity data from two facilities of lime production, two facilities of glass production (one plant after 2005, one plant is not active late 2008) and one plant of steel production (Table 4.10).

Activity data were taken from industrial production plants. Industrial producers are participants of the EU ETS the GHG reports of these enterprises have to be freely available according to EU ETS regulations. The GHG reports of EU ETS operators are published on LEGMC home page (http://www.meteo.lv/lapas/uznemumi-kuriem-izsniegtas-siltumnicefekta-gazu-emisijas-atlaujas-2-pe?id=1253&nid=575).

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 in 2009. 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. Still to improve CO_2 emission estimation activity data of first year's data available was used to estimate emissions for the prior years, for example, for Iron & Steel production plant year 2005 data was used to estimate the emissions for 1990-2004.

Table 4.10 Limestone, dolomite and soda ash use activity data (t CO_2/t raw material)

	Limestone and Dolomite Use (total)	Dolomite use (glass production)	Limestone use (glass production)	Dolomite use (steel production)	Limestone use (steel production)	Dolomite use (lime production)	Limestone use (lime production)	Limestone use (sugar production)	**Soda ash use (glass production)**
1990	452.542	NO	0.800	33.000	14.300	404.442	NO	NO	NO
1991	351.482	NO	0.833	33.000	14.300	303.349	NO	NO	NO
1992	160.309	NO	0.870	33.000	14.300	112.139	NO	NO	NO
1993	104.575	1.273	0.958	33.000	14.300	55.045	NO	NO	**1.162**
1994	96.700	2.523	0.472	33.000	14.300	46.405	NO	NO	**2.204**
1995	88.957	1.697	4.425	33.000	14.300	35.535	NO	NO	**1.549**
1996	85.235	2.694	4.904	33.000	14.300	30.338	NO	NO	**2.333**
1997	71.746	2.706	1.433	33.000	14.300	20.307	NO	NO	**2.416**
1998	75.794	2.621	3.096	33.000	14.300	22.777	NO	NO	**2.392**
1999	69.402	2.563	4.410	33.000	14.300	15.129	NO	NO	**2.265**
2000	70.912	2.875	6.133	33.000	14.300	14.604	NO	NO	**4.200**
2001	68.794	1.917	7.017	33.000	14.300	12.560	NO	NO	**3.609**
2002	70.653	3.414	7.439	33.000	14.300	12.500	NO	NO	**4.875**
2003	67.069	2.730	6.748	33.000	14.300	10.291	NO	NO	**4.214**
2004	66.212	2.140	6.964	33.000	14.300	9.808	NO	NO	**3.650**
2005	51.493	2.088	7.070	29.707	6.326	6.303	NO	11.021	**3.743**

	Limestone and Dolomite Use (total)	Dolomite use (glass production)	Limestone use (glass production)	Dolomite use (steel production)	Limestone use (steel production)	Dolomite use (lime production)	Limestone use (lime production)	Limestone use (sugar production)	**Soda ash use (glass production)**
2006	51.958	NO	4.991	30.491	12.025	4.452	NO	10.746	**1.122**
2007	53.096	NO	9.899	30.405	9.017	3.776	1.078	NO	**0.090**
2008	41.649	NO	9.073	26.245	5.378	0.954	3.654	NO	NO
2009	37.866	NO	5.853	22.393	8.472	1.149	0.229	NO	NO
2010	43.656	NO	10.072	28.115	4.147	1.323	0.349	NO	NO
2011	11.297	NO	9.726	0.246	0.002	1.323	0.350	NO	NO
2012	11.301	NO	8.475	1.555	0.541	0.730	0.323	NO	NO

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. The total amount of raw material used was affected by the closing of glass and sugar production plant, suspending of activity of another glass production plant. In 2010 activity data are increased by 23.03% due to overall increasing of activity in all industrial sector. Exception is limestone use in steel production. This activity data are still decreasing due to changes of steel production GHG permit. In 2011, there is overall decreasing of total emissions from 2.A.3 subsector about 74.12 % due to changes of steel production technology as plant switched on steel production in EAF (Electric arc furnace) only and operation of this plant was partialy suspended due to reconstruction. As is seen in Table 4.10 in latest two years there are overall decrease of activity in sectors 2.A.3 and 2.A.4.

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 (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 Monitoring and Reporting Guidelines) are used whereby 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. There are no specific issues.

4.2.4.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG 2000.

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 check the annual GHG reports and approve 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.

The QC check-list has been filled in for each category taking into account criteria given in QA/QC plan approved in national legislation. Check-list then is archived.

There were involved external auditor for QA/QC in 2013. No specific or significant uncertanties were found under this sector.

Tier3 methodology is used for CO_2 emission estimation from dolomite use in lime production as CO_2 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.

4.2.4.5 Source-specific recalculations

No recalculation has been done for the sector.

4.2.4.6 Source-specific planned improvements

No improvements are planned for the sector.

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.

According to CSB information the biggest part of NMVOC and CO_2 occurs during road paving with asphalt. Just small part of all bitumen mixtures are used in asphalt roofing sector.

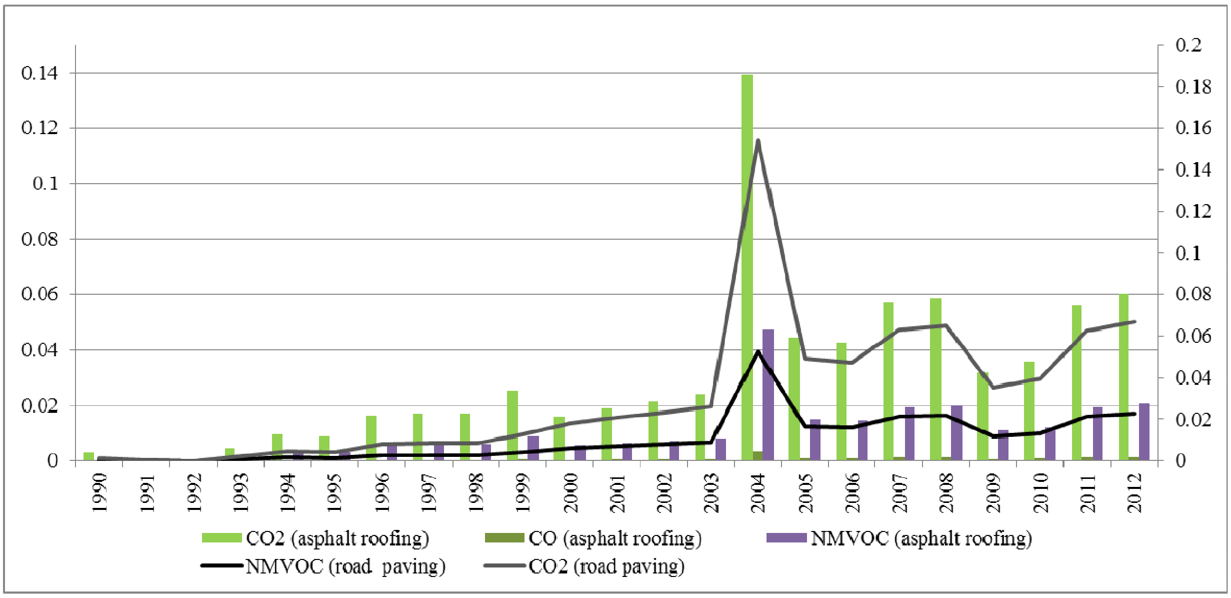

Figure 4.4 Emissions from asphalt roofing and road paving in 1990–2012 (Gg)23

The emissions from these two particular sectors are constantly increasing since the beginning of 90ties. Slight emission decrease in 1999-2000 is explained with the change of percentage that is used to divide activity data used in roofing and road paving. The sharp emission increase in 2003-2004 is explained with Latvia's accession to EU in the May of 2004 before and after what the road paving works were very active. As it is explained previous there are tend to increase CO_2 emissions from road paving and asphalt roofing activity in 2010. In 2011 and 2012 there are increased amount of activity data used for road paving and asphalt roofing about 58.08% and 6.99% (Figure 4.4).

4.2.5.2 Methodological issues

EMEP/EEA 2013 Tier1 was used to estimate NMVOC emissions from the 2.A.5. Road Paving with Asphalt and 2.A.6 Road Paving with Asphalt. According to CSB the biggest part of bitumen mixtures amount is used for road paving. Only small part is used for roofing activities (Table 4.11).

NMVOC emissions are estimated using simpler default methodology:

$$E_{NMVOC} = AD_{bitumen} \times EF_{NMVOC}$$

where:

E_{NMVOC} – NMVOC emissions (Gg)

$AD_{bitumen}$ – bitumen and bitumen mixtures used in CRF 2.A.5 and 2.A.6 activities (Gg)

EF_{NMVOC} –NMVOC emission factor (Gg/Gg)

For Submission 2014 indirect CO_2 emissions from asphalt roofing and road paving with asphalt activities were estimated according to IPCC 2006 provided methodology and explanation of indirect CO_2 emission estimation basing on carbon conversion factor and average default carbon content amount.

[23] Emissions from road paving with asphalt on secondary axis

For the CO_2 emission estimation NMVOC emissions were taken as activity data and CO_2 emissions were estimated using carbon conversion factor.

$$E_{CO_2} = EF_{CO_2} \times NMVOC$$

where:

E_{CO2} – CO_2 emissions (Gg)

EF_{CO2} – estimated CO_2 emission factor

NMVOC – NMVOC emissions (Gg)

Emission factors

For CO_2 emission estimation 80% of carbon content conversion factor. According to IPCC 2006[24], indirect emissions of CO_2 from atmospheric oxidation of emitted NMVOC are to be included in the national emission inventory. The average amount of carbon in NMVOC is assumed to be 80%[25]. The default carbon content conversion factor of IPCC 2006 that is 60% was assumed as too low.

So the CO_2 emission factor was estimated using following equation:

$$EF_{CO_2} = 80\% \times 44.0098/12.011$$

where

EF_{CO2} – CO_2 emission factor (Gg/Gg)

80% – the average amount of carbon in NMVOC

44.0098 / 12.011 – carbon dioxide and carbon molmass ratio

This leads to an emission factor for indirect CO_2 release of 2.931299642 kg CO_2/kg NMVOC.

Default CO and NMVOC emission factors are taken from EMEP/EEA 2013.[26,27] Due to lack of the technology use information Tier1 EFs were used (Table 4.11).

Table 4.11 Emission factors for asphalt roofing and road paving in 1990–2012

	CO_2 (t CO_2/t NMVOC)	CO (Gg/Gg)	NMVOC (Gg/Gg)
Asphalt Roofing	2.93	0.0000095	0.00013
Road Paving with Asphalt	2.93	NE	0.000016

Activity data

The activity data to calculate NMVOC emissions from road paving and asphalt roofing are taken from the CSB (Table 4.11). For submission 2013 the amount of bitumen mixtures was used as activity data. According to CSB the bitumen mixtures includes:

- Asphalt bitumen that usually consists of 60% or more of bitumen and solvent. Used for highway paving;
- Emulsion – or a solid asphalt, bitumen, pitch, tar suspensions in water that are used especially in highway paving;

[24] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_7_Ch7_Precursors_Indirect.pdf (page 7.6)
[25] Basing of the most often used average carbon conversion factor
[26] http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009/part-b-sectoral-guidance-chapters/2-industrial-processes/2-a-mineral-industry/2-a-5-asphalt-roofing.pdf (page 7)
[27] http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009/part-b-sectoral-guidance-chapters/2-industrial-processes/2-a-mineral-industry/2-a-6-road-paving-with-asphalt.pdf (page 9)

- Asphalt mastic and other bitumen resins, and similar bituminous mixtures that include minerals such as sand or asbestos.
- Products that are sintered in blocks and that are repeatedly melted before use.

According to information from CSB the biggest part of bitumen mixtures is used for road paving. According to IPCC 2006 typically 80-90% of bitumen is used for road paving materials.[28] Still as Latvia before the beginning of 90ties was part of former USSR and was going through the economical transitions phase, it was assumed that 80% is used for road paving and remaining is used for asphalt roofing till 2000. After that the 90% amount was used to road paving.

Table 4.12 Activity data for road paving with asphalt and asphalt roofing production

	Amount of bitumen mixtures used (Gg)	% of asphalt used for Road Paving	% of asphalt used for Asphalt roofing	Road Paving with asphalt (Gg)	Asphalt roofing (Gg)
1990	39.000	80%	20%	31.200	7.800
1991	12.600	80%	20%	10.080	2.520
1992	2.100	80%	20%	1.680	0.420
1993	58.928	80%	20%	47.142	11.786
1994	125.625	80%	20%	100.500	25.125
1995	116.990	80%	20%	93.592	23.398
1996	214.811	80%	20%	171.849	42.962
1997	224.999	80%	20%	179.999	45.000
1998	225.533	80%	20%	180.426	45.107
1999	334.811	80%	20%	267.848	66.962
2000	423.643	90%	10%	381.278	42.364
2001	495.700	90%	10%	446.130	49.570
2002	558.424	90%	10%	502.581	55.842
2003	625.675	90%	10%	563.107	62.567
2004	3651.959	90%	10%	3286.763	365.196
2005	1165.015	90%	10%	1048.514	116.502
2006	1116.697	90%	10%	1005.027	111.670
2007	1492.517	90%	10%	1343.265	149.252
2008	1536.659	90%	10%	1382.993	153.666
2009	838.446	90%	10%	754.602	83.845
2010	937.177	90%	10%	843.459	93.718
2011	1481.480	90%	10%	1333.332	148.148

[28] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_5_Ch5_Non_Energy_Products.pdf (page 5.14)

	Amount of bitumen mixtures used (Gg)	% of asphalt used for Road Paving	% of asphalt used for Asphalt roofing	Road Paving with asphalt (Gg)	Asphalt roofing (Gg)
2012	1584.974	90%	10%	1426.476	158.497

As mentioned before in 2004 the sharp increase of bitumen mixtures use was observed that is explained with large amount of road paving works before Latvia's accession to EU and after that when EU financial instruments became available (Table 4.12).

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 low as CSB data of used bitumen mixtures are used and the percentage of IPCC 2006 is used to divide bitumen use for roofing and paving activities. Still as it is not clearly known how much of the total bitumen is used for asphalt paving and for asphalt roofing (bitumen use in construction sector) the uncertainty is assumed as at least 20%.

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/EEA 2009 As Tier1 EFs is assumed as high as 50% as the default emission factors are 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. 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 2000.

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.

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.

The QC form has been filled in for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is archived.

There were involved external auditor for QA/QC in 2013. All specific or significant uncertanties were checked and corrected (mainly rounding issues between CRF and NIR reported tablees).

4.2.5.5 Source-specific recalculations

On submission 2014 there were made recalculations in all time series due to updated EF for CO and NMVOC taken from EMEP/EEA 2013 in sectors 2.A.5 and 2.A.6.

According to these recalculations CO_2 and NMVOC emissions are increased about 2500% in 2.A.5 sector and decreased about 99.9% in 2.A.6 sector. CO emissions are decreased about 5 % in 2.A.5 sector.

Table 4.13 Total emission changes in sectors 2.A.5 and 2.A.6

	Total CO_2 emissions after recalculation (Gg)		Total NMVOC emissions after recalculation (Gg)		Total CO emissions after recalculation (Gg)	
	2.A.5	**2.A.6**	**2.A.5**	**2.A.6**	**2.A.5**	**2.A.6**
1990	0.00297	0.00146	0.00101	0.00050	0.00007	NE
1991	0.00096	0.00047	0.00033	0.00016	0.00002	NE
1992	0.00016	0.00008	0.00005	0.00003	0.00000	NE
1993	0.00449	0.00221	0.00153	0.00075	0.00011	NE
1994	0.00957	0.00471	0.00327	0.00161	0.00024	NE
1995	0.00892	0.00439	0.00304	0.00150	0.00022	NE
1996	0.01637	0.00806	0.00559	0.00275	0.00041	NE
1997	0.01715	0.00844	0.00585	0.00288	0.00043	NE
1998	0.01719	0.00846	0.00586	0.00289	0.00043	NE
1999	0.02552	0.01256	0.00871	0.00429	0.00064	NE
2000	0.01614	0.01788	0.00551	0.00610	0.00040	NE
2001	0.01889	0.02092	0.00644	0.00714	0.00047	NE
2002	0.02128	0.02357	0.00726	0.00804	0.00053	NE
2003	0.02384	0.02641	0.00813	0.00901	0.00059	NE
2004	0.13916	0.15415	0.04748	0.05259	0.00347	NE
2005	0.04440	0.04918	0.01515	0.01678	0.00111	NE
2006	0.04255	0.04714	0.01452	0.01608	0.00106	NE
2007	0.05688	0.06300	0.01940	0.02149	0.00142	NE
2008	0.05856	0.06486	0.01998	0.02213	0.00146	NE
2009	0.03195	0.03539	0.01090	0.01207	0.00080	NE
2010	0.03571	0.03956	0.01218	0.01350	0.00089	NE
2011	0.05645	0.06253	0.01926	0.02133	0.00141	NE
2012	0.06040	0.06690	0.02060	0.02282	0.00151	NE

4.2.5.6 Source-specific planned improvements

No improvements are planned for the sector.

4.2.6 Glass Production (CRF 2.A.7)

4.2.6.1 Source category description

In this sector CO_2 emissions from use of additional raw materials used in glass production plants – fluorspar, potash and whiterite (barium carbonate), are reported, as well as NMVOC emissions from glass production and glass fibre production reported by production facilities. CO_2 emissions from glass fibre production processes are estimated from NMVOC emissions due to lack of CO_2 emission factors and activity data to CO_2 emissions directly.

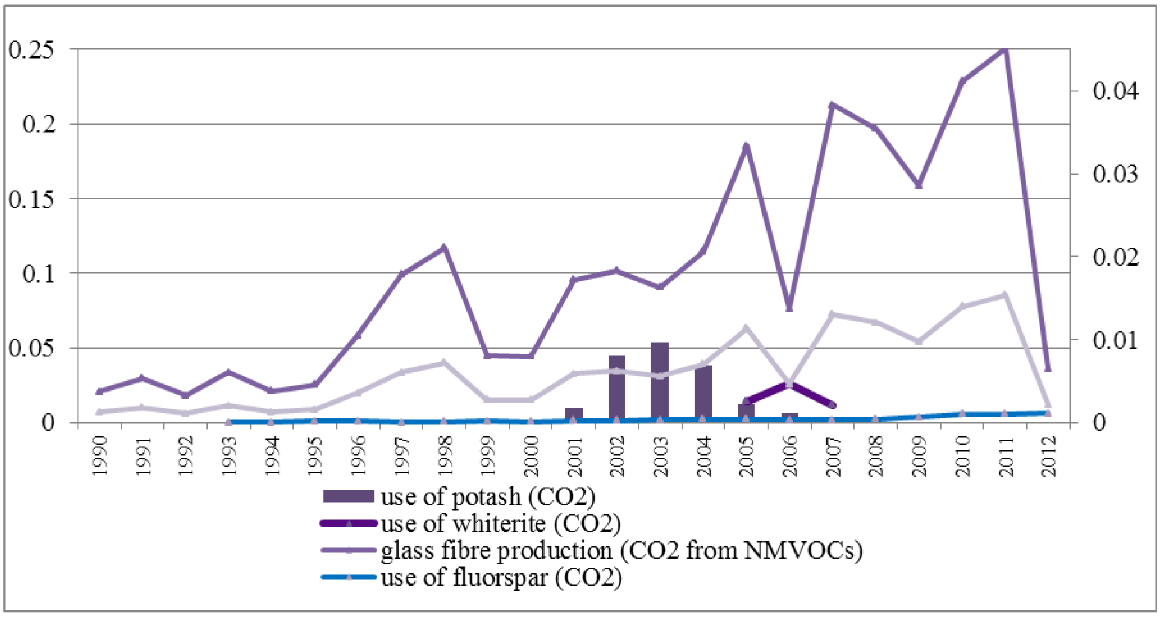

Figure 4.5 Emissions from raw materials use in glass production 1990-2012 (Gg)[29]

Use of potash as well as NMVOC emissions from glass production stopped 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. Use of whiterite is occurring only in 2005-2007 in glass production manufacturing plant but in 2008 and 2009 the plant has suspended it activity. Since 2005 NMVOC emissions are still emitted but in smaller amounts from glass fibre production (Figure 4.5).

NMVOC emissions for time period 1997-2012 were taken from national database "2-AIR" where glass fibre production plant reported its emissions divided by NMVOC sub-type (

Table **4.14**). For time period 1990-1996 only butylacetate data is available from glass fibre production company's application for GHG permit within EU ETS. For year 2005, also glass production company had reported its NMVOC emissions (these emissions are reported together under Glass fibre production sector in CRF Reporter) but since then glass production is not operating therefore NMVOC emissions from glass production are reported only for 2005.

[29] Emissions from use of potash on primary axis

Table 4.14 NMVOC emissions from glass fibre and glass production in 1990–2012 (Gg)

	Acetone	Butylacetate	Acetic acid	Formaldehyde	Isopropanol (isopropyl)	Methanol (methyl alcohol)	Methane	Kerosene	Propan (propyl alcohol)	Formic acid	**total NMVOC in glass fibre production**	**total NMVOC in glass production**	**total NMVOC (Gg)**
1990	NO	0.0013	NO	NO	NO	NO	NO	NO	NO	NO	**0.00128**	NO	**0.00158**
1991	NO	0.0018	NO	NO	NO	NO	NO	NO	NO	NO	**0.00182**	NO	**0.00360**
1992	NO	0.0011	NO	NO	NO	NO	NO	NO	NO	NO	**0.00111**	NO	**0.00609**
1993	NO	0.0021	NO	NO	NO	NO	NO	NO	NO	NO	**0.00207**	NO	**0.00721**
1994	NO	0.0013	NO	NO	NO	NO	NO	NO	NO	NO	**0.00131**	NO	**0.00275**
1995	NO	0.0016	NO	NO	NO	NO	NO	NO	NO	NO	**0.00158**	NO	**0.00273**
1996	NO	0.0036	NO	NO	NO	NO	NO	NO	NO	NO	**0.00360**	NO	**0.00590**
1997	1.570	3.8040	0.5380	0.1820	NO	NO	NO	NO	NO	NO	**0.00609**	NO	**0.00624**
1998	1.360	3.7510	0.3000	0.0840	NO	NO	NO	1.7100	NO	NO	**0.00721**	NO	**0.00557**
1999	1.121	0.3790	0.2280	0.0810	NO	NO	NO	0.9420	NO	NO	**0.00275**	NO	**0.00703**
2000	0.140	0.6640	0.2940	0.0660	NO	NO	NO	1.5700	NO	NO	**0.00273**	NO	**0.01138**
2001	1.187	1.3670	0.5221	0.0698	0.0991	0.0098	NO	2.6013	NO	0.0396	**0.00590**	NO	**0.00469**
2002	NO	0.6561	0.6483	0.1082	0.1908	0.0263	NO	4.4906	NO	0.1235	**0.00624**	NO	**0.01307**
2003	NO	0.4852	1.1747	0.1073	0.2585	0.0708	NO	3.2663	NO	0.2071	**0.00557**	NO	**0.01210**
2004	NO	0.7470	1.2473	0.1532	0.3566	0.1070	0.0378	4.0271	NO	0.3568	**0.00703**	NO	**0.00976**
2005	NO	1.4932	0.9089	0.1067	0.2757	0.0835	NO	0.6586	1.2000	0.2331	**0.01138**	**0.00642**	**0.01404**
2006	NO	1.4859	0.9603	0.1010	0.3600	0.2316	NO	0.0940	1.2737	0.1878	**0.00469**	NO	**0.01539**
2007	NO	1.3145	1.7041	NO	1.7221	2.4136	NO	NO	5.9203	NO	**0.01307**	NO	**0.00224**
2008	NO	0.9678	1.5477	NO	1.5986	2.1726	NO	NO	5.8104	NO	**0.01210**	NO	**0.00158**
2009	NO	1.1724	0.4018	NO	1.0712	0.4009	NO	NO	6.7152	NO	**0.00976**	NO	**0.00360**
2010	NO	1.6839	1.6732	NO	1.3547	2.6126	NO	NO	6.7115	NO	**0.01404**	NO	**0.00609**
2011	NO	1.6220	1.9080	NO	2.3510	2.8730	NO	NO	6.6400	NO	**0.01539**	NO	**0.00721**
2012	NO	1.9080	NO	NO	2.8730	0.0000	NO	NO	0.0000	NO	**0.00224**	NO	**0.00275**

4.2.6.2 Methodological issues

Methods

Default methodology was used to estimate emissions when activity data is multiplied with emission factor. CO_2 emission factors used to estimate emissions from raw materials use in glass production are plant specific and taken from plants annual GHG reports within EU ETS (Table 4.15). NMVOC emissions for time period 1997-2012 are taken from national database "2-AIR" where both glass production and glass fibre production companies report their emissions. NMVOC emissions for 1990-1996 are estimated only for butylacetate use that glass fibre production company reported in its application for GHG permit during the implementation of ETS in Latvia.

For Submission 2014, indirect CO_2 emissions from glass fibre production processes were estimated according to IPCC 2006 provided methodology and explanation of indirect CO_2 emission estimation basing on carbon conversion factor and average default carbon content amount. CO_2 emission factors are not provided in emission estimation methodology and it wouldn't be possible to obtain activity data for direct CO_2 emission estimation.

For the CO_2 emission estimation NMVOC emissions were taken as activity data and CO_2 emissions were estimated using carbon conversion factor.

$$E_{CO_2} = EF_{CO_2} \times NMVOC$$

where:

E_{CO2} – CO_2 emissions (Gg)

EF_{CO2} – estimated CO_2 emission factor

NMVOC – NMVOC emissions (Gg)

Emission factors

CO_2 emission factors for emission from additional raw materials use in glass production processes were taken from reports of glass production plants submitted within EU ETS implementation and from applications to GHG permits. These are plant specific emission factors.

Table 4.15 Emission factors for materials use in glass production (t emissions / t product or raw material)

	1990 – 2012
Fluorspar use	0.0017
Potash use	0.32
Barium carbonate (whiterite) use	0.223
Butylacetate use (NMVOC)[30]	1.0

For CO_2 emission from glass fibre production estimation 80% of carbon content conversion factor. According to IPCC 2006[31], indirect emissions of CO_2 from atmospheric oxidation of emitted NMVOC are to be included in the national emission inventory. The average amount of carbon in NMVOC is assumed to be 80%[32]. The default carbon content conversion factor of IPCC 2006 that is 60% was assumed as too low.

The CO_2 emission factor was estimated using following equation:

[30] For emission estimation only for year 1990-1996, since 1997 the plant reported data from national database "2-AIR" is used
[31] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_7_Ch7_Precursors_Indirect.pdf (page 7.6)
[32] Basing of the most often used average carbon conversion factor

$$EF_{CO_2} = 80\% \times 44.0098/12.011$$

where

EF_{CO2} – CO_2 emission factor (Gg/Gg)

80% – the average amount of carbon in NMVOC

44.0098 / 12.011 – carbon dioxide and carbon molmass ratio

This leads to an emission factor for indirect CO_2 release of 2.931299642 kg CO_2/kg NMVOC.

Activity data

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 4.16).

Table 4.16 Activity data for raw materials use in glass production 1990-2012 (Gg)

	Use of potash (Gg)	Use of fluorspar (Gg)	Use of barium carbonate (Gg)	Use of butylacetate (Gg)
1990	NO	NO	NO	0.0013
1991	NO	NO	NO	0.0018
1992	NO	NO	NO	0.0011
1993	NO	0.0217	NO	0.0021
1994	NO	0.0100	NO	0.0013
1995	NO	0.1158	NO	0.0016
1996	NO	0.1181	NO	0.0036
1997	NO	0.0328	NO	NO
1998	NO	0.0743	NO	NO
1999	NO	0.1074	NO	NO
2000	NO	0.0840	NO	NO
2001	0.0318	0.1520	NO	NO
2002	0.1420	0.1580	NO	NO
2003	0.1671	0.2160	NO	NO
2004	0.1191	0.2460	NO	NO
2005	0.0376	0.2652	0.0115	NO
2006	0.0198	0.2221	0.0209	NO
2007	0.0088	0.2013	0.0096	NO
2008	NO	0.2552	NO	NO
2009	NO	0.4084	NO	NO
2010	NO	0.6222	NO	NO
2011	NO	0.5912	NO	NO

	Use of potash (Gg)	Use of fluorspar (Gg)	Use of barium carbonate (Gg)	Use of butylacetate (Gg)
2012	NO	0.6390	NO	NO

In 2008-2012, only use of fluorspar in glass fibre production plant is occurring as other two glass production plants or either stopped its activity or suspended it.

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 Environmental 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 2000.

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 check 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.

There were involved external auditor for QA/QC in 2013. No specific or significant uncertanties were found under this sector.

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. Still from 5 now operating bricks production plants only two were operating up to 1990, there is no information if the other companies were working for time period 1990-1993 what is not covered by GHG permit application requirements.

For now it is known that only plants 1 and 5 were operating in time period 1990-1993 so the indicator IE is used for both these plants in time period 1990-1993. As it was not possible to obtain the data for raw materials use in Bricks production companies No 1 and 5, there wasn't possible to estimate the emissions using the same methodology as for 1993-2008 and follow the consistency. Therefore the CO_2 emissions were estimated only using total produced bricks amount for 1990-1993 for these two plants. And after 1993 it was possible to increase methodology level and estimate CO_2 emissions for each plant separately.

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.

CO_2 emission estimation for 1990-1992

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 4.17). In CO_2 emission estimation emission factor 0.047 tCO_2/t used clay is used.

Table 4.17 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.

1st bricks production plant

During the revision of 1st bricks production plant's application to GHG permit, annual GHG reports for 2005-2009 it was stated that the plant has changed used CO_2 emission estimation methodology 3 times:

1. 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).
2. For 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.
3. For years 2008-2009 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 several times and for 2008 estimation methodology is again switched from Tier2 to Tier1 and default average CO_2 emission factor is used.

Methods

The CO_2 emissions in whole time period was calculated by 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[33].

According to bricks production plant's reported information the following equation to estimate CO_2 emissions was used:

$$CO_2 = \sum\left(\left(AD_{raw} \times AD_{CaO,MgO}\right) \times EF \times CF\right)$$

where:

CO_2 – total CO_2 emissions from bricks production (Gg)

AD_{raw} – activity data of used raw materials – clay (Gg)

$AD_{CaO,MgO}$ – CaO and MgO content in used raw materials (%)

EF – CO_2 emission factor of CaO and MgO (Gg/Gg)

CF – conversion factor

Emission factors

CO_2 emission factors for CaO and MgO – 0.785 and 1.092 for tonne CO_2 per tonne of oxide respectively, were taken from MRG[34] (Table 4.18).

Activity data

[33] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 80)
[34] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 81)

As MgO and CaO content data was not available for years 1993-2004 so the data reported in bricks production plant's GHG report for 2005 was used: MgO content – 4.9%, CaO content – 11.6%.

As for years 2008-2009 different emission estimation methodology is used and MgO and CaO data is not available content data of 2006-2007 was used also to estimate emissions for 2008-2012: MgO content – 2.9%, CaO content – 10.26%.

Table 4.18 Data and assumptions used for CO_2 emission estimation from 1st bricks production plant

	Use of clay (Gg)	MgO content (%)	CaO content (%)	MgO amount (Gg)	CaO amount (Gg)	MgO CO_2 EF (tCO_2/t oxide)	CaO CO_2 EF (tCO_2/t oxide)	**CO_2 emissions (Gg)**	Average CO_2 EF (tCO_2/t oxides)
1993	2.000	4.90%	11.60%	0.098	0.232	1.092	0.785	**0.289**	0.876
1994	2.400	4.90%	11.60%	0.118	0.278	1.092	0.785	**0.347**	0.876
1995	2.700	4.90%	11.60%	0.132	0.313	1.092	0.785	**0.390**	0.876
1996	3.000	4.90%	11.60%	0.147	0.348	1.092	0.785	**0.434**	0.876
1997	3.600	4.90%	11.60%	0.176	0.418	1.092	0.785	**0.520**	0.876
1998	4.000	4.90%	11.60%	0.196	0.464	1.092	0.785	**0.578**	0.876
1999	4.400	4.90%	11.60%	0.216	0.510	1.092	0.785	**0.636**	0.876
2000	4.800	4.90%	11.60%	0.235	0.557	1.092	0.785	**0.694**	0.876
2001	4.800	4.90%	11.60%	0.235	0.557	1.092	0.785	**0.694**	0.876
2002	4.800	4.90%	11.60%	0.235	0.557	1.092	0.785	**0.694**	0.876
2003	6.500	4.90%	11.60%	0.319	0.754	1.092	0.785	**0.940**	0.876
2004	6.500	4.90%	11.60%	0.319	0.754	1.092	0.785	**0.940**	0.876
2005	5.257	4.90%	11.60%	0.258	0.610	1.092	0.785	**0.760**	0.876
2006	6.245	2.90%	10.26%	0.181	0.641	1.092	0.785	**0.701**	0.853
2007	7.745	2.90%	10.26%	0.225	0.795	1.092	0.785	**0.869**	0.853
2008	3.880	2.90%	10.26%	0.113	0.398	1.092	0.785	**0.435**	0.853
2009	2.268	2.90%	10.26%	0.066	0.233	1.092	0.785	**0.254**	0.853
2010	1.922	2.90%	10.26%	0.056	0.197	1.092	0.785	**0.216**	0.853
2011	1.698	2.90%	10.26%	0.049	0.174	1.092	0.785	**0.191**	0.853
2012	1.670	2.90%	10.26%	0.048	0.171	1.092	0.785	**0.187**	0.853

2nd bricks production plant

CO_2 emissions for 2nd bricks production plant is recalculated only for year 2008 in comparison with plant's annual GHG report. For 1999-2008, the plant is using the same emission estimation methodology but for year 2008 average default emission factor from

MRG is used. As this emission factor is Tier1 emission factor but for previous years Tier2 emission factors are used it was decided to recalculate emissions for 2008.

The plant was closed at the end of 2008 and wasn't operated in 2009 due to company's reorganization when production plant using old obsolete installations were closed and all production was transferred to other modern production facilities.

Methods

Calculation method A – carbon input, from the MRG[35] is used in plant's emission estimation for its application for GHG permit as well for reporting of annual CO_2 emission:

$$CO_2 = \left(AD_{raw} \times AD_{CaCO_3} \times EF_{CaCO_3}\right) + \left(AD_{raw} \times AD_{MgCO_3} \times EF_{MgCO_3}\right)$$

where:

CO_2 – CO_2 emissions from 3rd bricks production plant (Gg)

AD_{raw} – activity data of used clay (Gg)

AD_{CaCO3} – $CaCO_3$ content in used clay (%)

EF_{CaCO3} – $CaCO_3$ emission factor (Gg/Gg)

AD_{MgCO3} – $MgCO_3$ content in used clay (%)

EF_{MgCO3} – $MgCO_3$ emission factor (Gg/Gg)

Emission factors

Default CO_2 emission factors from the MRG for the $CaCO_3$ and $MgCO_3$ are used. 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 $MgCO_3$.

Activity data

The content of $CaCO_3$ and $MgCO_3$ are determined in plant laboratories or stated in mineral deposits passport.

Activity data carbonate is $CaCO_3$, $MgCO_3$ or other alkali earth or alkali carbonates amount that is used during the reporting period input (clay). Carbonate mass is estimated using clay consumption amount and results of clay content measurement with maximal allowable process uncertainty of ± 2.5% (Table 4.19).

Table 4.19 Data and assumptions used for CO_2 emission estimation from 2nd 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

[35] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 79)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
$MgCO_3$ CO_2 EF (tCO_2/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 (tCO_2/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 (tCO_2/t oxides)	0.469	0.469	0.469	0.469	0.469	0.469	0.477	0.475	0.475	0.474

As it was mentioned the plant wasn't operated in 2009 and it is approved that most likely the plant will not be reopened again.

3rd bricks production plant

CO_2 emission that 3rd plant is estimated for 1998-2004 in its application for GHG permit during the implementation of ETS in Latvia by using the methodology that is not in line with IPCC Guidelines. Still in the application the plant had reported the MgO and CaO content data in used dry clay so the emissions were recalculated using the available activity data.

The CO_2 emissions from particular bricks production plant was recalculated for 2008 and 2009 as the methodology use was stated as consistent only in 1998-2007 although the methodology was changed in 2005. The methodology was changed from one approach – alkali earth oxides, to other approach – carbon input because the carbon input laboratory measurement data is available since 2005. As both methodologies are appropriate and both are assumed as Tier2 therefore the methodology change was considered as acceptable.

Still for years 2008-2009 lower tier emission factor from MRG[36] – a conservative value of 0.2 tonnes $CaCO_3$ (corresponding to 0,08794 tonnes of CO_2) per tonne of dry clay, was used to estimate CO_2 emissions. The plant indicates that the lower tier use is acceptable within EU ETS as the plant is low emission producer.

Methods

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.

According to bricks production plant's reported information the following equation to estimate CO_2 emissions was used:

$$CO_2 = \sum \left(\left(AD_{raw} \times AD_{CaO,MgO} \right) \times EF \times CF \right)$$

where:

CO_2 – total CO_2 emissions from bricks production (Gg)

AD_{raw} – activity data of used raw materials – clay (Gg)

$AD_{CaO,MgO}$ – CaO and MgO content in used raw materials (%)

EF – CO_2 emission factor of CaO and MgO (Gg/Gg)

CF – conversion factor

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. As it was mentioned above the plant in using different methodology again for 2008-2009 so the data was recalculated using the emission estimation method as for 2005-2007. Following equation from MRG is used to estimate emissions for 2005-2009:

[36] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 80)

$$CO_2 = \left(AD_{raw} \times AD_{CaCO_3} \times EF_{CaCO_3}\right) + \left(AD_{raw} \times AD_{MgCO_3} \times EF_{MgCO_3}\right)$$

where:

CO_2 – CO_2 emissions from 3rd bricks production plant (Gg)

AD_{raw} – activity data of used clay (Gg)

AD_{CaCO3} – $CaCO_3$ content in used clay (%)

EF_{CaCO3} – $CaCO_3$ emission factor (Gg/Gg)

AD_{MgCO3} – $MgCO_3$ content in used clay (%)

EF_{MgCO3} – $MgCO_3$ emission factor (Gg/Gg)

Emission factors

CO_2 emission factors for CaO and MgO – 0.785 and 1.092 for tonne CO_2 per tonne of oxide respectively, were taken from MRG[37] (Table 4.2.17).

CO_2 emission factors for $CaCO_3$ and $MgCO_3$ – 0.44 and 0.522 for tonne CO_2 per tonne of carbonates respectively, were taken from MRG[38] to recalculate the emissions (Table 4.20, Table 4.21).

Activity data

For 1998-2004 emission estimation MgO and CaO content is used. According to mineral passport of State Geology Service's quarry "Progress" alkali earth oxides – MgO and CaO, contents are 8.03% and 3.02% respectively.

For years 2005-2007 emission estimation the contents of $CaCO_3$ and $MgCO_3$ are determined in plant laboratories or stated in mineral deposits passport and are 12.79% and 10.75% respectively. As for year 2008-2009 the carbonates input percentage amount is not known the data of 2005-2007 was used (Table 4.20, Table 4.21).

According to production plant's application for GHG permit and annual GHG reports activity data of used raw materials is estimated using following equation:

$$AD_{raw} = AD_{clay} \times \left(1 - M\right)$$

where:

AD_{raw} – activity data of used raw materials – dray clay (Gg)

AD_{clay} – amount of used clay (Gg)

M – moisture content of clay in bricks pressing process (%)

For year 2005-2012 the activity data was estimated by using following equation from bricks production plant's GHG report:

$$AD_{raw} = \sum \left(AD_{bulk} \times M_{av}\right)$$

where:

AD_{raw} – activity data of used raw materials – clay (Gg)

AD_{bulk} – amount of dried bulk materials (pieces)

M_{av} – average mass with 0% moisture content (Gg)

The activity data was estimated by plant randomly taking 10 examples of production from drying tunnels dried after that till 0% moisture content and weighted. After that average mass

[37] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 81)
[38] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 79)

of production is estimated. So for year 2005-2012 the used clay is reported already with 0% moisture content.

The used raw materials – used clay, were estimated by taking into account the moisture content of the clay.

Table 4.20 Data and assumptions used for CO_2 emission estimation from 3rd 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
moisture content (%)	17.00%	17.00%	17.00%	17.00%	17.00%	17.00%	17.00%
used raw materials - dry clay (Gg)	6.20	8.01	8.51	8.61	9.33	9.10	9.63
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)	0.498	0.644	0.683	0.691	0.749	0.731	0.773
CaO amount (Gg)	0.187	0.242	0.257	0.260	0.282	0.275	0.291
MgO CO_2 EF (tCO_2/t oxide)	1.092	1.092	1.092	1.092	1.092	1.092	1.092
CaO CO_2 EF (tCO_2/t oxide)	0.785	0.785	0.785	0.785	0.785	0.785	0.785
CO_2 emissions (Gg)	**0.6907**	**0.89**	**0.95**	**0.96**	**1.04**	**1.01**	**1.07**
Average CO_2 EF (tCO_2/t oxides)	1.008	1.008	1.008	1.008	1.008	1.008	1.008

Table 4.21 Data and assumptions used for CO_2 emission estimation from 3rd bricks production plant (continuation)

	use of clay (Gg)	$MgCO_3$ content (%)	$CaCO_3$ content (%)	$MgCO_3$ amount (Gg)	$CaCO_3$ amount (Gg)	$MgCO_3$ CO_2 EF (tCO_2/t oxide)	$CaCO_3$ CO_2 EF (tCO_2/t oxide)	**CO_2 emissions (Gg)**	Average CO_2 EF (tCO_2/t oxides)
2005	29.891	10.75%	12.79%	3.213	3.823	0.522	0.44	**3.359**	0.477
2006	22.316	10.75%	12.79%	2.399	2.854	0.522	0.44	**2.508**	0.477
2007	23.854	10.75%	12.79%	2.564	3.051	0.522	0.44	**2.681**	0.477
2008	77.687	10.75%	12.79%	8.351	9.936	0.522	0.44	**8.73**	0.477
2009	19.814	10.75%	12.79%	2.13	2.534	0.522	0.44	**2.23**	0.477
2010	32.513	10.75%	12.79%	3.495	4.158	0.522	0.44	**3.65**	0.477
2011	38.914	10.75%	12.79%	4.183	4.977	0.522	0.44	**4.37**	0.477
2012	40.698	10.75%	12.79%	4.375	5.205	0.522	0.440	**4.57**	0.477

4th bricks production plant

The CO_2 emission estimation from 4^{th} bricks production plant is rather complicated due to allowed approach in Latvia that Latvia's ETS operator can use different methodology for every year to estimate their CO_2 emissions.

After the review of 4th bricks production plant's application for GHG permit during ETS implementation in Latvia and the plant's annual GHG reports in 2005-2008 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:

1. 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. Then CO_2 emission factor for dry clay is estimated by reducing it by 23% that gives emission factor – 0.050666 tCO_2/t used clay.
2. 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.
3. 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.
4. 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.

So to make emission estimation more consistent CO_2 emissions from 4th bricks production plant was recalculated:

1. for years 2000-2004 were recalculate by using the $CaCO_3$ and $MgCO_3$ content data reported by plant in its application for GHG permit when ETS was implemented in Latvia – $CaCO_3$ – 11.48%, and $MgCO_3$ – 1.8%, and using emission factors from MRG.
2. 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.
3. For year 2008 the same $CaCO_3$ and $MgCO_3$ content data as for 2007 was used in emission estimation as other information was not available (Table 4.22).

Methods

As bricks production plant is constantly changing used methodology to estimate their annual CO_2 emissions within ETS requirements, the emissions were recalculated using the most appropriate approach for the best result. As the $CaCO_3$ and $MgCO_3$ content data was available for 2000-2004 and then for 2005 but MgO and CaO content data was available for 2006-2007 it was decided to estimate CO_2 emissions using Calculation A method – carbon input from MRG[39].

The following equation was used to estimate CO_2 emissions from 4th bricks production plant:

$$CO_2 = \left(AD_{clay} \times AD_{CaCO_3} \times EF_{CaCO_3}\right) + \left(AD_{clay} \times AD_{MgCO_3} \times EF_{MgCO_3}\right)$$

where:

CO_2 – CO_2 emissions from 4th bricks production plant (Gg)

[39] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (pages 78,79)

AD_{clay} – activity data of used clay (Gg)

AD_{CaCO3} – $CaCO_3$ content in used clay (%)

EF_{CaCO3} – $CaCO_3$ emission factor (Gg/Gg)

AD_{MgCO3} – $MgCO_3$ content in used clay (%)

EF_{MgCO3} – $MgCO_3$ emission factor (Gg/Gg)

Emission factors

CO_2 emission factors for $CaCO_3$ and $MgCO_3$ – 0.44 and 0.522 for tonne CO_2 per tonne of carbonates respectively, were taken from MRG[40] to recalculate the emissions.

Activity data

The plant reported that amount of carbonates ($CaCO_3$ and $MgCO_3$) in used clay is estimated according to chemical content of clay that was determined in Institute of Silicate Materials. For years 2005 the $CaCO_3$ and $MgCO_3$ content is taken from production plant's annual GHG report. For years 2006-2007 $CaCO_3$ and $MgCO_3$ data was estimated by taking into account used clay content data and its estimation parameters available from bricks production plant. For year 2008 that particular data was no available so the percentage amount of carbonates of year 2007 was used. (Table 4.22).

According to production plant's application for GHG permit and annual GHG reports activity data of used raw materials is estimated using following equation:

$$AD_{raw} = \sum \left(AD_{bulk} \times M_{av} - M_{bulk} \times moisture / 100 \right) - M_{chippings} - M_{tenisite}$$

where:

AD_{raw} – activity data of used raw materials – clay (Gg)

AD_{bulk} – amount of dried bulk materials (pieces)

M_{av} – average mass (Gg)

M_{bulk} – mass of dried bulk materials loaded in furnace

moisture/100 – average moisture content of clay (%)

$M_{chippings}$ – mass of dried scobs (Gg)

$M_{tenisite}$ – mass of tenisite (granulated burnt defectives of ceramics) (Gg)

Mass of chippings wasn't taken into account as it is biomass and is assumed as CO_2 neutral. Mass of tenisite – granulated burnt defectives of previously made ceramics that is folded into mass of clay to improve lasting of final production, is not taken into account as it is secondary process and during repeated burning the CO_2 emissions are not emitted.

Table 4.22 Data and assumptions used for CO_2 emission estimation from 4th 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%	6.47%	6.67%	6.67%
$CaCO_3$ content (%)	11.48%	11.48%	11.48%	11.48%	11.48%	14.62%	14.62%	13.71%	13.71%

[40] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 79)

	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	1.929	2.280	1.824
$CaCO_3$ amount (Gg)	1.033	1.348	2.766	2.897	2.638	3.691	4.361	4.684	3.747
$MgCO_3$ CO_2 EF (tCO_2/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 (tCO_2/t oxide)	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440	0.440
CO_2 emissions (Gg)	**0.539**	**0.703**	**1.443**	**1.512**	**1.377**	**2.477**	**2.926**	**3.251**	**2.601**
Average CO_2 EF (tCO_2/t oxides)	0.451	0.451	0.451	0.451	0.451	0.465	0.465	0.467	0.467

In year 2009 the bricks production plant is not operating due to economical crisis that affected construction sector in Latvia where demand of the production sharply decreased. Still the non-operation of particular plant is assumed only temporary and it is prospective that plant will be operating again.

5th bricks production plant

In the bricks production plant's application for GHG permit during the implementation of ETS in Latvia in 2005 the 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. 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 Riga Technical University Institute of Silicate Materials for the clay used in particular plant. The plant's used an unknown source CO_2 EF for time series 1993-2004 so plant's reported data were recalculated according to available information and using the methodology from plant's latest reported annual GHG reports.

Methods

The particular bricks production plant is using Calculation method B – alkali earth oxides, from MRG[41]. According to MRG calcination of CO_2 is calculated based on the amounts of ceramics produced and the CaO, MgO and other (earth) alkali oxide contents of the ceramics.

Following equation from bricks production plant's annual GHG reports within EU ETS was used to estimate CO_2 emissions.

$$CO_2 = \sum\left(\left(AD_{raw} \times AD_{CaO,MgO} / 100\right) \times EF \times CF\right)$$

where:

CO_2 – total CO_2 emissions from bricks production (Gg)

AD_{raw} – activity data of used raw materials – clay (Gg)

$AD_{CaO,MgO}$% / 100 – CaO and/or MgO content in used raw materials (%)

EF – CO_2 emission factor of CaO and/or MgO (Gg/Gg)

CF – conversion factor

[41] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 80)

For some years in bricks production also $CaCO_3$ was used as additive to clay for yellow bricks production. Following equation from plant's annual GHG reported was used to estimate CO_2 emissions from $CaCO_3$ use:

$$CO_2 = \sum\left(\left(AD_{raw} \times AD_{additive} / 100\right) \times 1.785 \times EF \times CF\right)$$

where:

CO_2 – total CO_2 emissions from additive use (Gg)

AD_{raw} – activity data of used raw materials – clay (Gg)

$AD_{additive}$% / 100 – CaO content in used raw materials (%)

1.785 – factor to estimate CaO from used $CaCO_3$ data

EF – CO_2 emission factor of CaO (Gg/Gg)

CF – conversion factor

In latest years 2008-2009 the CO_2 emissions were estimated for different bulks of used clay so CaO and MgO content data for these bulks differs. Therefore the CO_2 emissions were estimated separately (Table 4.2.19 continuation).

Emission factors

CO_2 emission factors for CaO and MgO – 0.785 and 1.092 for tonne CO_2 per tonne of oxide respectively, were taken from MRG[42]. In plant's application to GHG permit unknown source emission factor was used so the data for 1993-2004 was recalculated using emission factor from MRG.

Activity data

According to production plant's application for GHG permit and annual GHG reports activity data of used raw materials is estimated using following equation:

$$AD_{raw} = \sum\left(AD_{bulk} \times M_{av} - M_{bulk} \times moisture / 100\right)$$

where:

AD_{raw} – activity data of used raw materials – clay (Gg)

AD_{bulk} – amount of dried bulk materials (pieces)

M_{av} – average mass (Gg)

M_{bulk} – mass of dried bulk materials

moisture/100 – content of moisture (%)

Content of CaO and MgO in used clay is determined in independent certified laboratory taking analysis of used clay. Used additives – $CaCO_3$ (limestone flour) is weighted in production plant before addition to clay.

For years 1993-2004 the CaO and MgO content was unknown as such laboratory measurements were done before EU ETS implementation requirements. The CaO and MgO content data was determined only in the end of 2003. This particular amount was then used for all years in time period 1993-2004 as other data was not available.

[42] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 81)

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.

4.2.7.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG 2000.

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.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived.

Plant specific CO_2 emission factors and Tier 2 CO_2 emission estimation methodology

Tier 2 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 2000.

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

No recalculation has been done for the sector.

4.2.7.6 Source-specific planned improvements

According to in country review in September of 2013 the ERT recommends Latvia to report aggregated brick production emissions in one line in the CRF table to avoid misunderstanding as incomplete reporting for a single plant, and in the meanwhile include plant-specific estimates in the NIR for the sake of transparency. On submission 2015 there are planed to make some technical updates in CRF under sector 2.A.7 Other following to ERT recommendations. It is planned to make these efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for next submission.

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 1995-2012 are reported in this sector. The tiles production plant is participant of EU ETS so the data from plant's annual GHG reports is available for inventory.

Table 4.23 CO_2 emissions from tile production in 1995-2012 (Gg)

	CO_2 emissions (Gg)
1995	0.163
1996	0.190
1997	0.235
1998	0.245
1999	0.217
2000	0.208
2001	0.325
2002	0.315
2003	0.382
2004	0.258
2005	0.135
2006	0.140
2007	0.179
2008	0.042
2009	0.229
2010	0.200

	CO_2 emissions (Gg)
2011	0.279
2012	0.483

Emissions are decreasing since 2003 with some fluctuation due to decrease of activity of tiles production plant. (Table 4.23). Still in 2009 the CO_2 emissions have increased approximately 4 times as the building and construction sector was again become active. In 2010 activity of tile production is decreased for about 12.66%. In 2011 and 2012 activity of tile production is increased for about 39.50% and 73.12%.

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 are taken from MRG.[43]

Amount of used clay in tiles production is taken from only tiles production plant in Latvia (Table 4.24).

Table 4.24 Activity data for tile production in 1995-2012 (Gg)

	Use of clay in tile production (Gg)
1995	0.163
1996	0.190
1997	0.235
1998	0.245
1999	0.217
2000	0.208
2001	0.325
2002	0.315
2003	0.382
2004	0.258
2005	0.135
2006	0.140
2007	0.179
2008	0.042
2009	0.229
2010	0.200

[43] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:LV:PDF, page 80

	Use of clay in tile production (Gg)
2011	0.279
2012	6.033

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 Environmental Boards so the activity data is adequately verified.

CO_2 emission factors used in emission calculation from tiles production are the default from MRG 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 2000.

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.

The QC form has been filled in for each category taking into account criteria given in QA/QC plan approved in national legislation. Form then is archived.

There were involved external auditor for QA/QC in 2013. No specific or significant uncertanties were found under this sector.

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 nonchemical industry production processes listed in IPCC GPG 2000 or EMEP/EEA 2013 that generate GHG emissions.

The biggest part of chemical industry is medicine production and then small part of paints and varnishes production.

4.4 METAL PRODUCTS (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.

Table 4.25 Emissions from 2.C Metal Production in 1990–2012 (Gg)

	CO_2	CH_4	NOx	CO	NMVOC	SO_2
1990	12.829	0.0028	2.805	0.0006	0.2475	0.088
1991	8.712	0.0019	1.905	0.0004	0.1681	0.060
1992	5.734	0.0012	1.254	0.0002	0.1106	0.039
1993	7.007	0.0015	1.532	0.0003	0.1352	0.048
1994	6.552	0.0017	1.693	0.0003	0.1494	0.053
1995	4.433	0.0014	1.425	0.0003	0.1257	0.045
1996	3.485	0.0015	1.495	0.0003	0.1319	0.047
1997	7.997	0.0023	2.369	0.0005	0.2090	0.074
1998	8.502	0.0024	2.401	0.0005	0.2119	0.075
1999	7.711	0.0024	2.467	0.0005	0.2177	0.077
2000	8.426	0.0025	2.551	0.0005	0.2251	0.080
2001	8.042	0.0025	2.562	0.0005	0.2260	0.080
2002	7.602	0.0025	2.587	0.0005	0.2282	0.081
2003	12.164	0.0027	2.791	0.0005	0.2463	0.088
2004	12.916	0.0028	2.841	0.0006	0.2506	0.089
2005	12.358	0.0028	2.827	0.0006	0.2495	0.089
2006	12.573	0.0028	2.828	0.0006	0.2495	0.089
2007	14.573	0.0028	2.847	0.0006	0.2512	0.089
2008	8.732	0.0027	2.705	0.0005	0.2387	0.085
2009	9.561	0.0022	2.246	0.0004	0.1982	0.070

	CO_2	CH_4	NOx	CO	NMVOC	SO_2
2010	11.278	0.0027	2.730	0.0005	0.2409	0.086
2011	0.476	0.0008	0.855	0.0002	0.0754	0.027
2012	1.871	0.0042	4.266	0.0008	0.3764	0.134
Share of total 2012 emissions[53]	**0.02%**	**0.00%**	**0.04%**	**0.00%**	**0.00%**	**0.00%**

Biggest decrease occurred in time period 1990–1992 due to changes in Latvia's national economy (Table 4.25). Decrease of CO_2 emissions in 1990–1996 also occurred due to decrease of used crude iron in open-hear furnaces (OHF) as 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. After going through a crisis in 2008-2009, there are increased all emissions from Metal production in 2010. In 2011 there are sharply decrease of emissions due to changing technology of metal production, so also decreased amount of mass of steel produced in electric arc furnaces (EAF) (about 75.11%) and mass of steel produced in OHF (about 68.67 %). This is due to reconstruction of steel production plant with aim in future to switch on EAF only. In 2012 there are increased emissions about 293.07% in this sector.

4.4.2 Methodological issues

IPCC 1996, IPCC GPG 2000 Tier2 and EMEP/CORINAIR 2009 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 EU 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[44] 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.

CO_2 emission estimations from crude steel production

Methods

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

[44] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF

CO_2 emissions were estimated only from crude iron used. In steel production plant mostly steel is produced by melting scrap metal that doesn't produce CO_2 emissions by leaking carbon. The only amount of total produced steel is reported by steel production company that means that the total amount of steel produced by using crude iron and melting scrap metal is known. Therefore it is needed to estimate the crude steel amount that is produced only by using crude iron and that caused CO_2 emissions. This amount is then used as activity data.

Following equation from IPCC GPG 2000 is used to calculate CO_2 emissions from steel production:

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

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, 2009-2012 and 3% for 2008;
- Average carbon content of produced steel is 0.1 – 0.4% for 1990-2006, 0.3% for 2007-2008 and 0.2% for 2009-2012.

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.

Emission factors

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.

Activity data

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.

So the used raw material amount in 2007-2009 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.

Data for CO_2 emission estimations are given in Table 4.26 below.

Table 4.26 Data for estimation of CO_2 emissions from steel production (tonnes)

	Crude steel production	% mass of steel produced in OHF	**Mass of steel produced in OHF**	Used scrap metal in open heart furnaces in steel production	Crude iron used in open heart furnaces	Crude iron/scrap metal ratio	% mass of steel produced in EAF	**Mass of steel produced in EAF**	**Amount of crude steel in what production crude iron where involved**	C content in crude iron	C content in crude steel	EF for EAF (t/t)	Conversion factor
1990	**550000**	98.74%	**543074**	537227	107732	20.05%	1.26%	**6926**	**108905**	3.50%	0.25%	0.0015	3.664
1991	**373492**	98.74%	**368789**	364818	73158	20.05%	1.26%	**4703**	**73955**	3.50%	0.25%	0.0015	3.664
1992	**245834**	98.74%	**242739**	240125	48153	20.05%	1.26%	**3096**	**48677**	3.50%	0.25%	0.0015	3.664
1993	**300393**	98.74%	**296611**	293417	58840	20.05%	1.26%	**3783**	**59480**	3.50%	0.25%	0.0015	3.664
1994	**331955**	98.86%	**328164**	317658	55116	17.35%	1.14%	**3791**	**56939**	3.50%	0.25%	0.0015	3.664
1995	**279326**	98.72%	**275747**	285015	37086	13.01%	1.28%	**3579**	**35880**	3.50%	0.25%	0.0015	3.664
1996	**293167**	98.90%	**289955**	307261	29099	9.47%	1.10%	**3212**	**27460**	3.50%	0.25%	0.0015	3.664
1997	**464529**	99.45%	**461978**	469205	67039	14.29%	0.55%	**2552**	**66006**	3.50%	0.25%	0.0015	3.664
1998	**470835**	99.48%	**468375**	470302	71341	15.17%	0.52%	**2460**	**71049**	3.50%	0.25%	0.0015	3.664
1999	**483744**	99.54%	**481521**	490912	64631	13.17%	0.46%	**2223**	**63395**	3.50%	0.25%	0.0015	3.664
2000	**500292**	99.23%	**496434**	503123	70637	14.04%	0.77%	**3858**	**69698**	3.50%	0.25%	0.0015	3.664
2001	**502277**	99.21%	**498296**	511026	67352	13.18%	0.79%	**3981**	**65674**	3.50%	0.25%	0.0015	3.664
2002	**507194**	99.19%	**503079**	520425	63620	12.22%	0.81%	**4115**	**61500**	3.50%	0.25%	0.0015	3.664
2003	**547346**	99.62%	**545265**	524232	102437	19.54%	0.38%	**2081**	**106547**	3.50%	0.25%	0.0015	3.664
2004	**556974**	98.92%	**550970**	527155	108762	20.63%	1.08%	**6004**	**113675**	3.50%	0.25%	0.0015	3.664
2005	**554345**	98.94%	**548472**	527950	104010	19.70%	1.06%	**5873**	**108053**	3.50%	0.25%	0.0015	3.664
2006	**554546**	98.90%	**548419**	531026	105769	19.92%	1.10%	**6127**	**109233**	3.50%	0.25%	0.0015	3.664
2007	**558156**	99.76%	**556814**	463940	109248	23.55%	0.24%	**1342**	**131118**	4.00%	0.30%	0.0015	3.664
2008	**530462**	99.34%	**526964**	492450	88319	17.93%	0.66%	**3498**	**94509**	3.00%	0.30%	0.0180	3.664
2009	**440458**	99.90%	**440016**	413058	68784	16.65%	0.10%	**442**	**73273**	4.00%	0.20%	0.0064	3.664
2010	**535301**	99.79%	**534168**	476868	81340	17.06%	0.21%	**1133**	**91114**	4.00%	0.20%	0.0064	3.644
2011	**167624**	99.83%	**167342**	187103	3389	1.81%	0.17%	**282**	**3031**	4.00%	0.20%	0.0064	3.644
2012	**836431**	99.96%	**836115**	900803	13387	1.49%	0.04%	**316**	**12426**	4.00%	0.20%	0.0014	3.644

CH_4 and indirect GHG emission estimations from crude steel production

Methods

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 2009 methodology and emission factors.

Emission factors

Emission factors of methane and indirect GHG emissions are taken from EMEP/CORINAIR 2009 methodology (Table 4.27).

Table 4.27 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 2009 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.

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 EMEP/CORINAIR 2009 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.

4.4.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from 2000 IPCC GPG.

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.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived.

There were involved external auditor for QA/QC in 2013. No specific or significant uncertanties were found under this sector.

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 CO_2 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 2000 and the Tier2 methodology was verified by ERT during two in-country reviews in 2007 and 2009 and accepted as correct.

4.4.5 Source-specific recalculations

No recalculations were done in the sector since last submission.

4.4.6 Source-specific planned improvements

It is important to revise CO_2 emission estimations for the sector as plant specific parameters and values are used in emission estimation. There were involved external auditor for QA/QC as this is a key source category. No specific or significant uncertanties there were found.

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.

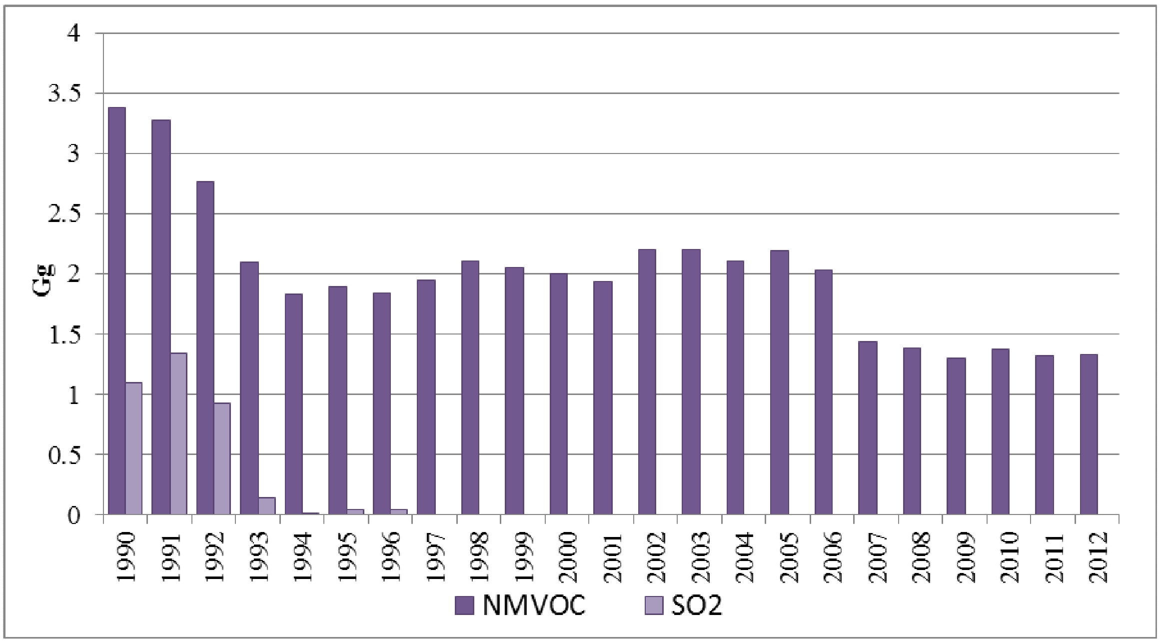

Figure 4.6 Total emissions from 2.D Other Production in 1990–2012 (Gg) [45]

Biggest fluctuations occurred in time period 1991–1993 due to changes in economical situation in country (Figure 4.6). 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.

Since 2007 the total amount of food and drink production sector is decreasing that is explained with economical crisis in 2008-2009 as well as of purchasing capacity population and difference in prices of national production and imported production.

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

SO_2 emission factor 0.03 (t/t) is taken from IPCC 1996.

The NMVOC emission factors (Table 4.28) are taken from the IPCC 1996 with exception of NMVOC emission factor for spirits production. NMVOC emissions factor from

[45] SO_2 emissions on secondary axis

EMEP/CORINAIR 2007 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 4.28 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
Meat, 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 4.29). LEGMC has signed an agreement with CSB to get data of total production of products from sectors where data are confidential.

Still for the 2012 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 2007-2012.

Table 4.29 Activity data of 2.D Other Production sector

	Pulp and Paper	Wine	Beer	Spirits	Meat, 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	19.9	87.4	324.5	569.3	31.0	54.8	314.0	200.0
1991	44.7	197.5	1295.3	330.0	490.4	35.0	39.2	293.0	200.0
1992	30.8	179.8	858.9	259.3	281.6	39.0	22.1	240.0	200.0
1993	4.7	87.7	545.9	217.4	154.0	26.0	15.8	177.4	245.4
1994	0.2	134.2	637.9	314.8	95.6	15.8	22.7	161.5	174.0
1995	1.5	159.2	652.8	341.5	82.8	29.3	24.4	145.4	214.4
1996	1.5	154.7	644.9	379.6	100.5	31.2	13.1	137.1	206.2
1997	NO	114.7	714.8	456.4	129.1	41.2	16.9	132.1	205.0
1998	NO	99.6	721.0	417.4	110.9	64.9	18.1	124.8	203.3
1999	NO	C	953.2	C	166.9	C	20.8	121.5	144.5
2000	NO	C	945.1	C	197.3	C	24.3	121.1	173.8
2001	NO	C	996.6	C	244.6	C	24.4	123.1	184.9
2002	NO	C	1199.2	C	262.9	C	29.0	122.6	201.3

	Pulp and Paper	Wine	Beer	Spirits	Meat, fish, poultry	Sugar	Cakes, biscuits, breakfast cereals	Bread	Animal forage
	Gg	1000 hl	1000 hl	1000 hl	Gg	Gg	Gg	Gg	Gg
2003	NO	C	1336.6	C	264.4	C	37.3	124.0	201.4
2004	NO	C	1313.1	C	262.5	C	43.6	119.3	211.8
2005	NO	C	1293.3	C	243.8	C	53.6	116.3	248.6
2006	NO	C	1383.0	C	288.4	C	45.0	107.3	244.2
2007	NO	C	1414.3	C	286.0	NO	46.5	102.3	336.8
2008	NO	C	1333.8	C	297.7	NO	38.5	100.7	307.3
2009	NO	C	1292.4	C	253.5	NO	33.3	95.9	299.3
2010	NO	C	1484.9	C	252.7	NO	38.0	90.0	409.8
2011	NO	C	1626.6	C	261.5	NO	39.7	88.6	360.9
2012	NO	C	1488.5	C	264.3	NO	44.5	91.4	348.2

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 2000.

Activity data used in NMVOC and SO_2 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. 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.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived.

There were involved external auditor for QA/QC in 2013. No specific or significant uncertanties were found under this sector.

4.5.5 Source-specific recalculations

No recalculations were done in the sector since last submission.

4.5.6 Source-specific improvements

No improvements are planned for this sector for nearest submissions.

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 it's *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) (hereinafter F-gases).

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.[46] 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.

According to (EC) No 842/2006 Regulation of the European Parliament and of the Council on certain fluorinated greenhouse gases Latvia has 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. 398 operators reported data of their operation with F-gases for submission 2012.

The calculation of emissions was carried out for 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 category includes emission sources from refrigeration and air conditioning equipment, foam blowing, fire extinguishers, metred dose inhalers, electrical equipment and other sources (emissions from shoes containing HFC). There is no production of HFCs in Latvia.

Emissions of the PFCs does not occur (NO) in Latvia for all time series.

The base year for HFC, PFC and SF_6 emission reporting is the year 1995.

The emissions of F-gases are linearly increasing since 1995 – 0.89 CO_2 eq. Gg in 1995 to 97.34 CO_2 eq. Gg in 2012 (Table 4.30, Figure 4.7).

[46] Project report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003", Riga 2004

Table 4.30 Total emissions of HFCs in 1990–2012 (Gg CO_2 eq)

Year	2.F Consumption of HFCs and SF_6	2.F.1 Refrigeration and air conditioning equipment	2.IIA.F.1.1 Domestic refrigeration	2.IIA.F.1.2 Commercial refrigeration	2.IIA.F.1.3 Transport Refrigeration	2.IIA.F.1.6 Mobile air conditioning	2.F.2 Foam blowin g	2.F.3 Fire Extinguishers	2.F.4 Metred dose inhalers	2.F.8 Electrical equipment
1995	0.889	0.274	0.079	NE,NO	0.176	0.020	NE	NE,NO	NE,NO	0.251
1996	1.120	0.448	0.110	NE,NO	0.042	0.296	NE	NE,NO	NE,NO	0.287
1997	2.432	1.518	0.125	NE,NO	0.088	1.305	NE	NE,NO	NE,NO	0.508
1998	3.566	2.243	0.140	0.022	0.316	1.765	NE	NE,NO	0.156	0.710
1999	4.248	2.429	0.172	0.052	0.164	2.041	NE	NE,NO	0.633	0.977
2000	6.387	3.281	0.201	0.074	0.164	2.970	NE	NE,NO	1.124	1.275
2001	9.553	4.588	0.233	0.172	0.035	4.109	NE	0.035	1.575	1.977
2002	13.236	6.177	0.285	0.246	0.074	5.561	NE	0.035	1.848	3.382
2003	20.116	8.432	0.358	0.333	0.086	7.470	3.271	0.088	1.753	4.413
2004	23.432	11.931	0.432	0.837	0.271	10.568	1.354	0.179	1.736	5.370
2005	35.892	17.351	0.533	0.631	0.095	16.005	5.685	0.115	1.938	7.530
2006	69.691	32.328	0.592	7.959	0.181	23.647	24.216	0.179	2.170	7.124
2007	107.154	49.450	0.655	15.504	0.130	33.291	41.877	0.111	2.516	8.596
2008	82.921	62.980	0.722	23.372	NO	38.886	1.652	0.181	2.725	10.076
2009	87.897	66.594	0.770	25.897	NO	39.927	0.009	0.252	2.563	13.529
2010	85.310	62.859	0.810	25.041	NO	37.008	0.850	0.322	2.471	13.129
2011	87.466	66.313	0.857	24.966	NO	40.489	0.646	0.393	2.462	12.454
2012	97.338	76.159	0.832	29.696	NO	45.639	0.641	0.463	2.315	13.688

As it can be seen in Figure 4.7, all F-gases emissions have increasing tendency with exception of Transport Refrigeration (2.IIA.F.1.3) and Fire Extinguishers (2.F.3) 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.

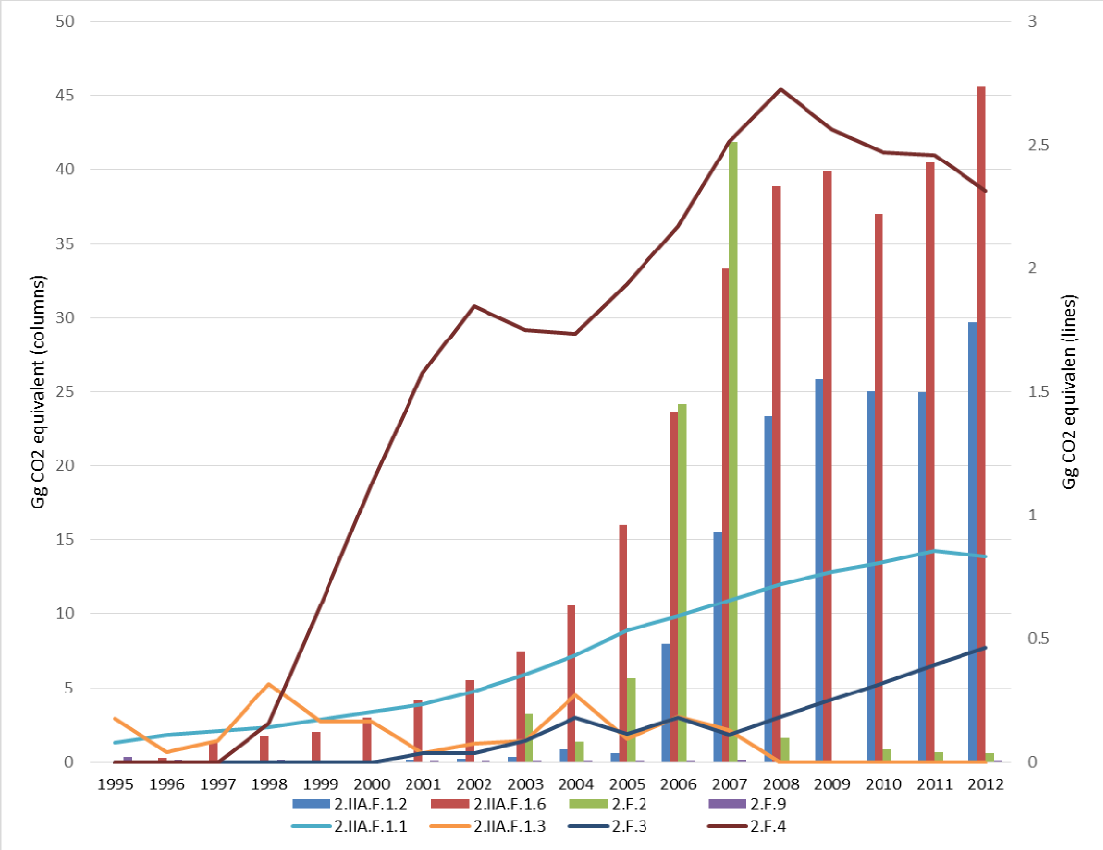

Figure 4.7 HFCs emissions from 2.F Consumption of Halocarbons and SF_6 sector in 1990–2012 ($Gg\ CO_2$ eq) [47]

Still as it can be predictable the emissions that are generated in construction sector or are related to population well being are decreasing for example foam blowing (2.F.2) emissions where the highest point of the emissions were in 2007 (41.88 Gg CO_2 eq). After that emissions have decreased very sharply (0.009 Gg CO_2 eq in 2009) because the foams are not almost imported in country and it is assumed that the foams previously imported and held in stocks are used.

Also emissions from metered dose inhalers are decreasing that is also explained with the decrease of population purchase power as well as decrease of total population number. The emissions are increasing in domestic (2.IIA.F.1.1), commercial (2.IIA.F.1.2) and mobile air conditioners (2.IIA.F.1.6) sectors. In 2012, there are increasing of overall HFC emissions due to growing of activity data used for sector 2.F. Consumption of Halocarbons and SF_6.

[47] sectors 2.IIA.F.1.1, 2.IIA.F.1.3, 2.F.3 and 2.F.4 on the secondary axis

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 3, *A.3.3 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. number of inhabitants in Latvia – obtained by CSB database ISG02 „Resident population at the beginning of the year"[48];
2. amount of households in Latvia – data for 1995 were extrapolated the value of 1996 from CSB database ISG21 „Total number of households and the average size of a household"[49]. For 1996 - 2012 data was taken from CSB database ISG21 „Total number of households and the average size of a household".
3. percentage amount of households using refrigerators and freezers – for 1996, 2001, 2006 and 2010 years data were taken from CSB database epm2.1. „Number of electrical appliances used in dwellings and average age of appliances". [50] Data obtained with questionnaires of households made every five years.
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".

As percentage amount of the domestic refrigerating equipment containing HFC-134a obtained during the preparation of the report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003" is know only for 1999-2003, data for historical years prior this time period was extrapolated. Data for 2004-2008 was calculated assuming the average increase of 4%, due to improvement of wellbeing of population and the requirements of European Union. It is assumed that the percentage of the refrigerators containing HFC-134a is increasing as previously used chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) is now prohibited since Latvia has undertook the obligations of the European Union in 2004. In 2009-2012 the increase of percentage amount of domestic refrigerators containing HFC-134a is assumed lower – 3%.

<u>HFC-134a from charging of domestic refrigerators and freezers</u>

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.

48http://data.csb.gov.lv/Selection.aspx?px_tableid=Sociala\Ikgad%C4%93jie+statistikas+dati\Iedz%C4%ABvot%C4%81ji\Iedz%C4%ABvot%C4%81ji+skaits+un+t%C4%81+izmai%C5%86as\IS0020.px&px_language=lv&px_type=PX&px_db=Sociala&rxid=992a0682-2c7d-4148-b242-7b48ff9fe0c2

49http://data.csb.gov.lv/Selection.aspx?px_tableid=Sociala\Ikgad%C4%93jie+statistikas+dati\Iedz%C4%ABvot%C4%81ji\Iedz%C4%ABvot%C4%81ji+skaits+un+t%C4%81+izmai%C5%86as\IS0210.px&px_language=lv&px_type=PX&px_db=Sociala&rxid=992a0682-2c7d-4148-b242-7b48ff9fe0c2

50http://data.csb.gov.lv/Selection.aspx?px_tableid=vide\Energoresursu+pat%C4%93ri%C5%86%C5%A1+m%C4%81jsaimniec%C4%ABb%C4%81s\0201.px&px_language=lv&px_type=PX&px_db=vide&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0

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 176.25g 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 2001-2012 lifetime factor used in emission estimation is assumed as 10 years. So for years 2001-2012 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.[51]

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 (%)

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.[52]

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 (%)

HFC-134a from disposal of domestic refrigerators and freezers

[51] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.56
[52] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.55

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".[53] 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. The main aspect of choosing "0" emissions from disposal is that collected electric and electronic equipment is not disposed in Latvia. All the equipment is collected and transported to other countries for recycling or disposing. So the notation key "NO" is used for domestic refrigeration sector emissions for 2005-2012.

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" 398 operators reported data of their operation with f-gases for submission 2014 for year 2012. 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 2006-2012 data were obtained from reporting within previously mentioned regulation act.

[53] http://www.likumi.lv/doc.php?id=96434&from=off

IPCC 1996 was used to estimate emissions from commercial freezing equipment.

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.[54] For time period 2006-2012 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:

$$E_{charged} = HFC_{charged} \times k$$

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 (%)

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)[55] 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 2006-2012 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:

$$E_{operation} = E_{stocks} \times x$$

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 (%)

F-gases from disposal of commercial and industrial refrigeration

[54] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.53

[55] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.56

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 it is 15 years[56] for early years in reporting period 1995-2000. For years 2001-2005 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 2001-2005.

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.

Since 2005 the amount of recycled, regenerated and destroyed is known for time period 2006-2010. These amounts are very small. As the collected amounts of F-gases have to be collected before the disposal of the refrigeration equipment and the collection has to be done according to rules without any possible leakage, it is assumed that the emissions from collection of the amount of F-gases destroyed or recycled after that are not occurring (NO).

According to previously mentioned 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 2005-2012.

4.6.2.3 Transport Refrigeration (CRF 2.F.1.3)

This group includes refrigerated road vehicles. There is no production of refrigeration units in Latvia so emissions occur from stock and from disposal.

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.

[56] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.56

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 2007-2012 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 (%)

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 2007-2012 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"

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 2005-2012.

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.

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 2007-2012 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 (%)

<u>HFC-134a from stocks of stationary and mobile air conditioning</u>

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. data obtained from CSB database TRG06. „Number of registered road vehicles" [57]. The amount of passenger cars and trucks manufactured after 1995 obtained by Road Traffic Safety Directorate were used in emission estimates;
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.

The fleet age is constantly improving when in 2002 only 2.13% of the total registered in country passenger cars manufacturing year were higher than year 2000, in 2005 this percentage was 5.99% but in year 2008 21.64% of total registered passenger cars is younger than year 2000 (manufacturing year). In 2009 22.51% of the total registered passenger cars have higher manufacturing year than 2000, but 11% have higher manufacturing year than 2005.

According to this aspect 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 with manufacturing year higher than 1995 equipped with F-gases filled MACs are constantly increasing and reaches 43% in year 2012. The same percentage increase has to be applied for trucks when percentage of trucks equipped with MACs increase from 50% in 2000 to 73.1% in 2012.

According to IPCC 1996 average percentage of losses during operation lifetime is 15% of the total quantity banked in the stock.[58]

[57] http://data.csb.gov.lv/Selection.aspx?px_tableid=transp\Ikgad%C4%93jie+statistikas+dati\Transports\TR0120.px&px_language=en&px_type=PX&px_db=transp&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0

[58] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.57

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 (%)

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.[59] 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 40% 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 100% of F-gases remained in MACs after their lifetime. For disposal emission estimation the default IPCC values was used.[60]

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 (%)

4.6.2.5 Potential Emissions from Refrigeration and Air Conditioning

Data for potential HFCs emission from refrigerants and air conditioning equipment estimation was taken from LEGMC Chemical Substances Registry where all enterprises operating with

[59] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref3.pdf (p.2.57)

[60] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf p.3.110, Table 3.23.

any chemical substances have to report the amount of imported, produced and exported chemical substances according to "Chemical Substances and Chemical Preparations Law".[61]

Potential annual consumption of particular f-gas was estimated by following equation:

$$HFC_{potencial} = \sum HFC_{produced} + \sum HFC_{imported} + \sum HFC_{\exp orted} + \sum HFC_{destruction}$$

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)

$HFC_{destructed}$ – amount of destructed 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)

[61] http://www.ttc.lv/export/sites/default/docs/LRTA/Likumi/Chemical_Substances_and_Chemical_Products_Law.doc

4.6.2.6 Foam Blowing (CRF 2.F.2)

Although the activity of building sector in last years radically increased emissions were 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.

Data of imported foams divided by particular foam type is known from Chemicals Register where all companies operating with products containing chemicals have to report their import/export and production amounts. No export and production data is reported to Register therefore only import amount is known. So only emissions from use of foams and disposal emissions after foam was been used – emissions from products left in foam packaging, containers etc.

Therefore only the potential emissions can be estimated for foam blowing as the emissions are based on import/export data (as for potential emissions estimations). Still taking into account the strong recommendations by ERT during centralized review 2010 these data was used to estimate actual emissions from foam use. The ERT requested to report potential emissions as actual emissions still this approach is very inappropriate as for potential emissions estimation it is assumed that 100% of HFCs stored in products is emitted. Still for actual emission estimation particular emission factors have to be used to estimate how much of HFCs stored in products are emitted during use / application.

HFCs emissions from processing of foams

The imported amount in Latvia is obtained from Chemicals Register where companies that import products containing specific chemicals have to report their data.

Although it can be assumed that not all foams imported in country in particular year are used in the same year the import data is used to estimate actual emissions as actual use or products sold data is not available.

According to data reported to Chemicals Register average percentage of HFC-134a and HFC-152 in mostly used types of foam is known. According to this information averagely 13% of HFC-134a and 10.5% of HFC-152 is stored in foams imported in country. So the data of particular HFCs in imported products can be estimated:

$$HFC = p \times AD_{foams}$$

where:

HFC – amount of particular HFC in total imported amount of foams (t)

p – percentage content of particular HFC in imported foams (%)

AD_{foams} – amount of imported foams (t)

According to IPCC 1996 the total quantity of HFC contained in the existing stock of insulating foam can be calculated as the product of the total quantity of insulating foam in use in year t and the average charge of chemical contained in each tonne of such installed insulating foam.[62]

Default emission factors from IPCC 1996 – 10% production lost, is used to estimate the emissions from foam use in particular year.[63]

[62] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref3.pdf (page 2.59)
[63] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref3.pdf (page 2.59)

Therefore the particular HFC emissions are estimated summing amount of each HFC in imported product (estimated using percentage amount of particular HFC in imported product) multiplied by default emission factor of use loss – 10%:

$$EM_{HFCs} = \sum HFC \times 10\%$$

where:

EM_{HFCs} – emissions of HFCs during application process (t)

HFC – amount of particular HFC in total imported amount of foams (t)

10% - default percentage amount of losses during application

For decommissioning losses estimation the manufacturing and/or processing of foams data in historical years have to be obtained. The product lifetime of foam is 20 years. Therefore it is necessary to obtain the data of the years prior 1989. As in that time Latvia was part of Soviet Union the specific data was not collected as well as it is believable that the foam blowing did not occur in country or it occur in very negligible amounts. Therefore decommissioning losses for foams use are assumed as not applicable (NA).

Potential emissions from foam blowing

It is assumed that 100% of the amount of particular HFC in imported foams is 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.

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 fire 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. Therefore only emissions from stocks were calculated.

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.[64]

For 2007-2012 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 (%)

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 (%)

Potential HFC-227ea from fire extinguish 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 (%)

[64] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.117

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 enterprises 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.[65] 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.

So only the aerosols 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 2007-2012 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.[66]

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 (%)

Potential HFC-134a emissions from metered dose inhalers

[65] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.87
[66] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) Industrial Processes, p.2.61

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 emissions 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.

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 SF_6 in newly installed equipment is used as activity data for emission estimation and 2% leakage factor from IPCC GPG 2000 for operations was used.[67]

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 (%).

SF_6 emissions from stocks of electrical equipment

According to IPCC GPG 2000 2% leakage factor for operations was used.[68]

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 (%)

[67] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.57
[68] http://www.ipcc-nggip.iges.or.jp/public/gp/english/3_Industry.pdf, p.3.57

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 2003-2012 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.

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:

$$P_{E_{HFC}} = E_{charged} + E_{stocks} + HFC_{containers} + E_{emergency} \times x$$

where:

P_{EHFCs} – total potential emissions of HFC-227ea from electrical equipment (t)

$E_{charged}$ – amount of emissions from installation of electrical equipment (t)

E_{stocks} – emissions of SF_6 from electrical equipment (t)

$E_{emergency}$ – emergency leakage 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.

Activity data for emission estimation is taken from CSB databases about produced imported and exported amount of shoes[69]

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. [70]

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:

$$HFC_{filled} = Sh_{produced} \times d_{HFC} \times HFC_{sh}$$

[69] http://data.csb.gov.lv/Selection.aspx?px_tableid=atirdz\Detaliz%C4%93ta+statistika\8+z%C4%ABmju+l%C4%ABmen%C4%AB\2012_imp_8.px&px_language=en&px_type=PX&px_db=atirdz&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0

[70] http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publications/2009/978-87-7052-962-4/html/bred01_eng.htm

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 (%)

HFC-134a emissions from stocks in shoes containing F-gases

In whole period 1995-2012 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:

$$HFC_{stocks} = HFC_{filled} + HFC_{imported} - HFC_{\exp orted}$$

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% (lifetime is 3 years) 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 (%)

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 no 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 (%)

<u>Potential HFC-134a emissions from shoes containing F-gases</u>

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.

4.6.4 Source-specific QA/QC and verification

QA/QC check is performed with Tier1 method from IPCC GPG 2000.

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.

Recommendations from a third part experts not involved in the preparation of the inventory were taken into account for improving the quality of the latest inventory. The QC check list is completed and provided in Annex 6.1. – Annual inventory submission.

Within the framework of the EU project „MS Support for KP Reporting" suggestions for improvements in F gases sector were recieved and implemented in the latest inventory.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived in centralized archiving system (common FTP folder).

4.6.5 Source-specific recalculations

In the sector 2 IIA.F.1.1 recalculations were made according to the updated statistical data in number of households and number of inhabitants. This caused changes in emissions by 0.07% of HFC-134a in all time series of Domestic Refrigeration subcategory both in actual and potential emissions.

4.6.6 Source-specific planned improvements

Within the EEA Financial Mechanism 2009-2014 Programme "National Climate Policy " it is planned to ensure detailed quality control procedures for quality assurance of Industrial process sector. Also it is planned to reduce uncertainties in this subsector within previous mentioned project.

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 – 2012 due to lack of historical statistical information regarding import and export of F – gases (Figure 4.8). 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.

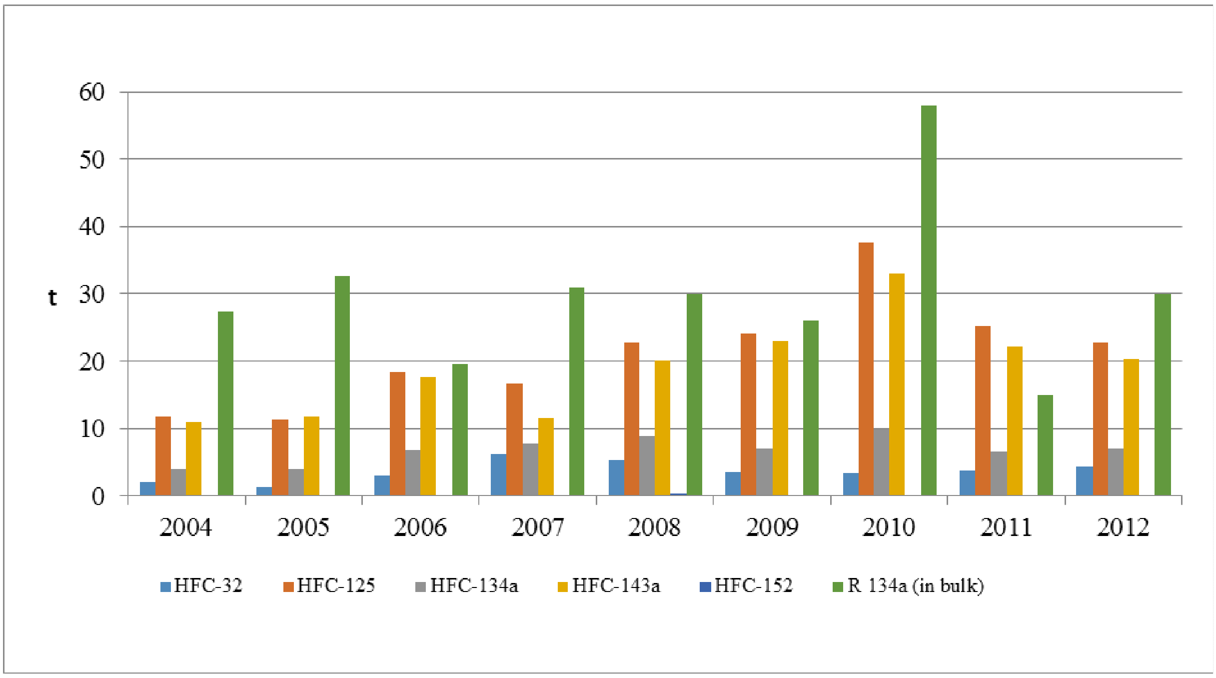

Figure 4.8 Total potential emissions of F-gases in 2004–2012, t

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

The activity data used in emission estimation is taken from Chemicals Register. The activity data is made confidential therefore it is not possible to report the import data in NIR.

The amount of HFCs in imported products is estimated taking into account product content data reported by importers. According to percentage amount (Table 4.31) of chemicals in imported freezing substances amount of chemicals were estimated and reported as potential emissions.

Table 4.31 Percentage amounts of chemicals in imported products 2004–2012 (%)

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%			

Chemicals, products	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea
DBS 9802 PUR B1			6.25%			
FIXER MEGAPRO			13%			
FIXER			13%			
FIXER			10.5%			
FIXER			10.5%			
R 417a		46.6%	50%			

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 2000.

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.

Quality control check list is filled for each category taking into account criteria given in QA/QC plan approved in national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived.

4.7.5 Source-specific recalculations

In the sector 2 IIA.F.1.1 recalculations were made according to the updated statistical data in number of households and number of inhabitants. This caused changes in emissions of HFC-134a in all time series of Domestic Refrigeration subcategory both in actual and potential emissions.

4.7.6 Source-specific planned improvements

Within the EEA Financial Mechanism 2009-2014 Programme "National Climate Policy " it is planned to ensure detailed quality control procedures for quality assurance of Industrial process sector.

4.8 REFERENCES

- Project report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003", Riga 2004.
- Annual data report on ozone-depleting substances and fluorinated greenhouse gases (the freezing agents) and activities with them (2012) – from Register of Chemical Substances and Chemical Mixtures;
- Annual data report on produced and imported fluorinated gases (2012) - Register of Chemical Substances and Chemical Mixtures;
- Implementation of QC procedures in Latvian GHG inventory (for Industrial processes and Solvents and Other Product Use) – the report of third part expert Janis Rekis;
- Data from State Agency of Medicines;
- Data from Central Statistical Bureau.

5. SOLVENT AND OTHER PRODUCT USE (CRF 3)

5.1 OVERVIEW OF SECTOR

5.1.1 Quantitative overview

This chapter describes emissions from Solvent and Other Product Use. Use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC) which are regarded as an indirect greenhouse gases as it over a period of time will oxidize into CO_2 when emitted to the atmosphere. The only direct greenhouse gas source in the Solvent and Other Product Use sector is the Use of N_2O for Anaesthesia.

Indirect CO_2 emissions from NMVOC and N_2O emissions (Table 5.1) for the following CRF categories were estimated:

- Paint Application (CRF 3.A);
- Degreasing and Dry Cleaning (CRF 3.B);
- Chemical Products, Manufacture and Processing (CRF 3.C);
- Other Product Use (CRF 3.D):
    - Use of N_2O for Anaesthesia (CRF 3.D.1);
    - Printing (CRF 3.D.5.1);
    - Domestic Solvent Use (CRF 3.D.5.2);
    - Other Product Use (CRF 3.D.5.3).

Table 5.1 Reported emissions from Solvent and Other Product Use in Latvia in 2012

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	
N_2O from Aerosol Cans (CRF 3.D.3)		NE	
Other Use of N_2O (CRF 3.D.4)		NO	
Printing (CRF 3.D.5.1)	√	NO	√
Domestic Solvent Use (CRF 3.D.5.2)	√	NO	√
Other Product Use (CRF 3.D.5.3)	√	NO	√

N_2O emissions from Fire Extinguishers (3.D.2) and Aerosol Cans (3.D.3) were not estimated due to unavailability of statistical data. N_2O emissions from Other Use of N_2O (3.D.4) were estimated as not occurring.

5.1.2 Description

In 2012 indirect greenhouse gases emissions from Solvent and Other Product Use sector contributed a small amount of the total greenhouse gas emissions in Latvia. Share of total indirect greenhouse gases emissions were only 0.4%. Emissions of the total greenhouse gases

from the Solvent and Other Product Use sector (CRF 3) have increased by 12%, from 42.9 Gg CO_2 equivalents in 1990 to 48.5 Gg CO_2 equivalents in 2012 (Figure 5.1).
The rise can mostly be explained by an increase in the use of solvents in CRF 3.B (Degreasing and Dry Cleaning) and 3.D (Other) due to the economic welfare of the country.

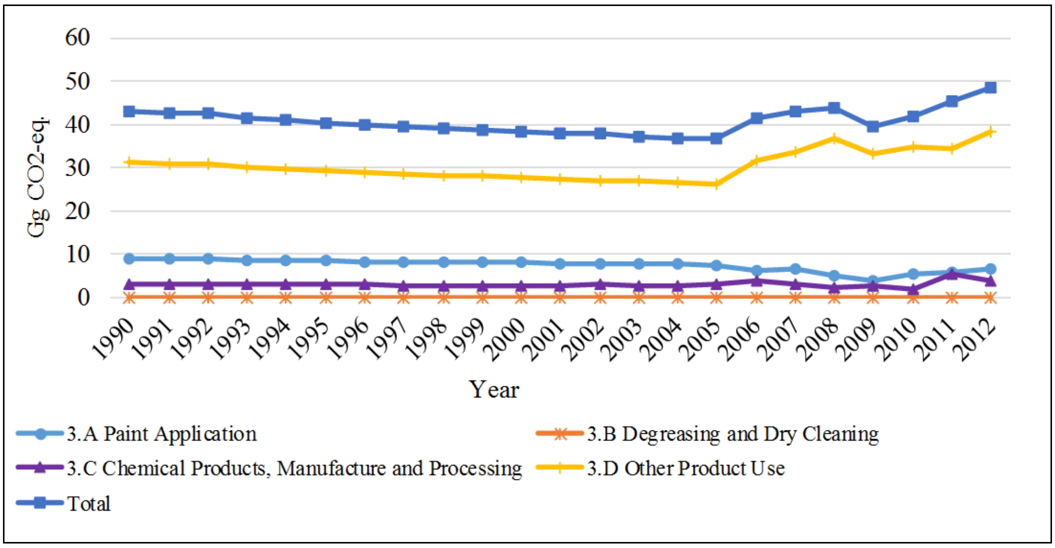

Figure 5.1 Total emissions of all greenhouse gases calculated as CO_2 equivalents from the different Solvent and Other product use sub-sectors

NMVOC emissions from the Solvent and Other Product Use sector constituted 41% (22.1 Gg) of the total NMVOC emissions of Latvia in 2012. Decrease in NMVOC emissions in the period 1990-2005 (Figure 5.2) has occurred mostly due to the industry going through a crisis. Between 2005 and 2008 the economic growth induced the increasing usage of NMVOC containing products from application of underseal treatment and conservation of vehicles, glues and adhesives, preservation of wood, domestic solvent use and other. At the end of 2008 the world was struck by the economic crisis which also affected the Solvent and Other Product Use sector in Latvia. There is an increase in trends of NMVOC emissions from Solvent and Other Product Use in later years. Since 2009 in CFR 3 sector NMVOC emissions have increased by 19%.

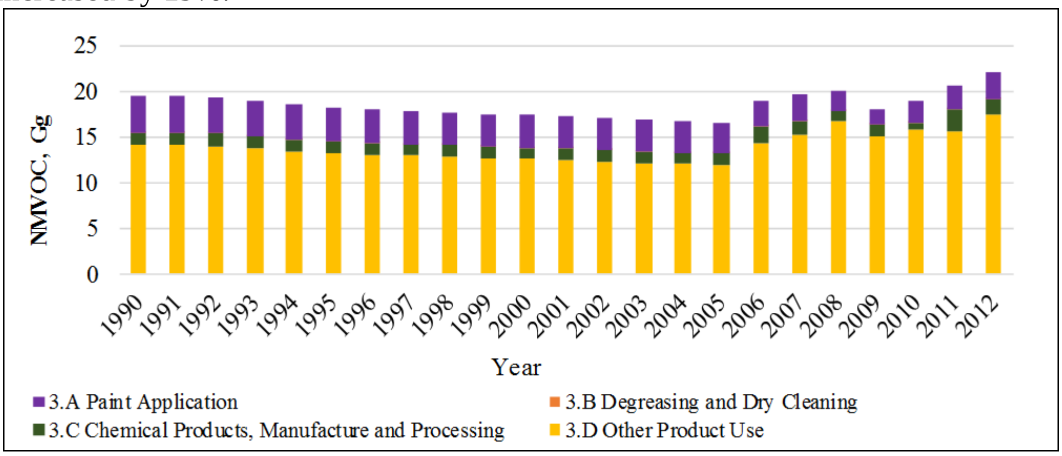

Figure 5.2 NMVOC emissions (Gg) from Solvent and Other Product Use sector in 1990-2012

N_2O emissions as CO_2 equivalent from the Use of N_2O for Anaesthesia (CRF 3.D.1) were negligible (0.005 Gg) in 2012 (Table 5.2).

Table 5.2 Emissions of N_2O, NMVOC and CO_2-eq in Gg per year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
N_2O emissions (Gg)											
3.D.1	1.5E-05	1.5E-05	1.5E-05	1.5 E-05	1.4 E-05	1.5E-05	1.7 E-05	1.7 E-05	1.3 E-05	1.4 E-05	1.0 E-05
NMVOC emissions (Gg)											
3.A	4.0	4.0	4.0	3.9	3.8	3.8	3.7	3.7	3.7	3.6	3.6
3.B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.21
3.D.5.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.5.2	3.8	3.8	3.8	3.7	3.6	3.6	3.5	3.5	3.5	3.4	3.4
3.D.5.3	10.3	10.3	10.2	10.0	9.8	9.7	9.6	9.5	9.4	9.3	9.2
Total	19.5	19.4	19.3	18.9	18.6	18.3	18.1	17.9	17.7	17.6	17.4
Total emissions – N_2O emissions and indirect CO_2 emissions from NMVOC (Gg CO_2 eq)											
Total	42.9	42.8	42.5	41.6	40.9	40.2	39.7	39.3	38.9	38.6	38.3

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
N_2O emissions (Gg)												
3.D.1	2.7 E-05	1.9 E-05	1.9 E-05	2.0 E-05	1.0 E-05	3.8 E-05	1.3 E-05	1.4 E-05	1.3 E-05	1.5 E-05	1.6 E-05	1.6 E-05
NMVOC emissions (Gg)												
3.A	3.6	3.5	3.5	3.4	3.4	2.8	2.9	2.2	1.7	2.4	2.6	2.9
3.B	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.C	1.2	1.4	1.2	1.2	1.3	1.7	1.4	1.1	1.1	0.8	2.5	1.8
3.D.5.1	0.00	0.00	0.00	0.00	0.00	0.27	0.35	0.29	0.01	0.31	0.29	0.02
3.D.5.2	3.4	3.3	3.3	3.3	3.2	4.5	5.6	6.7	4.5	4.8	4.7	5.7
3.D.5.3	9.1	9.0	8.9	8.8	8.7	9.6	9.3	9.7	10.6	10.7	10.7	11.7
Total	17.2	17.2	16.9	16.7	16.6	18.9	19.6	20.0	17.9	19.0	20.7	22.1
Total emissions – N_2O emissions and indirect CO_2 emissions from NMVOC (Gg CO_2 eq)												
Total	37.9	37.7	37.1	36.6	36.6	41.5	43.1	43.9	39.4	41.7	45.4	48.5

5.2 PAINT APPLICATION (CRF 3.A), DEGREASING AND DRY CLEANING (CRF 3.B) AND OTHER (CRF 3.D.5)

5.2.1 Source category description

Paint Application (CRF 3.A) includes paints and varnishes from decorative coating application (paints for architectural application by construction enterprises and proffesional painters as well as by private consumers), industrial coating application (paint application for manufacture automobiles, car repairing, coil coating, boat building, wood as well as other industrial paint applications) and other coating applications as described by EMEP/EEA air pollutant emission inventory guidebook – 2009. Paint Application constituted 6.4% of the total CO_2 eq emissions under Solvent and Other product Use sector in 2012.

Degreasing and Dry Cleaning (CRF 3.B) consists of two sub-sectors. Degreasing includes cleaning products from water-insoluble substances such as grease, fats, oils waxes and tars. In this sub-sector a wide range of activities were covered according to EMEP/EEA air pollutant emission inventory guidebook – 2009. Dry Cleaning constitutes a small amount of whole CRF 3.B sector.

Other (CRF 3.D.5) was the biggest sub-category (78% or 38 Gg CO_2 eq) of total CO_2 eq emissions in Solvent and Other Product Use in 2012. Other Product Use (CRF 3.D.5.3) produced 67.2% (26 Gg CO_2 eq), Domestic Solvent Use (CRF 3.D.5.2) – 32.7% (12 Gg CO_2 eq) and Printing (CRF 3.D.5.1) – less than 1 % of these 38 Gg.

To divide the NMVOC containing products by CRF 3.D.5 subsectors EMEP/EEA air pollutant emission inventory guidebook – 2009 was used. Printing (CRF 3.D.5.1) involved the use of inks, cleaning solvents and organic dampeners. Domestic Solvent Use including fungicides (CRF 3.D.5.2) comprises NMVOC emissions from a number of product categories, for instance, cosmetics & toiletries, household products, construction and car care products. Other Product Use (CRF 3.D.5.3) includes emissions from application of underseal treatment and conservation of vehicles, glues and adhesives, preservation of wood and other solvent use.

Indirect CO_2 emissions from NMVOC emissions under CRF 3.A, 3.B. and 3.D.5 were calculated according to Table 5.3.

Table 5.3 Summary of source category description, CRF 3.A, 3.B, and 3.D.5

Emissions	Period	Method	EF
NMVOC, CO_2	1990-2004	T1	CS
	2005-2012	T3	CS

5.2.2 Methodological issues

From the 1990ties till 2004 statistics for CRF 3.A, 3.B and 3.D.5 was not well kept due to the country-wide changes in governmental system and national economy. For 2005-2012 all activity data was obtained from the Chemical Register (CR) at Ltd. Latvian Environment, Geology and Meteorology Centre (Table 5.5). In CR data of imported and produced amount of chemical products containing NMVOCs is collected together with the percentage of a particular NMVOC in imported or produced products. It is assumed that the NMVOC containing products imported in the country in a particular year are utilized in the same year as the data of the actual use is not available or is confidential. In CR information on a particular year, amount of produced and imported chemicals (ton), NACE code, trade name, chemical name, CAS number and concentration (from … till %) is provided.

Table 5.4 Activity data for Paint Application (CRF 3.A), Degreasing and Dry Cleaning (CRF 3.B) and Other (CRF 3.D.5) in 2005-2012 (Gg)

	2005	2006	2007	2008	2009	2010	2011	2012
3.A	11.68	17.06	24.60	13.66	23.18	20.13	16.98	21.32
3.B	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01
3.D.5.1	0.00	0.47	0.52	0.47	0.12	0.55	0.50	0.04
3.D.5.2	8.04	13.01	16.30	58.70	22.89	31.65	12.44	11.48
3.D.5.3	12.38	17.73	21.07	18.09	18.61	28.19	13.23	26.02

The average content of NMVOC in NMVOC containing product is calculated by arithmetic average and is presented in mass percentage. The percentage content is used as NMVOC emission factor. NMVOC emissions (Gg) from Solvent and Other Product Use were calculated for the time series 1990-2012 using the equation below.

$$E_{NMVOC} = EF_{NMVOC} \times AD$$

where:

E_{NMVOC} – non-methane volatile organic compounds emissions from solvents and other production use (Gg);

EF_{NMVOC} – emission factor is assumed as the average percentage of a particular NMVOC in NMVOC containing product;

AD – activity data from Chemical Register, Gg.

To obtain a comparable data in time series for years 1990-2004 NMVOC emissions were calculated using the same methodology as for years 2005-2012. Assuming that base year for NMVOC emissions is year 2005, NMVOC emissions for years 1990-2004 were calculated proportionally, taking into account the number of inhabitants provided by the Central Statistical Bureau (Table 5.5). Therefore Implied emission factor (IEF) depends on the amount of NMVOC containing products in particular year (activity data varies year to year).

Table 5.5 The number of population is used as activity data under CRF 3.A, 3.B and 3.D.5 for years 1990-2005

Year	Population
1990	2 668 140
1991	2 658 161
1992	2 643 000
1993	2 585 675
1994	2 540 904
1995	2 500 580

Year	Population
1996	2 469 531
1997	2 444 912
1998	2 420 789
1999	2 399 248
2000	2 381 715
2001	2 353 384
2002	2 320 956
2003	2 299 390
2004	2 276 520
2005	2 249 724

Indirect CO_2 eq (Gg) emissions (from CRF 3.A, 3.B, 3.D.5) were calculated from NMVOC emissions for the time series 1990-2012 using the equation below.

$$Emissions_{CO2} = Emissions_{NMVOC} \times Percent\ carbon\ in\ NMVOCs\ by\ mass \times 44.0098/12.011$$

It was assumed that the average carbon content is 60% by mass for all categories under the sector of Solvent and Other Product Use in accordance with the 2006 IPCC Guidelines. As described in the Guidelines, the used fossil carbon content fraction of NMVOC is based on limited and published national analyses of speciation profile.

5.2.3 Uncertainties and time series consistency

Uncertainty of available activity data under CRF 3.A, 3.B and 3.D.5 sub-sector was ±2% in 2012. Emission factor uncertainty is assumed to be 75%. Time series consistency was ensured by using one method for all time series.

5.2.4 Source-specific QA/QC and verification

QA/QC procedures according to the IPCC GPG 2000 Tier 1 method for Solvent and Other Product Use sector were performed. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.
In year 2013 Solvent and Other Product Use sector was checked by third part expert and taking into account suggestions were carried out recalculations under CRF 3.A, 3.B and 3.D.5 sub-sector.

5.2.5 Source-specific recalculations

For period 1990-2012 recalculations have been carried out under CRF 3.A, 3.B and 3.D.5 mainly due to two reasons. The first one is that the list of NMVOCs substance is supplemented, therefore recalculations are carried out for all time series. The second reason is that the time series consistency is performed using one method for all time series.

5.2.6 Source-specific planned improvements

It is planned to obtain much more activity data from „Chemical Register" to ensure completeness of the next submission. To achieve results it is necessary to supplement the list of NMVOC substances.

5.3 CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING (CRF 3.C)

5.3.1 Source category description

This sector covers NMVOC emissions from the use of chemical products taking into account many activities such as polyurethane and polystyrene foam processing, speciality organic chemical industry, manufacture of paints, inks and glues, fat edible and non-edible oil extraction and industrial application of adhesives as described by EMEP/EEA air pollutant emission inventory guidebook – 2009.

Indirect CO_2 emissions from NMVOC emissions under CRF 3.C according to Table 5.6.

Table 5.6 Summary of source category description, CRF 3.C

Emissions	Period	Method	EF
NMVOC, CO_2	1990-2003	T1	CS
	2004-2012	T3	CS

5.3.2 Methodological issues

From the 1990ties till 2003 statistics for CRF 3.C also was not well kept due to the country-wide changes in governmental system and national economy. For 2004-2012 all NMVOC emissions data is obtained directly from database "2-Air" at Ltd. Latvian Environment, Geology and Meteorology Centre. "2-AIR" is database where enterprises (that do any pollution activity and have category A, B, or C polluting activity) report their emissions data; it is approximately 3000 enterprises in total every year. From these approximately 3000 enterprises data is used only from the enterprises that produced NMVOC emissions according to EMEP/EEA air pollutant emission inventory guidebook – 2009. The enterprises have been reporting their produced NMVOC emissions dividing in a particular NMVOC. Activity data for time period 2004-2012 reported by enterprises is not available as these data is not required to be reported and could be assumed as confidential.

To obtain a comparable data in time series for years 1990-2003 it was assumed that base year for NMVOC emissions is year 2004, NMVOC emissions for years 1990-2003 were calculated proportionally, taking into account the number of inhabitants provided by the Central Statistical Bureau (Table 5.5).

Indirect CO_2 eq (Gg) emissions from CRF 3.C were calculated from NMVOC emissions (Gg) for the time series 1990-2012 using the equation below.

$$Emissions_{CO2} = Emissions_{NMVOC} \times Percent\ carbon\ in\ NMVOCs\ by\ mass \times 44.0098/12.011$$

It was assumed that the average carbon content is 60% by mass for all categories under the sector of Solvent and Other Products Use in accordance with the 2006 IPCC Guidelines. As described in the Guidelines, the used fossil carbon content fraction of NMVOC is based on limited and published national analyses of speciation profile.

5.3.3 Uncertainties and time series consistency

Uncertainty of available activity data under CRF 3.C sub-sector was ±3% in 2012. Emission factor uncertainty is assumed to be 20%. Time series consistency was ensured by using one method for all time series.

5.3.4 Source-specific QA/QC and verification

QA/QC procedures according to the IPCC GPG 2000 Tier 1 method for Solvent and Other Product Use sector were performed. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.
In year 2013 Solvent and Other Product Use sector was checked by third part expert and taking into account suggestions were carried out recalculations under CRF 3.C.

5.3.5 Source-specific recalculations

For period 1990-2012 recalculations have been carried out under CRF 3.C mainly for two reasons. The first one is that the list of NACE code is supplemented therefore recalculations are carried out for all time series. The second reason is that the time series consistency is performed using one method for all time series.

5.3.6 Source-specific planned improvements

It is planned to obtain much more activity data from „Air-2” to ensure completeness of the next submission. To achieve results it is necessary to supplement the list of NACE code and particular NMVOC emitted substances.

5.4 USE OF N_2O IN ANAESTHESIA (CRF 3.D.1)

5.4.1 Source category description

The N_2O emissions under CRF 3.D.1 are from Use of N_2O in Anaesthesia. N_2O emissions from anaesthesia formed a negligible part of total Solvent and Other Product Use, in 2012 these emissions totalled 0.005 Gg CO_2 eq.

5.4.2 Methodological issues

N_2O emissions from N_2O used in anaesthesia were estimated taking into account the amount of N_2O sold. According to the 2006 IPCC Guidelines, it was assumed that 100% of N_2O sold for anaesthesia was emitted to the air, therefore activity data is equal to estimated emissions. The data on the N_2O sales was available since 1995. Activity data was provided by the State Agency of Medicines of Latvia. The estimation of emissions is based on the assumption that all used N_2O is emitted to the atmosphere in the same year when it is produced or imported in Latvia.

To obtain a comparable data in time series for years 1990-1994 assume that base year for NMVOC emissions is year 1995, N_2O emissions for years 1990-1994 were calculated proportionally, taking into account the number of inhabitants provided by the Central Statistical Bureau (Table 5.5).

5.4.3 Uncertainties and time series consistency

Uncertainty of available activity data under CRF 3.D.1 sub-sector was ±2% in 2012. Emission factor uncertainty is assumed to be 2%. Time series consistency was ensured by using one method for all time series.

5.4.4 Source-specific QA/QC and verification

QA/QC procedures according to the IPCC GPG 2000 Tier 1 method for Solvent and Other Product Use sector were performed. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived.
In year 2013 Solvent and Other Product Use sector was checked by third part expert and taking into account suggestions were carried out recalculations under CRF 3.D.1.

5.4.5 Source-specific recalculations

For period 1990-2012 recalculations have been carried out under CRF 3.D.1 mainly due to two reasons. The first one is that during QA/QC procedures mistakes in calculation of activity data were found and therefore recalculation was performed. The second reason is that the time series consistency is performed using one method for all time series.

5.4.6 Source-specific planned improvements

No improvements are planned under CRF 3.D.1.

5.5 REFERENCES

- IPCC 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Hayama: IPCC and IGES. http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm.
- IPCC GPG 2000 - IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000);
- EMEP/EEA (2009). EMEP/EEA air pollutant emission inventory guidebook 2009. Technical guidance to prepare national emission inventories. Technical report No 9/2009.
- Implementation of QC procedures in Latvian GHG inventory (for Industrial processes and Solvents and Other Product Use) – the report of third part expert Janis Rekis.
- Register of Chemical Substances and Chemical Mixtures;
- Database "2-Air";
- Data from State Agency of Medicines;
- Data from Central Statistical Bureau.

6. AGRICULTURE (CRF 4)

6.1 OVERVIEW OF SECTOR

6.1.1 Overview of greenhouse gas emissions

The emissions of greenhouse gases (GHG) from agriculture sector in Latvia include: 1) emissions of CH_4 (methane) from enteric fermentation of domestic livestock and manure management;
2) emissions of N_2O (nitrous oxide) from manure management and agricultural soils. Emissions from agricultural soils include direct N_2O emissions (application of synthetic N-fertilizer, animal manure application to soils, biological nitrogen fixation of N-fixing crops, crop residues and cultivation of organic soils) and indirect N_2O emissions (atmospherics deposition and nitrogen leaching and run-off).

Rice cultivation (4 C) and savannas (4 E) are not typical for Latvia; therefore these categories are reported as "NO" in CRF tables. Legislative measures and agricultural residue management practices prohibit field burning of agricultural residues in Latvia. This is explained by Latvian Administrative Violations Code Section 179 Violation of Fire Safety Regulations[71], therefore notation key "NO" is used in CRF tables under category 4 F. The calculation of emissions is based on *Revised 1996 IPCC Guidelines* and *IPCC GPG Guidelines 2000* methodology. Detailed information about methods is described under each subcategory.

In 2012, agriculture sector contributed 2424.30 Gg CO_2 eq. (equivalents) which was approximately 22% of total national emissions and it was the second largest source of GHG emissions in Latvia. Nitrous oxide emissions contributed 67% (1636.16 Gg CO_2 eq.), but CH_4 emissions contributed remaining 32% (784.14 Gg CO_2 eq.) of total GHG emissions from agricultural sector. 87% of total methane emissions from agriculture sector resulted from enteric fermentation and 13% from manure management. The major portion (almost 92%) of agriculture sector total nitrous oxide emissions resulted from direct-indirect emissions; only 8% of total nitrous oxide emissions were contributed from manure management. The share of GHG emissions by subcategories in agriculture sector in 2012 is presented in Figure 6.1.

[71] Available at http://www.likumi.lv/doc.php?id=89648

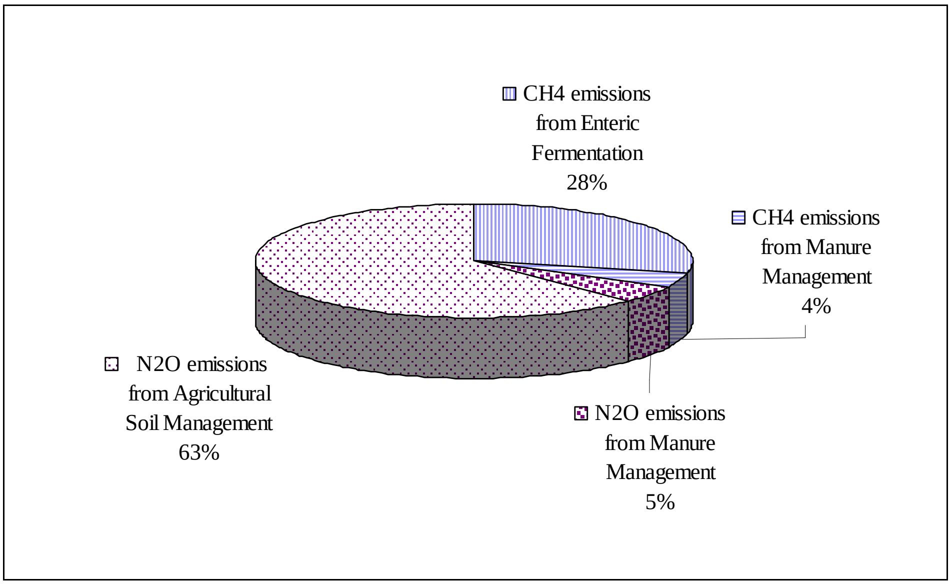

Figure 6.1 The share of GHG emissions by subcategories in agriculture sector, 2012 (%)

GHG emissions increased in 2012 by 4.3%, if to compare with 2011. However, the annual emissions have reduced approximately by 60% since 1990 due to decreases in the number of livestock, nitrogen fertilization and etc. (Table 6.1, Figure 6.2).

Table 6.1 Greenhouse gas emissions (Gg CO_2 eq.) in the agricultural sector, 1990– 2012

Year	CH_4	N_2O	Total
1990	2351.75	3580.79	5932.54
1991	2242.05	3321.16	5563.21
1992	1827.80	2544.32	4372.12
1993	1136.94	1771.94	2908.88
1994	972.74	1536.81	2509.55
1995	955.21	1356.31	2311.52
1996	904.14	1338.59	2242.73
1997	887.91	1343.79	2231.70
1998	822.26	1294.00	2116.25
1999	715.23	1215.88	1931.11
2000	717.98	1239.12	1957.11
2001	758.73	1343.66	2102.39
2002	754.85	1311.77	2066.62
2003	751.43	1383.25	2134.68
2004	728.89	1354.70	2083.59
2005	752.63	1423.25	2175.88
2006	749.60	1419.89	2169.49
2007	783.28	1478.01	2261.29
2008	756.80	1468.53	2225.32
2009	752.37	1504.75	2257.11
2010	759.92	1567.45	2327.37
2011	761.67	1559.53	2321.21
2012	784.14	1636.16	2420.30

Some inter-annual variation between the years can be noticed from the time series mainly caused by fluctuation in activity data between the years because of changes in animal numbers, which is significantly affected by economical situation in country as well as agricultural policy. Methane and nitrous oxide 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. Nitrous oxide 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 have large variation between the years.

The major part of emissions from agriculture in Latvia originates from agricultural soils. The share of these emissions during 1990-2012 increased from 50 to 62%. Second the most important source of emissions is enteric fermentation. The share of enteric fermentation emissions from1990 to 2012 decreased to 28%, however in the beginning of 90`s the share of enteric fermentation emissions was close to 40%. Less significant part of total agriculture emissions is relevant to manure management. The share of these emissions in the beginning of 90`s was around 14% and they decrease to 9% in 2012 (Figure 6.2).

Emissions from agriculture noticeably decreased in the beginning of 90`s after Soviet system and large state, or collective farms collapsis. However, in recent years there is possible to observe a slight increase of sown area, consumption of synthetics N-fertilizers and non-dairy, sheep and poultry numbers. State efforts to improve animal waste management systems (AWMS) and expansion of anaerobic digester production as AWMS in the largest farms is main reason that reduces the increase of emissions from manure management in the last years.

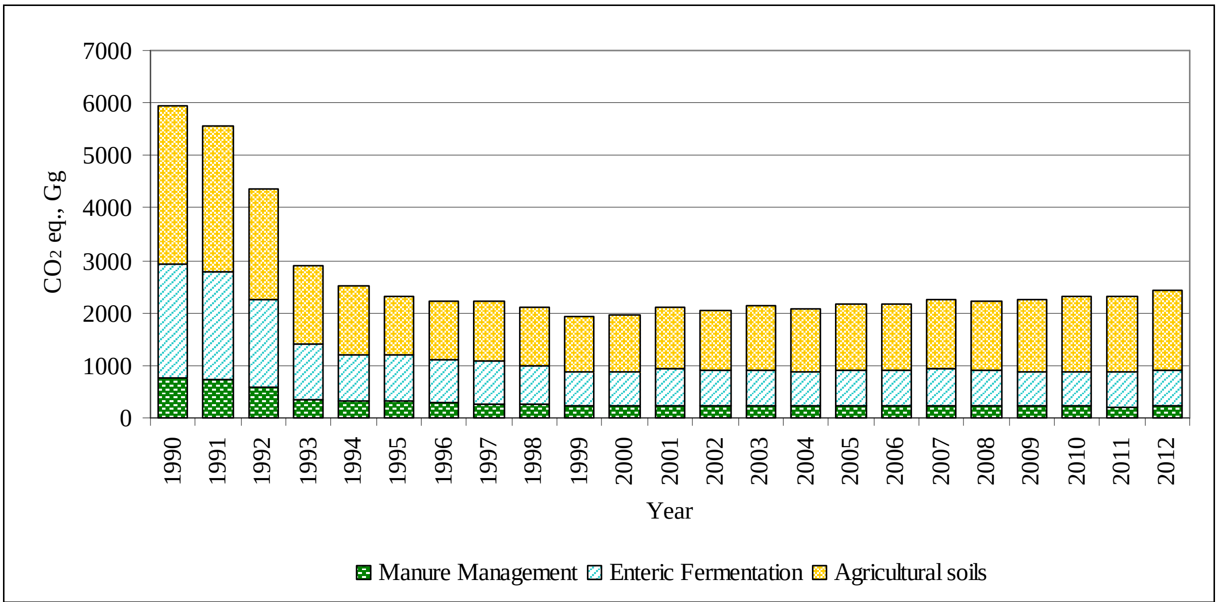

Figure 6.2 Trends of emissions by category within the sector, 1990-2012 (Gg, CO_2 eq.)

6.1.2 Sources of information and activity data

Numbers of cattle, sheep, goats, horses, swine and poultry population, as well as data on milk production and fat content in milk are obtained from the CSB (Central Statistical Bureau) of Latvia Database and statistical yearbooks[72]. Similarly like numbers of domestic livestock, also statistical information about amounts of nitrogen (N) synthetic fertilizers application and

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crop production is obtained from CSB database. The distribution of different manure management systems is adopted from national studies in two periods:
1) 1990-1999 according to research made by Latvian State Institute of Agrarian Economics (LSIAE, 2005);
2) 2000-2012 according to research activities provided by Latvia University of Agriculture[73]. Numbers of cultivated Histosols area are provided by Latvian State Forest Research Institute "Silava".

Statistical information about livestock numbers in Latvia is included in Table 6.2.

Table 6.2 Number of livestock (thousand heads), 1990-2012

Year	Dairy cattle	Non - Dairy cattle	Sheep	Goats	Horses	Swine	Poultry
1990	535.1	904.2	164.6	5.4	30.9	1401.1	10321.1
1991	531.4	851.5	183.7	6.1	30.0	1246.5	10395.1
1992	481.7	662.6	164.7	6.4	28.4	866.5	5438.3
1993	351.0	326.9	114.0	6.3	26.2	481.8	4123.7
1994	311.9	238.9	86.3	7.4	26.8	500.7	3699.6
1995	291.9	245.2	72.2	8.9	27.2	552.8	4198.3
1996	274.6	234.8	55.5	8.4	25.8	459.6	3790.7
1997	262.8	214.1	40.7	8.9	23.3	429.9	3550.7
1998	242.1	192.3	29.4	10.5	22.0	421.1	3208.8
1999	205.6	172.8	27.0	8.1	19.0	404.9	3236.9
2000	204.5	162.2	28.6	10.4	19.9	393.5	3104.6
2001	209.1	175.6	29.0	11.5	19.6	428.7	3621.2
2002	204.6	183.5	31.5	13.2	18.5	453.2	3882.0
2003	186.3	193.3	39.2	15.0	15.4	444.4	4002.6
2004	186.2	184.9	38.6	14.7	15.5	435.7	4049.5
2005	185.2	200.0	41.6	14.9	13.9	427.9	4092.3
2006	182.4	194.7	41.3	14.3	14.0	416.8	4488.1
2007	180.4	218.3	53.9	13.0	13.0	414.4	4756.8
2008	170.4	209.8	67.1	12.9	13.1	383.7	4620.5
2009	165.5	212.7	70.7	13.2	12.6	376.5	4828.9
2010	164.1	215.4	76.8	13.5	12.0	389.7	4948.7
2011	164.1	216.5	79.7	13.4	11.5	375.0	4417.9
2012	164.6	228.5	83.6	13.3	10.9	355.2	4910.9

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 restoration of Latvian independence when most of big farms went into liquidation. Since the Soviet Union had a planned economy, most of the output of livestock products was carried out in other Soviet republics. Russian crisis almost stopped the export of livestock products. Reorientation of livestock product export to Western markets was more difficult in terms of market saturation and because the Latvian products are not necessarily in their requirements. All the above conditions affect the Latvian farmers and they were forced to reduce the milk, meat and egg production levels. Consequently, livestock numbers declined most rapidly in 1990-1994 in all sectors, except for goat farming. In the case of stud-farms - all the above-mentioned social and economic changes lead to eliminating of stud-farms, the horses were sold, only the strongest stud-farms continued to work. Starting with 2002 the

73 Rivža P. u.c. Lauksaimniecības rādītāju prognoze 2015. un 2020. gadam. Latvijas Republikas Zemkopības ministrija. Latvijas Lauksaimniecības universitāte. 2011

number of animals has stabilized, but with 2004, according to Latvian accession to the European Union, the increase in the number of animals is characteristic for beef cattle, sheep, goat and poultry industries. The livestock sector has contributed to the development of European Union agricultural subsidies and public sectors.

Statistical information about crop production in Latvia is included in Table 6.3.

Table 6.3 Crop production (thousand t) statistics for calculation of nitrous oxide emissions1990-2012

Year	Wheat	Barley	Triticale	Maize for silage and forage	Oats	Rye	Crops for green feed and silage	Rape	Mixed cereals and pulses	Buck-wheat	Potatoes	Sugar beet	Feedbeet	Vegetable	Peas and beans
1990	371.8	697	-	967.3	176.1	323.6	952.8	3.7	30.7	0.0	1016.1	439.1	1388.4	169.4	22.7
1991	190.2	764.9	7.4	785	177.2	145.8	894.1	0.9	29.3	0.0	944	377.9	1211.8	209.2	20.7
1992	432.4	433.5	8.6	317.5	60.0	295.0	442	1.4	13.3	0.0	1167.4	462.6	901.5	250.8	8.6
1993	338.3	455.5	13.6	137.6	73.7	340.7	341.6	2.5	8.8	0.1	1271.7	298	859	284.8	4.3
1994	199.4	481.1	5.6	26.5	88.9	113.4	206.6	1.8	7.6	0.1	1044.9	228.2	687.2	233.2	4.5
1995	243.7	284	4.9	13.0	73.2	71.3	164.8	0.9	11.9	0.0	863.7	250	432.7	223.7	4.7
1996	357.5	371.5	3.4	11.9	101.4	112.9	151.3	1.3	14.0	0.1	1081.9	257.8	399.1	179.5	7.8
1997	394.6	359.8	7.5	10.4	116.5	133.5	154.3	0.5	22.5	0.8	946.2	387.5	404	162.5	8.3
1998	385.3	321.7	12.6	13.3	103.6	104.8	164.3	1.6	29.3	1.6	694.1	597	347	119.6	11.3
1999	351.9	232.6	11.9	15.7	66.1	88.7	128.0	11.7	16.2	2.2	795.5	451.5	235.1	130.1	3.6
2000	427.4	261.1	13.5	24.1	79.6	110.7	137.6	10.0	25.4	5.9	747.1	407.7	222.3	105.8	3.9
2001	451.7	231.1	28.9	25.1	82.4	107.2	98.0	13.0	16.9	9.8	615.3	491.2	203.0	159.3	4.0
2002	519.5	262.4	40.9	25.7	79.7	101.5	98.4	32.7	16.2	8.3	768.4	622.3	153.7	148.2	4.2
2003	468.4	246.6	33.0	44.3	78.3	87.6	140.3	37.4	13.1	5.4	739.0	532.4	158.5	217.5	5.0
2004	499.9	283.5	42.1	52.8	107.4	96.8	148.5	103.6	22.9	6.9	628.4	505.6	130.1	180.8	4.5
2005	676.5	365.8	31.8	58.0	122.0	87.2	112.1	145.7	21.1	9.9	658.2	519.9	88.3	172.2	3.5
2006	598.3	307.0	22.2	63.8	91.6	116.8	110.7	120.6	15.9	6.9	550.9	473.9	61.4	174.4	1.4
2007	807.3	350.5	37.9	122.6	130.2	181.1	148.6	196.9	17.1	11.1	642.1	11.0	53.2	155.9	2.6
2008	989.6	307.1	35.2	125.3	141.5	194.9	109.9	198.5	14.0	7.1	673.4	-	22.4	143.2	2.9
2009	1036.4	265.4	33.3	226.6	141.4	162.2	90.7	204.7	19.6	4.8	525.4	-	17.6	182.5	5.2
2010	989.3	228.5	26.4	209.0	100.6	70.2	82.6	226.3	15.0	5.5	484.3	-	20.4	151.0	5.4
2011	939.5	236.7	21.4	345.6	120.9	64.0	84.0	219.1	19.9	9.6	498.6	-	14.8	168.2	8.4
2012	1539.8	248.6	48.8	553.7	137	124.2	167.7	303.5	18.1	8	538.9	-	17.4	161.4	11.1

Statistical surveys are the source of data on crop production in commercial companies, private farms and individual merchants. 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.

Agricultural statistics data fully comply with criteria determined by the EU and precision requirements determined in the legislative acts. The Project Documentation System (ADS) is established at CSB. It is quality metadata system for internal and external users. There are methodological descriptions of all statistical surveys and calculation. Annual samples are made up as stratified simple samples. Holdings are selected by economic size (standard output - SO) and type of farming. Standard output is standard indicator characterizing the economic activity of agricultural holding, i.e., value acquired from one hectare of agricultural crops or one livestock head (unit), estimated at prices of corresponding region and expressed in EUR. Total standard output characterise the economic size of the holding in monetary terms. Farms with SO >= 50000 EUR are included for 100% statistical surveys; farms with 2000 EUR<SO < 50000 EUR are selected by economic size and type of farming. Sample size for annual sample (Crop and Animal survey) includes 5.1 thousand holdings. Small holdings with SO < 2000 EUR are not included in annual Crop and Animal surveys, but information for these holdings is estimated using expert's method. For this estimation CSB uses information from Agricultural Censuses and surveys of small farms, which are organized between Censuses. Crop and livestock statistics quality reports are available on CSB web page[74;75].

Other statistical data are included in relevant subchapters.

6.2 ENTERIC FERMENTATION (CRF 4.A)

6.2.1 Source category description

Methane (CH_4) is emitted as a by-product of the normal livestock digestive process, in which microbes resident in the animal's digestive system ferment the feed consumed by the animal. This fermentation process is also known as enteric fermentation[76]. Ruminant livestock (cattle, sheep and goats) are primary source of methane 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.

The emission source covers domestic livestock. Latvia reports emissions from cattle (including dairy cows), swine, horses, goats and sheep (Table 6.4). Emissions from poultry have not been estimated. According to *Revised 1996 Guidelines for National Greenhouse Gas Inventories* methane emissions relevant to poultry are negligible.

Table 6.4 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 Lamas	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

Cattle are the largest source of enteric methane emissions (96% from total methane emissions from enteric fermentation) in Latvia. In 2012, methane emissions from enteric fermentation of domestic livestock increased by 0.92 Gg, if to compare with 2011. This is caused by the increase of the number of non-dairy cattle and sheep by approximately 5%. Since 1990 generally due to evident fall of the number of cattle, emissions decreased by 68% (Table 6.5).

[74] http://www.csb.gov.lv/sites/default/files/quality_report_on_annual_crop_statistics_2010_0.pdf
[75] http://www.csb.gov.lv/sites/default/files/quality_report_on_livestock_and_meat_statistics_2010_0.pdf
[76] IPCC GPG, 2000

Table 6.5 Methane emissions from Enteric Fermentation by animal type in 1990–2012 (Gg)

Year	Dairy cattle	Non-Dairy cattle	Sheep	Goats	Horses	Swine	Total, CH_4	Total, CO_2 eq.
1990	51.14	47.18	1.32	0.03	0.56	2.10	102.32	2148.74
1991	49.50	44.43	1.47	0.03	0.54	1.87	97.84	2054.65
1992	42.80	34.58	1.32	0.03	0.51	1.30	80.54	1691.24
1993	31.00	17.06	0.91	0.03	0.47	0.72	50.19	1054.03
1994	28.13	12.47	0.69	0.04	0.48	0.75	42.56	893.80
1995	26.79	12.80	0.58	0.04	0.49	0.83	41.53	872.05
1996	25.67	12.25	0.44	0.04	0.46	0.69	39.56	830.79
1997	26.33	11.17	0.33	0.04	0.42	0.64	38.93	817.61
1998	24.62	10.03	0.24	0.05	0.40	0.63	35.97	755.34
1999	20.89	9.02	0.22	0.04	0.34	0.61	31.11	653.33
2000	20.96	8.52	0.23	0.05	0.36	0.59	30.71	644.84
2001	21.80	9.21	0.23	0.06	0.35	0.64	32.29	678.17
2002	21.11	9.63	0.25	0.07	0.33	0.68	32.07	673.47
2003	20.53	10.14	0.31	0.08	0.28	0.67	32.01	672.17
2004	19.89	9.70	0.31	0.07	0.28	0.65	30.90	648.86
2005	20.14	10.48	0.33	0.07	0.25	0.64	31.92	670.36
2006	20.10	10.18	0.33	0.07	0.24	0.63	31.55	662.54
2007	20.23	11.40	0.43	0.07	0.23	0.62	32.99	692.75
2008	19.45	10.95	0.54	0.06	0.24	0.58	31.81	667.96
2009	19.04	11.09	0.57	0.07	0.23	0.56	31.55	662.51
2010	19.05	11.21	0.61	0.07	0.22	0.58	31.73	666.43
2011	19.08	11.27	0.64	0.07	0.21	0.56	31.83	668.36
2012	19.40	11.88	0.67	0.07	0.20	0.53	32.74	687.58
Share of total % in 2012	59.24%	36.29%	2.04%	0.20%	0.60%	1.63%	100%	+3% versus 2011

6.2.2 Methodological issues

The Tier 1 approach relies on default emissions factors. For Tier 1, countries are required to collect data on the average number of animals for each animal group. The Tier 2 approach is more complex than Tier 1 because it draws upon country-specific information on animal and feed characteristics. The Tier 2 approach is recommended to estimate methane emissions for countries with large cattle and sheep populations.

Emissions from enteric fermentation of domestic livestock in Latvia have been calculated by using the *IPCC* Tier 1 and Tier 2 methodologies presented in the *Revised 1996 IPCC* and the *IPCC GPG 2000*. Methane emissions from enteric fermentation for horses, swine, sheep 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 as shown in *IPCC GPG 2000* equation 4.12:

$$Emissions\ CH_4 = EF * population / (10^6\ kg/Gg)$$

The default emission factors as for developed countries according to *Revised 1996 IPCC* (Table 4-3, page 4.10) were used to calculate methane emissions from enteric fermentation for sheep, goats, horses and swine (Table 6.6).

Table 6.6 Default methane emission factors from Enteric Fermentation

Types of animals	EF (kg/head/year)
Sheep	8
Goats	5
Horses	18
Swine	1.5

The contribution of emissions from horses, swine, sheep and goats to the total emissions from enteric fermentation is less significant, therefore default Tier 1 was applied. The Tier 2 method has been used for cattle, because emissions from cattle make the biggest part of total agricultural sector methane emissions. With the Tier 2 method methane emissions have been calculated as in the Tier 1 method mentioned above, but the emission factors for dairy cattle and non-dairy cattle has been calculated according to Equation 4.14 in the *IPCC GPG 2000*:

$$EF = (GE * Ym * 365\ days/year)/(55.65\ MJ/kg\ CH_4)$$

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).

For cattle, the gross energy intake (GE) has been calculated by using the *IPCC GPG 2000* methodology by using a slightly modified version of Equation 4.11:

$$GE = \{[NEm + NEa + NE_l + NEp) /(NEma/DE)] + [(NEg) / (NEga / DE)]\} / (DE / 100)$$

where:

NEm = Net energy for maintenance, MJ/day;
NEa = Net energy for activity, MJ/day;
NE_l = Net energy for lactation, MJ/day (dairy cattle);
NEp = Net energy required for pregnancy, MJ/day (dairy cattle, corrected on 80% according to IPCC GPG 2000);
NEma/DE = ratio of net energy available in a diet for maintenance to digestible energy consumed;
NEg = Net energy for growth, MJ/day;
NEga/DE = Ratio of net energy available for growth in a diet to digestible energy consumed;
DE = Digestible energy expressed as a percentage of gross energy.

The equations for calculating *NEm* (Equation 4.1, 2000 IPCC GPG), *NEa* (Equation 4.2.a, 2000 IPCC GPG), *NE_l* (Equation 4.5.a, 2000 IPCC GPG), *NEp* (Equation 4.8, 2000 IPCC GPG), *NEg* (Equation 4.3.a, 2000 IPCC GPG), *NEma/DE* (Equation 4.9, 2000 IPCC GPG) *and NEga/DE* (Equation 4.10, 2000 IPCC GPG) are:

$$NEm = Cfi * (Weight)^{0.75}$$

$$NEa = [Cap * (tp / 365) + Cao * (1 - (tp / 365))] * NEm$$

$$NE_l = My / 365 * 1.47 + 0.40 * Fat)$$

$$NEp = Cp * NEm$$

$$NEg = 4.18 * \{0.0635 * [0.891 * (BV * 0.96) * (478 / (C * MW))]^{0.75} * (WG * 0.92)^{1.097}\}$$

$$NEma/DE = 1.123 - (4.092 * 10^{-3} * DE) + [1.126 * 10^{-5} * (DE)^2] - (25.4/DE)$$

$$NEga/DE = 1.164 - (5.160 * 10^{-3} * DE) + (1.308 * 10^{-5} * (DE)^2) - (37.4/DE)$$

where,

Cfi = Maintenance coefficient;
Weight = Animal weight, kg;
tp = Length of pasture season, days;
Cap = Coefficient corresponding to animal's feeding situation for pasture;
Cao = Coefficient corresponding to animal's feeding situation for stall;
My = Amount of milk produced per year, kg /cow;
Fat = Fat content in milk, %;
Cp = Pregnancy coefficient;
C = Coefficient related to growth;
BV = Live body weight of the animal, kg;
MW = Mature weight, kg;
WG = Daily weight gain, kg/day;
DE = Feed digestibility, %.

Detailed information about applied coefficients and other parameter values for calculation of cattle GE, as well as sources of information are summarized in Table 6.7.

Table 6.7 Input data for gross energy intake calculation

Parameter	Symbol	Dairy cattle	Non-Dairy cattle	Comments
Maintenance coefficient	Cfi	0.335	0.322	Table 4.4, 2000 IPCC GPG
Coefficient corresponding to animal's feeding situation (pasture)	Cap	0.17	0.17	Table 4.5, 2000 IPCC GPG
Coefficient corresponding to animal's feeding situation (stall)	Cao	0	0	Table 4.5, 2000 IPCC GPG
Pregnancy coefficient	Cp	0.1	-	Table 4.7, 2000 IPCC GPG
Growth coefficient	C	0.8	1.2	Page 4.15, 2000 IPCC GPG
Weight (kg)	Weight	550	500	National studies
Weight gain (kg/day)	WG	0.25	0.5	National studies
Mature weight (kg)	MW	550	500	National studies
Live body weight (kg)	BV	39	39	National studies
Feed Digestibility (%)	DE	60	60	Page 4.13, 2000 IPCC GPG
Pasture season length (days)	tp	145	185	National studies 1990-1999. From 2000 calculated based on AWMS
Milk yield (kg/cow/year)	My	Table 6.8	-	National studies
Milk fat (%)	fat	Table 6.8	-	National studies

The calculation of GE is strongly based on the milk production and fat content in milk. Trends about milk production and fat content in milk are presented in Table 6.8. Values of milk fat contend for 1990-1997 is based on national expert judgment; all other information comes from CSB.

Table 6.8 Average milk yield per cow (kg/head/year) and fat content (%)

Year	Average milk yield	Fat content
1990	3437	3.50
1991	3205	3.50
1992	2793	3.50
1993	2741	3.50
1994	2923	3.50
1995	3074	3.50
1996	3237	3.50
1997	3585	4.09
1998	3733	4.06
1999	3754	4.00
2000	3898	4.08
2001	4055	4.08
2002	3958	4.08
2003	4261	4.11
2004	4251	4.17
2005	4364	4.25
2006	4492	4.26
2007	4636	4.31
2008	4822	4.29
2009	4892	4.31
2010	4998	4.29
2011	5064	4.22
2012	5250	4.16

Results of calculation of GE and emission factors for dairy and non-dairy cattle from enteric fermentation are summarized in Table 6.9.

Table 6.9 Calculated average gross energy intake (MJ/head/day) and emission factors of methane emission from Enteric Fermentation (kg CH_4/head/year), 1990-2012

Year	GE for Dairy Cattle	GE for Non-Dairy Cattle	EF for Dairy Cattle	EF for Non-Dairy Cattle
1990	242.83	132.60	95.56	52.18
1991	236.69	132.60	93.14	52.18
1992	225.77	132.60	88.85	52.18
1993	224.40	132.60	88.31	52.18
1994	229.22	132.60	90.20	52.18
1995	233.22	132.60	91.78	52.18
1996	237.54	132.60	93.48	52.18
1997	254.56	132.60	100.18	52.18
1998	258.39	132.60	101.69	52.18
1999	258.16	132.60	101.60	52.18
2000	260.47	133.40	102.50	52.50
2001	264.88	133.31	104.24	52.46
2002	262.15	133.38	103.16	52.49

Year	GE for Dairy Cattle	GE for Non-Dairy Cattle	EF for Dairy Cattle	EF for Non-Dairy Cattle
2003	280.06	133.35	110.21	52.48
2004	271.39	133.27	106.80	52.44
2005	276.40	133.13	108.77	52.39
2006	280.04	132.82	110.20	52.27
2007	285.00	132.74	112.16	52.24
2008	290.00	132.60	114.12	52.18
2009	292.29	132.47	115.03	52.13
2010	294.94	132.19	116.07	52.02
2011	295.45	132.31	116.27	52.07
2012	299.43	132.14	117.84	52.00

6.2.3 Uncertainties and time series consistency

CSB assessed that for number of livestock uncertainty could be 2-3%. 2% uncertainty is used for the calculations. Emission factors estimated using the Tier 1 method may be uncertain in a range from ±30% to ±50%[77]. Emission factor estimates using the Tier 2 method are likely to be in the order of ± 20% [78].

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 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.

6.2.5 Source-specific recalculations

For 2014 submission recalculations of methane emissions from dairy cattle for period 2000-2011 are done based on ERT recommendation about different approach to calculate number of days on pasture. Same minor recalculations are done according to correction of statistical data about livestock numbers.

6.2.6 Source-specific planned improvements

Elaboration of methodology to expand calculations on age subgroups of non-dairy livestock.

6.3 MANURE MANAGEMENT (CRF 4.B)

6.3.1 Source category description

The emission sources cover management of manure from domestic livestock. Latvia reports methane (CH_4) and nitrous oxide (N_2O) emissions from cattle (including dairy cows), swine, horses, goats, sheep and poultry (Table 6.10). When organic matter in livestock manure decomposes in anaerobic environment, methanogenic bacteria produce methane. The amount

[77] IPCC GPG 2000, p. 4.27
[78] IPCC GPG 2000, p. 4.28

of methane produced from manure depends on livestock type and diet, special feeding and digestibility of food, as well as waste management system. The nitrous oxide estimated in this section is the N_2O produced during the storage and treatment of manure before it is applied to land. Production of nitrous oxide during storage and treatment of animal wastes occur via combined nitrification-denitrification of nitrogen in animal waste.

Table 6.10 Reported emissions under the subcategory Manure Management

CRF	Source	Emissions reported
4.B 1	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 Lamas	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

Methane emissions from manure management have decreased by 51%, but nitrous oxide emissions by 78% over the time period 1990-2012 (Table 6.11, Table 6.12). In 2012, methane emissions from manure management of domestic livestock increased by 0.16 Gg, if to compare with 2011. Nitrous oxide emissions in 2012 increased by 0.01 Gg compared to 2011. The fluctuation of emissions is related to the variation of animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of animal waste management systems (AWMS).

Table 6.11 Methane emissions from Manure Management by animal type, 1990-2012 (Gg)

Year	Dairy cattle	Non-Dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total, CH_4	Total, CO_2 eq.
1990	2.00	1.18	0.03	0.00	0.04	5.60	0.81	9.67	203.01
1991	1.94	1.11	0.03	0.00	0.04	4.99	0.81	8.92	187.40
1992	1.67	0.87	0.03	0.00	0.04	3.47	0.42	6.50	136.55
1993	1.21	0.43	0.02	0.00	0.04	1.93	0.32	3.95	82.90
1994	1.10	0.31	0.02	0.00	0.04	2.00	0.29	3.76	78.94
1995	1.05	0.32	0.01	0.00	0.04	2.21	0.33	3.96	83.16
1996	1.00	0.31	0.01	0.00	0.04	1.84	0.30	3.49	73.35
1997	1.03	0.28	0.01	0.00	0.03	1.72	0.28	3.35	70.30
1998	0.96	0.25	0.01	0.00	0.03	1.68	0.25	3.19	66.92
1999	0.82	0.23	0.01	0.00	0.03	1.62	0.25	2.95	61.90
2000	1.31	0.32	0.01	0.00	0.03	1.57	0.24	3.48	73.14
2001	1.42	0.36	0.01	0.00	0.03	1.72	0.28	3.82	80.18
2002	1.33	0.36	0.01	0.00	0.03	1.81	0.30	3.85	80.82
2003	1.33	0.39	0.01	0.00	0.02	1.78	0.31	3.83	80.46
2004	1.34	0.38	0.01	0.00	0.02	1.74	0.32	3.81	80.03
2005	1.42	0.43	0.01	0.00	0.02	1.71	0.32	3.92	82.27
2006	1.65	0.48	0.01	0.00	0.02	1.67	0.35	4.17	87.58
2007	1.71	0.55	0.01	0.00	0.02	1.66	0.37	4.32	90.70

Year	Dairy cattle	Non-Dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total, CH_4	Total, CO_2 eq.
2008	1.75	0.55	0.01	0.00	0.02	1.53	0.36	4.23	88.84
2009	1.78	0.58	0.01	0.00	0.02	1.51	0.38	4.28	89.86
2010	1.84	0.63	0.01	0.00	0.02	1.56	0.39	4.45	93.50
2011	1.92	0.65	0.02	0.00	0.02	1.50	0.34	4.44	93.31
2012	2.04	0.72	0.02	0.00	0.02	1.42	0.38	4.60	96.60
Share of total % in 2012	44.30%	15.70%	0.40%	0.00%	0.40%	30.9%	8.30%	100%	+3% versus 2011

Table 6.12 Nitrous oxide emissions from Manure Management by animal type, 1990-2012* (Gg)

Year	Dairy cattle	Non-Dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total, N_2O	Total, CO_2 eq.
1990	0.68	0.75	0.02	0.00	0.02	0.25	0.12	1.84	569.75
1991	0.67	0.71	0.02	0.00	0.02	0.22	0.12	1.76	547.00
1992	0.61	0.55	0.02	0.00	0.02	0.15	0.06	1.42	438.86
1993	0.44	0.27	0.01	0.00	0.02	0.09	0.05	0.88	273.13
1994	0.39	0.20	0.01	0.00	0.02	0.09	0.04	0.75	233.88
1995	0.37	0.20	0.01	0.00	0.02	0.10	0.05	0.75	232.02
1996	0.35	0.19	0.01	0.00	0.02	0.08	0.04	0.69	215.06
1997	0.33	0.18	0.00	0.00	0.02	0.08	0.04	0.65	201.57
1998	0.31	0.16	0.00	0.00	0.02	0.07	0.04	0.60	185.49
1999	0.26	0.14	0.00	0.00	0.01	0.07	0.04	0.53	164.55
2000	0.28	0.09	0.00	0.00	0.01	0.07	0.05	0.52	160.59
2001	0.29	0.10	0.00	0.00	0.01	0.07	0.06	0.54	166.59
2002	0.28	0.11	0.00	0.00	0.01	0.06	0.07	0.54	167.01
2003	0.26	0.11	0.00	0.00	0.01	0.06	0.07	0.51	157.93
2004	0.25	0.11	0.00	0.00	0.01	0.05	0.07	0.49	153.43
2005	0.24	0.11	0.01	0.00	0.01	0.04	0.07	0.50	153.68
2006	0.23	0.11	0.01	0.00	0.01	0.03	0.08	0.47	145.74
2007	0.22	0.12	0.01	0.00	0.01	0.03	0.08	0.48	148.76
2008	0.21	0.11	0.01	0.00	0.01	0.03	0.08	0.45	140.68
2009	0.20	0.11	0.01	0.00	0.01	0.02	0.09	0.45	138.75
2010	0.19	0.11	0.01	0.00	0.01	0.02	0.06	0.42	129.61
2011	0.19	0.11	0.01	0.00	0.01	0.02	0.05	0.39	122.13
2012	0.19	0.11	0.01	0.00	0.01	0.02	0.05	0.40	123.24
Share of total % in 2012	47.15%	28.75%	3.44%	0.96%	2.07%	4.96%	12.67%	100.00%	+1% versus 2011

***emissions from pasture not included, they are reported under 4.D Agricultural soils

6.3.2 Methodological issues

The *IPCC Guidelines* include two tiers to estimate methane emissions from livestock manure. The Tier 1 approach requires livestock population data by animal species/category and climate region in order to estimate emissions. The Tier 2 approach requires detailed information on animal characteristics and the manner in which manure is managed; it is encouraged to be used for countries where a particular livestock species/category represents a significant share of emissions.

The process of developing Tier 2 emission factors involves determining the mass of volatile solids excreted by the animals (VS, in kg) along with the maximum methane producing capacity for the manure (Bo, in m3/kg of VS). In addition, a methane conversion factor (MCF) that accounts for the influence of climate on methane production must be obtained for each manure management system[79].

Methane emissions from manure management for sheep, goats, horses, swine and poultry are calculated by multiplying the number of the animals in each category with the default emission factor for each category according to Equation 4.15 in the *IPCC GPG 2000:*

$$Emissions\ CH_4 = Emission\ Factor * population / (10^6\ kg/Gg)$$

Mainly default emission factors according to Revised 1996 IPCC (Tables 4-5, 4-6 pages 4.12-4.13) were used to calculate methane emissions from manure management. Emission factors as for *cool* climate region were chosen (Table 6.13).

Table 6.13 Methane emission factors from Manure Management

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

For dairy cattle and non-dairy cattle the Tier 2 approach was used for estimating methane emissions from manure management systems as dairy cattle's represent a significant share of emissions. This method requires detailed information on animal characteristics and the manner in which manure is managed.

Tier 2 emission factors (for defined livestock population, kg) were developed for period 1990-2012 (Table 6.14) according to *IPCC GPG 2000*, Equation 4.17:

$$EF = VS * 365\ days/year * Bo * 0.67\ kg/m3 * \Sigma(MCF * MS)$$

where,

VS = daily VS excreted for an animal within defined population, kg;
Bo = maximum CH_4 producing capacity for manure produced by an animal within defined population, m3/kg of VS (0.24 for dairy cattle and 0.17 for non-dairy cattle);
MCF = CH_4 conversion factor for each manure management system by climate region (Solid Storage – 1%, Liquid Storage – 10%, Pasture/Range/Paddock – 1%; Anaerobic Digester – 0%);
MS = fraction of animal species/category manure handled using each manure system by climate region (Table 6.15-Table 6.28).

The preferred method to obtain methane producing potential values Bo values is to use data from country-specific published sources, measured with a standardised method. For Latvia country-specific Bo measurement values are not available, therefore default values are used: 0.24 for dairy cattle and 0.17 for non-dairy cattle[80]. Default Methane conversion factor MCF

[79] IPCC GPG 2000, p. 4.31
[80] Revised 1996 IPCC Guidelines (Volume 3). Reference Manual, Table B-1. p. 4.39

values provided in the *IPCC GPD 2000* Table 4.10 are included for calculations for different manure management systems: Pasture/Range/Paddock – 1%; Solid Storage – 1%, Anaerobic Digester – 0%. For Liquid Storage Latvia uses MCF 10% as noted in *Revised 1996 IPCC Guidelines Reference Manual, Table 4-8*[81]. According to local expert judgement these MCF values are appropriate to manure management systems for Latvia. Evaluation of measurements of MCF for Latvia include following factors: timing of storage/application; length of storage; manure characteristics; determination of the amount of manure left in the storage facility. VS excretion rate (per day on a dry-matter weight basis, kg-dm/day) is estimated as shown in Equation 4.16 in the *IPCC GPG 2000:*

$$VS = GE * (1\ kg\text{-}dm/18.45\ MJ) * (1 - DE/100) * (1 - ASH/100)$$

where,

GE = Estimated daily average feed intake in MJ/day (Table 6.9);
DE = Digestible energy of the feed in percent (60%);
ASH = Ash content of the manure in percent (8%).

Results of calculation of country specific emissions factors for methane emissions from manure management are included in Table 6.14.

Table 6.14 Calculated methane emission factors for Dairy and Non-Dairy cattle from Manure Management

Year	Implemented EF for Dairy-cattle	Implemented EF for Non-Dairy-cattle
1990	3.74	1.31
1991	3.64	1.31
1992	3.48	1.31
1993	3.45	1.31
1994	3.53	1.31
1995	3.59	1.31
1996	3.66	1.31
1997	3.92	1.31
1998	3.98	1.31
1999	3.97	1.31
2000	6.42	1.96
2001	6.81	2.05
2002	6.52	1.98
2003	7.11	2.01
2004	7.18	2.08
2005	7.69	2.17
2006	9.03	2.46
2007	9.49	2.53
2008	10.27	2.63
2009	10.75	2.75
2010	11.24	2.93
2011	11.68	3.00
2012	12.40	3.96

[81] Revised 1996 IPCC Guidelines (Volume 3). Reference Manual, Table 4-8. p. 4.25

The *IPCC Guidelines* methodology were used for estimating nitrous oxide emissions (N_2O) emissions from manure management by multiplying the total amount of N excretion (from all animal species/categories) in each type of manure management system by an emission factor for that type of manure management system. Emissions are then summed over all manure management systems[82].

Nitrous oxide emissions (kg N_2O-N/yr) from manure management have been calculated by using IPCC GPG 2000 methodology equation 4.18:

$$Emissions\ N_2O\text{-}N = \sum_{(S)} \{[\sum_{(T)} (N_{(T)} * Nex_{(T)} * MS_{(T,S)})] * EF_{3(S)}\}$$

where:

$N_{(T)}$ = Number of head of livestock species/category T in the country (Table 6.2);
$Nex_{(T)}$ = Annual average N excretion per head of species/category T in the country, kg N/animal/yr (Table 6.30);
$MS_{(T,S)}$ = Fraction of total annual excretion for each livestock species/category T that is managed in manure management system S in the country (Table 6.15-Table 6.28);
$EF_{3(S)}$ = N_2O emission factor for manure management system S in the country, kg N_2O-N/kg N in manure management system S (Table 6.29);
S = Manure management system;
T = Species/category of livestock.

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 (S) reported in the inventory is liquid system, solid storage and dry lot, pasture range and paddock and anaerobic digester. Nitrous oxide emissions from pasture are calculated under manure management, but are reported under pasture, range and paddock manure in CRF 4.D.

The distribution of animal waste management systems (AWMS) according to national studies is shown in the Table 6.15- Table 6.28.

Table 6.15 Distribution of different manure management systems for 1990-1999 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	3.5	56.5	40
Non - Dairy cattle	2.1	52.7	45.2
Sheep		57.5	42.5
Goats		57.5	42.5
Horses		49.3	50.7
Swine	46	54	
Poultry	39	61	

Table 6.16 Distribution of different manure management systems for 2000 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	12.3	61.4	26.3
Non - Dairy cattle	8.6	36.6	54.8
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	42.5	53.8	3.7
Poultry		91.5	8.5

[82] IPCC GPG 2000, p. 4.40

Table 6.17 Distribution of different manure management systems for 2001 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	13.3	60.8	25.9
Non - Dairy cattle	9.5	36.2	54.3
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	48.5	48.2	3.3
Poultry		92.1	7.9

Table 6.18 Distribution of different manure management systems for 2002 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	12.5	61.2	26.3
Non - Dairy cattle	8.8	36.5	54.7
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	54.8	42.4	2.8
Poultry		92.3	7.7

Table 6.19 Distribution of different manure management systems for 2003 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	13	60.9	26.1
Non - Dairy cattle	9.1	36.4	54.5
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	60	37.5	2.5
Poultry		92.6	7.4

Table 6.20 Distribution of different manure management systems for 2004 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	14	60.2	25.8
Non - Dairy cattle	9.8	36.1	54.1
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	65.6	32.2	2.2
Poultry		92.9	7.1

Table 6.21 Distribution of different manure management systems for 2005 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	15.3	59.3	25.4
Non - Dairy cattle	10.7	35.9	53.4
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	69.4	28.6	2
Poultry		93.1	6.9

Table 6.22 Distribution of different manure management systems for 2006 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	19.5	56.3	24.2
Non - Dairy cattle	13.7	34.5	51.8
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	77.4	21.2	1.4
Poultry		93.2	6.8

Table 6.23 Distribution of different manure management systems for 2007 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	20.5	55.6	23.9
Non - Dairy cattle	14.4	34.2	51.4
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	80.1	18.6	1.3
Poultry		93.3	6.7

Table 6.24 Distribution of different manure management systems for 2008 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock
Dairy cattle	22.5	54.2	23.3
Non - Dairy cattle	15.5	33.8	50.7
Sheep		40	60
Goats		70	30
Horses		50	50
Swine	80.8	17.8	1.4
Poultry		93.6	6.4

Table 6.25 Distribution of different manure management systems for 2009 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock	Anaerobic digester
Dairy cattle	23.8	53.3	22.8	0.1
Non - Dairy cattle	16.7	33.3	50	
Sheep		40	60	
Goats		70	30	
Horses		50	50	
Swine	81.8	16.9	1.3	
Poultry		93.8	6.2	

Table 6.26 Distribution of different manure management systems for 2010 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock	Anaerobic digester
Dairy cattle	25.1	52.1	22.3	0.5
Non - Dairy cattle	18.6	32.5	48.6	0.3
Sheep		40	60	
Goats		70	30	
Horses		50	50	
Swine	83.2	15.6	1.2	
Poultry		65.5	4.5	30

Table 6.27 Distribution of different manure management systems for 2011 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock	Anaerobic digester
Dairy cattle	26.5	50.9	21.8	0.8
Non - Dairy cattle	19.3	31.1	49.2	0.4
Sheep		40	60	
Goats		70	30	
Horses		50	50	
Swine	84.1	14.7	1.1	0.1
Poultry		56.0	4.0	40

Table 6.28 Distribution of different manure management systems for 2012 (%)

Animal category	Liquid system	Solid storage and dry lot	Pasture range and paddock	Anaerobic digester
Dairy cattle	28.3	50.3	20.5	0.9
Non - Dairy cattle	20.9	30.4	48.3	0.4
Sheep		40	60	
Goats		70	30	
Horses		50	50	
Swine	85.3	13.4	1.1	0.2
Poultry		52.2	3.8	44

Calculation of nitrous oxide emissions from manure management is based on default EF_3 emission factors[83] (Table 6.29).

Table 6.29 IPCC default emission factors for nitrous oxide from Manure Management

Manure Management System	Emission factor (kg N_2O – N/kg), EF_3
Liquid system	0.001
Solid storage and dry lot	0.020
Anaerobic digester	0.001

N excretion during the year per each animal type and the distribution of manure management systems are country specific calculated values. Data about annual N excretion ($Nex_{(T)}$) per animal until 2004 are obtained from national studies. National expert made an account, based on a research, in which livestock manure amount and nitrogen amount was analyzed over a long time period as well as different available information. Since 2005, annual N excretion per animal for emission calculation is corrected according to results of studies on development of manure normative and livestock units carried out by the State Ltd. "Agrochemical Research Centre". Results of project [LAD110507/S109] activities from 11.05.2007 till 01.12.2007 described by project leader R.Timbare are available at Latvia University of Agriculture in Latvian[84]. This research was basis for animal N excretion values official declaring in Republic of Latvia Ministers Cabinet Regulation No. 33 *Regarding Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Activity* (Adopted 11 January 2011) that was issued pursuant to the *Law On Pollution.* The mass balance approach was used for estimating N excretion by farm livestock. It requires information on both input (N_{intake}) and output ($N_{products}$) factors. N_{intake} was calculated as feed intake (kg of dry matter) x N content of the feed. $N_{products}$ were evaluated by the N in live

[83] IPCC GPG 2000,Table 4.12
[84] http://www.llu.lv/projektu-apskate?projekti_id=501

weight gain, milk, etc. Average N excretions values used for emissions calculations is included in (Table 6.30). According to information from national studies regarding average $Nex_{(T)}$ for sheep and goats there is lower than IPCC default[85] because of:

- basis of sheep and goats nutrition was rather poor as sheep and goats usually were not fed additionally;
- mainly local breed was used which is not very productive;
- in general sheep and goat farming as a branch is relatively narrow in Latvia.

Since Latvia entered to European Union (EU) in 2004 the increase in the number of animals is evident for sheep and goats. The reason for this is the increase of funding formed by EU budget and state subsidies. Technologies and quality of production were improved and the capacity of realization of products was increased.

Table 6.30 Average N excretions per head of animal

Types of animals	**N, kg/year till 2004**	**N, kg/year starting from 2005**
Other cattle	50	50
Dairy cattle	71	70
Swine	10	10
Sheep, Goats	6	13
Horse	46	48
Poultry	0.6	0.6

N excretion per swine 10 kg nitrogen per animal in a year is a low value compared with IPCC default (20 kg/animal/yr). The national studies show a big difference in N excretion (4.5-19.4 kg/animal/yr) by different sub-categories of swine, but in average N excretion is about 10 kg/animal/yr (Table 6.31).

Table 6.31 N excretion for swine in average

Livestock Category	**N excretion, kg/head/yr***
Piglets (7.0-30.0 kg)	4.5
Fattening pigs (30-100 kg)	10.2
Young breeding sow (80-180 kg)	15.6
Breeding sows (180- 240 kg)	19.4
In average	9.7

**No. of production cycles/year: 6.4 for piglets, 3.2 for fattening pigs, 1,85 for young breeding sows, 2.35 for breeding sows*

The CSB of Latvia is collecting data on population of swine of such sub- categories:

- piglets, live weight less than 20 kg (including sucking piglets);
- young pigs, live weight 20- 50 kg;
- fattening pigs;
- young breeding sows;
- breeding sows.

Commercial pig production in Latvia mainly includes four or five phases, to take account of changes in nutrient requirements with increasing age of the pig: piglets with live weight 7-30 kg, fattening pigs 30-100 kg or 7-100 kg, young breeding sows and breeding sows.

[85] Revised 1996 IPCC, Table 4-20, page 4.99.

Therefore there are not researches data on N excretion by young pigs with live weight 20-50 kg.

6.3.3 Uncertainties and time series consistency

CSB assessed that for number of livestock uncertainty could be 2-3%. For emission calculation with Tier 1 30% uncertainty was used.

6.3.4 Source-specific QA/QC and verification

General (Tier 1) Quality Control (QC) procedures are applied to the category manure management. The QA/QC process for the agricultural sector includes the QC measures based on the guidelines of the IPCC (IPCC GPG 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.

6.3.5 Source-specific recalculations

For 2014 submission, recalculations of methane emissions from dairy cattle for period 2000-2011 are done based on ERT recommendation about different approach to calculate number of days on pasture.

6.3.6 Source-specific planned improvements

Elaboration of methodology to expand calculations on age subgroups of non-dairy livestock.

6.4 AGRICULTURAL SOILS (CRF 4.D)

6.4.1 Source category description

Nitrous oxide (N_2O) is produced naturally in soils through the microbial processes of nitrification and denitrification. The emissions of nitrous oxide that result from anthropogenic N inputs occur through a direct pathway (directly from the soils to which the N is added), and through two indirect pathways (through volatilisation as NH_3 and NOx and subsequent redeposition, and through leaching and runoff)[86]. This source category includes both direct and indirect nitrous oxide emissions from agricultural soils (Table 6.32). Direct nitrous oxide emissions include emissions from application of synthetic fertilizers and animal manure, biological nitrogen fixation via cultivation of N-fixing crops, incorporation of crop residues in to soils and cultivation of Histosols.

In the *IPCC Guidelines*, direct and indirect emissions of nitrous oxide from agricultural soils are estimated separately. The *IPCC Guidelines* methodology for estimating direct nitrous oxide emissions from agricultural soils has two parts:

1) estimation of direct N_2O emissions due to N-inputs to soils (excluding N-inputs from animals on pasture, range, and paddock);

[86] IPCC GPG 2000,Table 4.53

2) estimation of direct N_2O emissions from manure deposited by animals on pasture, range, and paddock).

Indirect nitrous oxide 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 6.32 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

Nitrous oxide emissions from agricultural soils were 4.91 Gg in 2012. Emissions have decreased in 2012 by 50% comparing with 1990. The main reason is decreasing of animal numbers that affected the amount of nitrogen excreted annually to soil and consumption of fertilizers. However, in 2012 nitrous oxide emissions increased by 0.27 Gg comparing with 2011 (Table 6.33). The main reason of the increase of emissions in the latest years is the growing demand of synthetic fertilizers and cultivation of organic soils. In 2012, total nitrous oxide emissions from agricultural soils originated as 66.7% from direct emissions, 27.5% from indirect emissions and 5.8% from emissions from pasture, range and paddock. Emissions from organic Histosols formed the major part of total direct emissions (49%), following by emissions from synthetic fertilizers (35%) and animal manure applied to soils (11%).

Table 6.33 Direct and indirect nitrous oxide emissions from agricultural soils by source category 1990-2012, (Gg)

Year	SF	MS	N	C	H	MP	A	L	GT, N_2O	GT, CO_2 eq.
1990	2.32	0.94	0.010	0.11	1.69	1.16	0.54	2.80	9.57	2967.74
1991	1.99	0.90	0.010	0.09	1.69	1.12	0.50	2.52	8.82	2734.45
1992	1.17	0.70	0.000	0.08	1.69	0.93	0.36	1.74	6.67	2067.65
1993	0.70	0.43	0.000	0.08	1.69	0.57	0.22	1.06	4.75	1471.64
1994	0.51	0.38	0.000	0.06	1.68	0.48	0.18	0.85	4.14	1284.72
1995	0.20	0.38	0.000	0.05	1.68	0.46	0.15	0.64	3.56	1103.94
1996	0.26	0.35	0.000	0.06	1.68	0.44	0.15	0.64	3.58	1108.27
1997	0.34	0.33	0.000	0.07	1.67	0.41	0.15	0.67	3.64	1128.12
1998	0.35	0.30	0.010	0.06	1.66	0.37	0.14	0.63	3.52	1092.62
1999	0.34	0.27	0.000	0.05	1.66	0.32	0.13	0.58	3.35	1037.91
2000	0.41	0.32	0.002	0.06	1.65	0.29	0.13	0.62	3.48	1079.42
2001	0.56	0.34	0.002	0.06	1.65	0.30	0.15	0.74	3.80	1179.24
2002	0.49	0.35	0.002	0.07	1.64	0.31	0.14	0.70	3.70	1147.62
2003	0.66	0.33	0.003	0.07	1.63	0.30	0.16	0.80	3.95	1223.88
2004	0.62	0.33	0.002	0.08	1.63	0.29	0.15	0.77	3.87	1200.63
2005	0.72	0.34	0.002	0.10	1.61	0.30	0.16	0.85	4.08	1265.73
2006	0.75	0.34	0.001	0.09	1.61	0.29	0.16	0.87	4.11	1273.48
2007	0.81	0.35	0.001	0.12	1.60	0.30	0.17	0.92	4.27	1323.39
2008	0.84	0.34	0.002	0.13	1.60	0.29	0.17	0.92	4.29	1329.28
2009	0.92	0.34	0.003	0.13	1.59	0.29	0.18	0.97	4.42	1369.58
2010	1.05	0.35	0.003	0.12	1.59	0.28	0.19	1.07	4.65	1440.88
2011	1.06	0.34	0.004	0.11	1.59	0.28	0.19	1.06	4.64	1437.78
2012	1.15	0.36	0.006	0.17	1.59	0.28	0.20	1.15	4.91	1521.93
Share of total % in 2012	23.5%	7.4%	0.1%	3.4%	32.4%	5.8%	4.1%	23.4%	100.00%	+6% versus 2011

SF=synthetic fertilizers, MS=manure applied to soils, N=N-fixation, C=crop residues, H=cultivation of organic soils, MP=manure deposited on pastures, A=atmospheric deposition, L=leaching and run-off, GT=grand total

6.4.2 Methodological issues

Direct nitrous oxide emissions from agricultural soils are calculated according to *IPCC GPG 2000*, Equation 4.20 (Tier 1a):

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

where:

F_{SN} = Annual amount of synthetic fertiliser nitrogen applied to soils adjusted to account for the amount that volatilises as NH_3 and NO_x;
F_{AM} = Annual amount of animal manure nitrogen intentionally applied to soils adjusted to account for the amount that volatilises as NH_3 and NO_x;
F_{BN} = Amount of nitrogen fixed by N-fixing crops cultivated annually;
F_{CR} = Amount of nitrogen in crop residues returned to soils annually;
F_{OS} = Area of organic soils (histosoils) cultivated annually;
EF_1 = Emission factor for emissions from N inputs (kg N_2O-N/kg N input), (Table 6.37);
EF_2 = Emission factor for emissions from organic soil cultivation (kg N_2O-N/ha-yr), (Table 6.37).

Synthetic fertiliser nitrogen adjusted for volatilisation (**F_{SN}**) input emissions through application of mineral fertilizers are calculated according to *IPCC GPG 2000*, Equation 4.22:

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

where:

N_{FERT} = annual amount of nitrogen in synthetic fertilizers applied to soils, thousand t (Table 6.34);
*$Frac_{GASF}$ = fraction of nitrogen lost through gaseous emissions of NH_3 and NOx (**0.1** kg NH_3-N +NOx-N/kg of synthetic fertilizer N applied, Revised 1996 IPCC, Table 4-19[87]).*

Total amount of nitrogen in fertilizers applied to soils is summarized in Table 6.34.

Table 6.34 Amount of Nitrogen used with synthetic fertilizers (thousand t)

Year	N in synthetic fertilizers
1990	131.4
1991	112.4
1992	66.0
1993	39.7
1994	29.0
1995	11.5
1996	14.5
1997	19.4
1998	19.6
1999	19.0
2000	23.0
2001	31.6

[87] Revised 1996 IPCC Guidelines (Volume 3). Reference Manual, Table 4-19. p. 4.94

Year	N in synthetic fertilizers
2002	27.6
2003	37.4
2004	35.2
2005	40.9
2006	42.7
2007	46.1
2008	47.5
2009	51.9
2010	59.5
2011	59.8
2012	65.2

Animal manure nitrogen used as fertiliser, adjusted for volatilisation (**F_{AM}**) refers to the amount of animal manure nitrogen intentionally applied to soils after adjusting to account for the amount that volatilises. Calculation of emissions from nitrogen input through application of animal manure is done according to *IPCC GPG 2000* Equation 4.23:

$$F_{AM} = \sum_T (N_{(T)} * Nex_{(T)}) * (1 - Frac_{GASM})[1 - (Frac_{FUEL\text{-}AM} + Frac_{PRP})]$$

were:

$\sum_T (N_{(T)} * Nex_{(T)})$ = Total amount of animal manure nitrogen produced annually, kg/Nyr;
*$Frac_{GASM}$ = fraction of livestock nitrogen excretion that volatilizes as NH_3 and NOx (**0.2** kg NH_3-N+NOx-N/kg, Revised 1996 IPCC, Table 4-19);*
$Frac_{FUEL\text{-}AM}$ = amount of animal manure that is burned for fuel, such activities not occurred in Latvia;
$Frac_{PRP}$ = amount of animal manure that is deposited onto soils by grazing livestock.

The approach presented in the *IPCC Guidelines* for estimating the amount of nitrogen fixed by N-fixing crops cultivated annually (**F_{BN}**) is based on the assumption that the amount of N contained in the aboveground plant material (crop product plus residues) is a reasonable proxy for the total amount of N fixed by the crop. The method applied for calculation of emissions is *IPCC GPG 2000* Tier 1b, Equation 4.26:

$$F_{BN} = \sum_i [Crop_{BFi} * (1 + Res_{BFi} / Crop_{BFi}) * Frac_{DMi} * Frac_{NCRBFi}]$$

were:

$Crop_{BFi}$ = Yield of pulses (peas and beans) (Table 6.3);
$Res_{BFi}/Crop_{BFi}$ = Residue to crop product ratio (Table 6.35);
$Frac_{DMi}$ = Dry matter fraction (Table 6.35);
$Frac_{NCRBFi}$ = Nitrogen fraction (Table 6.35)

In the *IPCC Guidelines*, the amount of nitrogen returned to soils annually through incorporation of crop residues (**F_{CR}**) is estimated by determining the total amount of crop residue N produced (from both non-N-fixing crops and N-fixing crops). The method applied for calculation of emissions is *IPCC GPG 2000* Tier 1b, modified Equation 4.29:

$$F_{CR} = \sum_i [(Crop_{Oi} * Res_{Oi} / Crop_{Oi} * Frac_{DMi} * Frac_{NCROi}) * (1 - Frac_R)] + \sum_j [(Crop_{BFj} * Res_{BFj}/Crop_{BFj} * Frac_{DMj} * Frac_{NCRBFj}) * (1 - Frac_R)]$$

where:

$Crop_{Oi}$ = Crop production (Table 6.3);
$Crop_{BFj}$ = Nitrogen-fixing crop production (Table 6.3);
$Res_{Oi}/Crop_{Oi}$; Res_{SBFj}/ $Crop_{BFj}$ = Residue to crop product ratio (Table 6.35);
$Frac_{DMi;}$ $Frac_{DMj}$ = Dry Matter Fraction (Table 6.35);
$Frac_{NCROi;}$ $Frac_{NCRBFj}$ = Nitrogen Fraction (Table 6.35);
$Frac_R$ = fraction of crop residue that is removed from the field as crop – 45 kg N/kg crop-N, (Revised 1996 IPCC, Table 4-19).

Values of residue to crop production ratio, dry matter fraction and nitrogen fraction are presented in the Table 6.35.

Table 6.35 Crop residue statistics

Crops	Dry Matter Fraction (Frac $_{DM}$)	Nitrogen Fraction (Frac $_{NCRBF}$)	Residue/Crop product ratio (Res_{BFi} /$Crop_{BFi}$)
Wheat*	0.86	0.005	1.2
Barley*	0.86	0.006	1
Triticale*	0.86	0.005	1.1
Oats*	0.86	0.006	1.1
Rye *	0.86	0.005	1.3
Rape*	0.86	0.007	2
Mixed cereals and pulses*	0.86	0.01	1.1
Buckwheat**	0.86	0.0106	2
Potatoes*	0.16	0.003	0.3
Sugar beet*	0.13	0.004	0.8
Feedbeet*	0.11	0.003	0.5
Maize for silage and forage***	0.25	0.0028	0.3
Crops for green feed and silage***	0.18	0.004	0.3
Vegetable*	0.13	0.015	0.2
Peas and beans *	0.86	0.0148	1.1

*A. Kārkliņš. Plant nutrient off-take as agro-environmental indicator. Latvian Academy of Agricultural and Forestry sciences, Latvia University of Agriculture: Proceedings in agronomy, No. 3, Jelgava, 2001, pp. 14-19 (all values , excl. Residue/crop product ratio on maize and other crops for green feed and silage)
**Augkopība. A.Ružas red. Latvijas lauksaimniecības universitāte, 2004.,4. pielikums.
***Trockenmassebilding und Stickstoffmengen in den Stoppeln und Wurzeln bei vershiedenen Zwishenfruchtformen. Nach V. Boguslawski, 1981. Faustzahlen fur Landwirtschaft un Gartenbau. 12. Auflage. Verlagsunion Agrar, 1993, s. 278 (Values on Residue/crop product ratio on maize and other crops for green feed and silage).

The *IPCC GPG 2000* defines (**F_{OS}**) as the area of organic soils cultivated annually. Areas of cultivated Histosols are represented in Table 6.36 according to information provided by Latvian State Forest Research Institute "Silava". Area of organic farmlands is changed because of update of the National forest inventory data on cropland and grassland area. Both, organic soils in cropland and grassland are considered in estimation, assuming that share of organic soils is equal in cropland and grassland (5.18 % of the total area). The share of organic soils in farmlands is estimated by the L.U. Consulting Company (2009) by evaluation of historical soil maps (representing situation in 60ths to 80ths of the last century). Due to the fact that land use is changed since that (croplands converted to grasslands, grasslands to forest lands and vice versa) actual distribution of organic soils in cropland and grassland is not known. The study on spatial assessment of organic soils in cropland and grassland is started in 2012. Preliminary results of the study (20% of the NFI sample plots visited) shows, that actual share of organic soils in cropland is below 0.5%, in grassland - below 2% and in afforested areas - about 3%; therefore, these results approves that emissions from organic soils in cultivated farmlands are not underestimating. Actual figures from the NFI will be used as soon as at least 50% of sample plots will be visited. Detailed description is included under LULUCF chapter.

Table 6.36 Areas of Histosols (ha/year)

Year	Area of cultivated organic soils
1990	134698
1991	134496
1992	134418
1993	134211
1994	133976
1995	133724
1996	133244
1997	132769
1998	132411
1999	131893
2000	131468
2001	130855
2002	130426
2003	129964
2004	129406
2005	128828
2006	128232
2007	127616
2008	126982
2009	126288
2010	126316
2011	126332
2012	126332

Indirect emissions calculation includes estimation of Atmospheric Deposition (NH_4 and NO_x) and Leaching and Runoff of applied or deposited nitrogen.

Atmospheric deposition of nitrogen compounds such as nitrogen oxides (NOx) and ammonium (NH_4) fertilises soils and surface waters, which results in enhanced biogenic N_2O formation. According to the *IPCC Guidelines*, the amount of applied agricultural N that volatilises and subsequently deposits on nearby soils is equal to the total amount of synthetic fertiliser nitrogen applied to soils (N_{FERT}) plus the total amount of animal manure nitrogen excreted in the country ($\sum_T(N_{(T)} * Nex_{(T)})$) multiplied by appropriate volatilisation factors. The volatilised N is then multiplied by an emission factor for atmospheric deposition (EF_4) to estimate N_2O emissions[88].The default *IPCC GPG 2000* Tier 1 method according to Equation 4.31 is used to estimate emissions (N_2O produced from atmospheric deposition of N, kg N/yr) from the atmospheric deposition:

$$N_2O_{(G)}\text{-}N = [(N_{FERT} * Frac_{GASF}) + (\sum_T(N_{(T)} * Nex_{(T)}) * Frac_{GASM})] * EF_4$$

where:

N_{FERT} = Total amount of synthetic nitrogen fertilizer applied to soil, kg N/yr (Table 6.34).

[88] IPCC GPG 2000, p.4.68

*$Frac_{GASF}$ = Fraction of synthetic N fertilizer volatilizes as NH_3 and NOx, (**0.1** kg NH_3-N+NOx-N/kg, Revised 1996 IPCC, Table 4-19[89];*
*$Frac_{GASM}$ = Fraction of animal manure N volatilizes as NH_3 and NOx, (**0.2** kg NH_3-N+NOx-N/kg, Revised 1996 IPCC, Table 4-19[90]);*
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 6.37).

A large proportion of nitrogen is lost from agricultural soils through leaching and runoff. This nitrogen enters the groundwater, riparian areas and wetlands and rivers, where it enhances biogenic production of nitrous oxide[91]. The default IPCC *GPG 2000* Tier 1 method according to Equation 4.34 is used to estimate emissions from the leaching/runoff:

$$N_2O_{(L)}\text{-}N = [N_{FERT} + \sum_T(N_{(T)} * Nex_{(T)})] * Frac_{LEACH} * EF_5$$

where:

N_{FERT} = Total amount of synthetic nitrogen fertilizer applied to soil, kg N/yr (Table 6.34);
*$Frac_{LEACH}$ = Fraction of N input that is lost through leaching and runoff (**0.3** kg N/kg nitrogen of fertilizer or manure, IPCC Workbook, Table 4-17[92]);*
EF_5 = Emission factor for leaching and runoff, kg N_2O-N/kg N leached and runoff (Table 6.37).

Nitrous oxide emissions from pasture, range and paddock calculation methodology is explained in Chapter 6.3 Manure Management.

IPCC default emission factors used for emissions calculation from agricultural soils are presented in Table 6.37.

Table 6.37 Nitrous oxide emission factors for emissions calculation from agricultural soils

Categories	Emission factors	Reference
Synthetic fertilizers, EF_1	0.0125 kg N_2O-N/kg N	IPCC GPG 2000, Table 4.17
Animal manure nitrogen, EF_1	0.0125 kg N_2O-N/kg N	IPCC GPG 2000, Table 4.17
N-fixing Crops, EF_1	0.0125 kg N_2O-N/kg dry biomass	IPCC GPG 2000, Table 4.17
Crop residue, EF_1	0.0125 kg N_2O-N/kg dry biomass	IPCC GPG 2000, Table 4.17
Organic soils, EF_2	8 kg N_2O – N/ha	IPCC GPG 2000, Table 4.17
Atmospheric deposition, EF_4	0.01 kg N_2O-N/kg NH_3-N& NOx-N deposited	IPCC GPG 2000, Table 4.18
N-leaching and run-off, EF_5	0.025 kg N_2O-N/kg N yr	IPCC GPG 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

6.4.3 Uncertainties and time series consistency

For estimating uncertainty for this category was used following assumptions:

1) CSB assessed that for number of livestock uncertainty could be 2-3%;

[89] Revised 1996 IPCC Guidelines (Volume 3). Reference Manual, Table 4-19. p. 4.94
[90] Revised 1996 IPCC Guidelines (Volume 3). Reference Manual, Table 4-19. p. 4.94
[91] IPCC GPG 2000, p. 4.70.
[92] IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, Table 4-17. p. 4.35

2) 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 GPG 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 was used to check consistency of the different sections of the agricultural inventory. The activity data was checked also by CSB and third part expert (not involved in GHG inventory preparation).

6.4.5 Source-specific recalculations

For submission 2014 recalculations of emissions from Histosols were done due to updating of data about Histosols areas.

6.4.6 Source-specific planned improvements

In the future submissions it is planned to evaluate new methodology for assessing area of cultivated organic soils (Histosols) for nitrous oxide emission calculation.

6.5 FIELD BURNING OF AGRICULTURAL RESIDUES (CRF 4.F)

Legislative measures and agricultural residue management practices prohibit field burning of agricultural residues. This is explained by Latvian Administrative Violations Code Section 179 Violation of Fire Safety Regulations[93]. Notation key – NO is used for reporting field burning of agricultural residues in Latvia.

[93] http://www.likumi.lv/doc.php?id=89648

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

7.1 OVERVIEW OF SECTOR

This category comprises CO_2 emissions and removals arising from Land Use, Land Use Change and Forestry (LULUCF). This sector is important in Latvia's GHG balance due to the fact, that more than half of the country area is covered with forests and due to long history of sustainable forest management, which secured that the increment of woody biomass in Latvia is one of the largest in Europe. According to data provided by National statistical forest inventory (NFI) total forest area (including afforested lands) in 2012 was 3 346 kha (52 % of total country area). Forest area is estimated using the National forest inventory (NFI) data, correction is applied to demonstrate impact of conversion between land use types and other land use changes. Total area of land converted to forest from 1990 to 2012 is 214 kha. Twenty years transition period is considered for land use changes, therefore area of historical forest lands is increasing during recent years, but area of lands converted to forest is decreasing, because area converted to forest until 1992 (including it) is now moved to forest land remaining forest. The same approach is applied to conversion of cropland to grassland. Conversion of forest land to other land use categories in 2010-2012 is calculated using the extrapolation method, assuming that conversion of forest land to cropland and to settlements follows to a linear regression based on data from 1990 to 2009.

Forest land remaining forest and forest land converted to other land use categories were estimated in 2009 using remote sensing approach – vegetation index were estimated in all the NFI points, including those outside forest lands in satellite image (LANDSAT) series from 1990, 1995 and 2000 to identify points where vegetation index permanently changed from values characteristic for forest lands to the one's characteristic for settlements, grassland and cropland. Empirical data from site visits of the NFI plots (2004-2008) were used to identify if forest land is converted to settlements or cropland. Emissions due to deforestation were estimated as losses in living and dead wood, litter and soil carbon pool as well as N_2O emissions related to disturbances due to conversion to cropland. Losses in living biomass and dead wood were accounted as average growing stock and dead wood stock in forests in the year of conversion according estimations on the NFI and recent research data provided by LSFRI Silava. Instant oxidation considered for all living and dead biomass carbon pools in case of conversion of forest land to other land use categories. Carbon stock changes in soil in case of conversion of forest land to other land use categories are accounted considering transition period of 20 years, assuming that in case of conversion to cropland carbon stock in 0-30 cm deep soil layer will reach average values in historical cropland, but in case of conversion to settlements carbon stock in soil in 0-30 cm layer will reach zero level during 20 years period.

Land converted to forest were estimated using different approach of evaluation of the NFI data – plots covered by woody vegetation on non-forest lands (less than 20 years old forest stands with no identified stumps on plain areas characteristic for croplands and grasslands) were separated from other forest lands and after mathematical reduction of age of the forest stands actual area of afforested lands in every year since 1990 were estimated. Increment in living biomass were estimated as stock difference assuming that growing characteristics of different stand types did not change since 1990. Results of the estimation are presented in the research conference Students on Their Way to Science[94] and summarized in research report

[94] Lazdiņš, A., 2011. Harmonization of land use matrix in Latvia according to requirements of international greenhouse gas reporting system - extending outputs of National Forest inventory program, in: Collection of Abstracts. Presented at the 6th Internationasl Scientific Conference Students on Their Way to Science, Latvia University of Agriculture, Faculty of Social Sciences, Faculty of Engineering, Forest Faculty, Jelgava, p. 10.

published in 2010[95]. Changes in dead wood and litter carbon pools are estimated assuming that these pools will reach average values in forest lands within 150 years (2 rotation periods in forest) following to a linear regression of accumulation of dead wood in afforested lands. No carbon stock changes due to conversion to forest land are considered in soil carbon pool due to recent research data demonstrating no statistically significant difference in carbon stock between grassland and forests of mineral soils[96]. The project on evaluation of average carbon stock in land historically being cropland and grassland is started in 2012 and the first results shows, that there is significant difference between forest land, grassland and cropland soil; 40 % of sample plots are covered up to now and the project results can be considered as preliminary[97]. The project on evaluation of carbon stock in soil in recently afforested grassland[98] demonstrated that there is no statistically significant difference between carbon stock in soil in historical grassland and afforested land.

Significant share of forested land fitting to the National definition (forest infrastructure, mares and wetlands) which do not fit to the forest definition under the convention are reported under settlements, wetlands or grasslands.

Category other lands consist of degraded areas. No removals or emissions are reported under this category, as it is not managed by definition and do not contains considerable amounts of organic carbon.

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 were estimated using mixed approach of Tier 1 and Tier 2 and country specific activity data, like increment and harvesting figures, mortality rate in forests, wood density values, BEFs, carbon stock in biomass, as well as the land use information. Calculations were done by Latvia 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) and wildfires (forest land and grassland) were estimated using Tier 1 and Tier 2 methods and country specific activity data. Emissions associated with industrial peat extraction in wetlands are reported under the Wetlands' category using Tier 1 approach and default activity data (IPCC GPG LULUCF 2003, TABLE 3a.3.3 Estimates of peat-land areas and use for tier 1 in 1000 hectares). Emissions due to conversion of forest land to other land use categories (living and dead wood, litter and soil carbon pools) were introduced in 2011 and the reporting methodology is now updated to switch from instant oxidation to periodic changes in soil carbon pool calculations. Currently living biomass, dead wood and litter is reported using instant oxidation method in forest land converted to other land use categories. Estimation of conversion of land use from cropland to grassland was introduced in 2011 to represent land use changes associated with reduction of area of cropland. Carbon stock changes are accounted using research data demonstrating difference of carbon stock in cropland and grassland[99]. Carbon stock changes in forest soils and litter are reported as not a source on the base of the Level 1 forest monitoring plots (95 plots distributed in 16 km grid). Similar sample plots are established in 2012 on cropland

95 Lazdiņš, A., Āboliņa, L., Zariņš, J., Jansons, J., Razma, Ģ., Donis, J., 2010. Mežu zemes izmantošanas maiņas matricas izstrādāšana un integrēšanu nacionālajā siltumnīcefekta gāzu inventarizācijas pārskatā par Kioto protokola 3.3 un 3.4 pantā minētajiem pasākumiem (Elaboration and integration with the GHG inventory report of the activities under Kyoto protocol articles 3.3 and 3.4 of forest land use change matrix). LVMI Silava, Salaspils.

96 Lazdiņš et al., *Atbalsts Klimata Pētījumu Programmai (Pārksats Par Projekta 2013. Gada Darba Uzdevumu Izpildi).*

97 Ibid.; Lazdiņš, *Atbalsts Klimata Pētījumu Programmai (starpziņojums Par 2012. Gada Darba Uzdevumu Izpildi).*

98 Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2013. Gada Darba Uzdevumu Izpildi).

99 Lazdiņš, Atbalsts Klimata Pētījumu Programmai (starpziņojums Par 2012. Gada Darba Uzdevumu Izpildi), Atbalsts Klimata Pētījumu Programmai (starpziņojums Par 2012. Gada Darba Uzdevumu Izpildi).

remaining cropland and grassland remaining grassland (up to now 40 % of sampling and analytical work is completed). According to preliminary results carbon stock in soil (0-30 cm) in land being cropland since 1990 is 63 ± 1.2 tons ha^{-1} and in land being grassland since 1990 - 77 ± 3.5 tons ha^{-1}.

Emissions of GHG due to forest fires in LULUCF sector in this report are calculated using data about areas of forest fires provided by the State forest service (SFS). Sum of actual growing stock of living biomass, dead wood and litter in a particular year and default emission factors were used in calculation. More detailed explanation is provided in further chapters. Default factors were utilized to estimate emissions from burning of grass in grassland.

This is the second year, when Latvia reported harvested wood products (HWP) pool using data, which were obtained during elaboration of the Forest management reference level (FMRL). The most of methodologies, like historical data on increment and mortality rate in forests were borrowed from the methodology of the FMRL calculations.

The information about area of all land use categories since 2009 comes from the NFI. Information about grassland, cropland, wetlands and other lands provided by the State land service (SLS) and Central statistical bureau (CSB) are used for reference – to estimate potential errors in the NFI data as well as to estimate the area of cropland and grassland in 1990. Conversion of cropland to grassland is estimated using remote sensing method comparing vegetation index in the NFI sample plots listed as cropland or grassland[100].

The data on land use change reported in 2014 are based on 60 % of data from the second NFI cycle and might be updated in future as final results of the second NFI cycle will be available only in summer, 2014. The areas of IPCC land-use categories and Latvia's official land area are given in Table 7.1. Slight changes are applied to the whole cycle due to harmonization of the country area.

Table 7.1 Areas of IPCC land-use classes in 1990-2012, 1000 ha

Year	Total country area	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
1990	6 457.30	3 168.56	1 842.24	755.01	238.82	448.35	4.32
1991	6 457.30	3 174.97	1 837.27	752.97	239.41	448.35	4.32
1992	6 457.30	3 179.04	1 833.98	751.61	240.01	448.35	4.32
1993	6 457.30	3 185.57	1 828.93	749.53	240.60	448.35	4.32
1994	6 457.30	3 192.65	1 823.50	747.29	241.19	448.35	4.32
1995	6 457.30	3 200.04	1 817.85	744.96	241.78	448.35	4.32
1996	6 457.30	3 210.13	1 810.36	741.89	242.26	448.35	4.32
1997	6 457.30	3 220.12	1 802.95	738.84	242.73	448.35	4.32
1998	6 457.30	3 227.86	1 797.12	736.44	243.20	448.35	4.32
1999	6 457.30	3 238.67	1 789.13	733.16	243.67	448.35	4.32
2000	6 457.30	3 247.70	1 782.39	730.39	244.15	448.35	4.32
2001	6 457.30	3 259.79	1 773.20	726.61	245.04	448.35	4.32
2002	6 457.30	3 268.30	1 766.53	723.87	245.92	448.35	4.32
2003	6 457.30	3 277.47	1 759.41	720.94	246.81	448.35	4.32
2004	6 457.30	3 288.49	1 750.97	717.47	247.70	448.35	4.32
2005	6 457.30	3 299.88	1 742.26	713.90	248.59	448.35	4.32
2006	6 457.30	3 311.64	1 733.30	710.21	249.48	448.35	4.32

100 Lazdiņš, Zariņš, Vēsturiskās (1990. gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana.

Year	Total country area	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
2007	6 457.30	3 323.77	1 724.07	706.43	250.36	448.35	4.32
2008	6 457.30	3 336.27	1 714.58	702.53	251.25	448.35	4.32
2009	6 457.30	3 349.41	1 704.63	698.45	252.15	448.35	4.32
2010	6 457.30	3 348.26	1 704.78	698.49	253.10	448.35	4.32
2011	6 457.30	3 347.17	1 704.87	698.52	254.07	448.35	4.32
2012	6 457.30	3 346.18	1 695.32	708.07	255.06	448.35	4.32

Net emissions of aggregated GHGs (CO_2, CH_4 and N_2O) in LULUCF sector in 2012 were 12 300.54 Gg of CO_2 equivalents (Table 7.2). Most of the emissions and removals are associated with the carbon stock changes, mainly in forest living biomass. Aggregated net removals of the GHGs reduced by 38 % in 2012 compared to 1990. Considerable reduction is associated with increase of the harvesting rate and increase of age of forests. The recalculation in 2014 resulted in significant reduction of net removals of CO_2 in living biomass, because of update of harvesting rate and natural mortality figures in forest on the base of preliminary NFI data, demonstrating considerable deviations between model based and actual figures.

Table 7.2 Summary of aggregated GHG emissions in 1990-2012, Gg CO_2 eq. annually

Year	Forest land	Cropland	Grassland	Wetlands	Settlements	LULUCF
1990	-22150.83	1856.99	207.33	21.12	135.66	**-19866.69**
1991	-23221.03	1880.56	175.68	21.12	162.29	**-20957.98**
1992	-22901.25	1905.96	150.28	21.12	189.77	**-19390.49**
1993	-22409.79	1930.54	117.37	21.12	220.05	**-19418.49**
1994	-23027.13	1955.26	83.25	21.12	247.34	**-20575.88**
1995	-20777.8	1978.1	49.21	21.12	276.19	**-18591.75**
1996	-20871.73	1644.12	12.03	21.12	263.01	**-19186.14**
1997	-17165.54	1647.34	-27.39	21.12	283.77	**-16372.88**
1998	-15207.5	1653.61	-56.67	21.12	306.78	**-14862.3**
1999	-14687.84	1658.03	-96.24	21.12	328.98	**-14496.4**
2000	-14145.9	1664.48	-131.83	21.12	351.38	**-14090.39**
2001	-13987.89	1629.86	-172.9	21.12	525.45	**-14068.27**
2002	-11863.75	1646.86	-194.18	21.12	567.28	**-11664.17**
2003	-13040.7	1658.16	-225.08	21.12	608.69	**-13044.29**
2004	-12931.72	1637.74	-281.89	21.12	651.16	**-12989.22**
2005	-13224.88	1639.28	-334.27	21.12	692.66	**-13394.76**
2006	-15524.27	1640.1	-334.2	21.12	734.28	**-15223.5**
2007	-15440.21	1644.81	-457.31	21.12	712.2	**-14760.01**
2008	-17358.37	1644.29	-509.42	21.12	755.62	**-16328.44**
2009	-15333.5	1546.01	-550.77	21.12	802.92	**-14372.87**
2010	-11284.98	1468.08	-554.09	21.12	836.64	**-11129.94**
2011	-11728.55	1437.25	-526.72	21.12	860.83	**-11830.54**
2012	-13099.39	1381.11	-537.73	21.12	897.08	**-12300.54**

In 2012, the LULUCF sector in Latvia is a sink because the total sector emissions are considerably smaller than removals; generally, due to accumulation of carbon in living biomass in forest lands. Emissions increased in settlements category during the reporting period due to conversion of forest land to settlements.

Area of organic soils in croplands and grasslands is updated according to the inventory of historical data about farmlands implemented in 2009[101]. Area of organic soils in cropland and grassland represented in the inventory characterizes situation before 1990. It is assumed that the share of organic soils in cropland and grassland is equal and do not changes in time, because no better data are available. Area of cropland and grassland in LULUCF reporting is synchronized with Agriculture reporting, including recalculation of cultivated organic soils. It is considered that all forest land, grassland, cropland and settlements are managed.
Detailed land use change matrices are provided in Table 7.4; summary – in Table 7.3.

Data on increment of aboveground biomass in forest lands are taken from the NFI. Recalculation to the total aboveground and underground biomass is done using national activity data on the gross increments, mortality rate and forest area and default wood density coefficients and biomass expansion factors in the IPCC GPG LULUCF 2003. Significant changes are introduced into the activity data, like mortality figures and harvested wood products. National spreadsheet based model is used to calculate carbon stock changes and GHG emissions due to forest management.

Emissions from drained organic and mineral soils are calculated using Tier 1 emission factors and national activity data. Information about area of drained mineral and organic soils in forest land is taken from the NFI (total area of forest types on drained soils).

Table 7.3 Summary of land use change matrix

Changes	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
1990	*3 168.56*	*1 842.24*	*755.01*	*238.82*	*448.35*	*4.32*
Forest land		19.72	0.00	16.24	0.00	0.00
Cropland	0.00		166.63	0.00	0.00	0.00
Grassland	213.58	0.00		0.00	0.00	0.00
Settlements	0.00	0.00	0.00		0.00	0.00
Wetland	0.00	0.00	0.00	0.00		0.00
Other land	0.00	0.00	0.00	0.00	0.00	0.00
2012	*3 346.18*	*1 695.32*	*708.07*	*255.06*	*448.35*	*4.32*

Table 7.4 Land use change matrix

Changes	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
Land use change 1989-1990						
1989	3 165.92	1 840.33	760.16	238.23	448.35	4.32
Forest land		1.91		0.59		
Cropland			0.00			
Grassland	5.14					
Settlements						
Wetland						
Other land						
Land use change 1990-1991						
1990	3 168.56	1 842.24	755.01	238.82	448.35	4.32
Forest land		1.91		0.59		
Cropland			6.87			
Grassland	8.91					

[101] L.U. Consulting, "Augšņu un reljefa izejas datu sagatavošana un Eiropas Komisijas izstrādāto augsnes un reljefa kritēriju mazāk labvēlīgo apvidu noteikšanai piemērošanas simulācija (Projekta kopsavilkuma ziņojums)" *(Elaboration of soil and terrain data and simulation of application of the criteria elaborated by the European Commission for identification of less valuable regions (Summary of the project report))*, Latvijas Republikas Zemkopības Ministrija, 2010.

Changes	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
Settlements						
Wetland						
Other land						
Land use change 1991-1992						
1991	3 174.97	1 837.27	752.97	239.41	448.35	4.32
Forest land		1.91		0.59		
Cropland			5.20			
Grassland	6.56					
Settlements						
Wetland						
Other land						
Land use change 1992-1993						
1992	3 179.04	1 833.98	751.61	240.01	448.35	4.32
Forest land		1.91		0.59		
Cropland			6.95			
Grassland	9.03					
Settlements						
Wetland						
Other land						
Land use change 1993-1994						
1993	3 185.57	1 828.93	749.53	240.60	448.35	4.32
Forest land		1.91		0.59		
Cropland			7.34			
Grassland	9.58					
Settlements						
Wetland						
Other land						
1994	3 192.65	1 823.50	747.29	241.19	448.35	4.32
Forest land		1.91		0.59		
Cropland			7.56			
Grassland	9.89					
Settlements						
Wetland						
Other land						
Land use change 1995-1996						
1995	3 200.04	1 817.85	744.96	241.78	448.35	4.32
Forest land		0.79		0.47		
Cropland			8.27			
Grassland	11.35					
Settlements						
Wetland						
Other land						
Land use change 1996-1997						
1996	3 210.13	1 810.36	741.89	242.26	448.35	4.32
Forest land		0.79		0.47		
Cropland			8.21			
Grassland	11.26					
Settlements						
Wetland						

Changes	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
Other land						
Land use change 1997-1998						
1997	3 220.12	1 802.95	738.84	242.73	448.35	4.32
Forest land		0.79		0.47		
Cropland			6.61			
Grassland	9.01					
Settlements						
Wetland						
Other land						
Land use change 1998-1999						
1998	3 227.86	1 797.12	736.44	243.20	448.35	4.32
Forest land		0.79		0.47		
Cropland			8.78			
Grassland	12.07					
Settlements						
Wetland						
Other land						
Land use change 1999-2000						
1999	3 238.67	1 789.13	733.16	243.67	448.35	4.32
Forest land		0.79		0.47		
Cropland			7.53			
Grassland	10.30					
Settlements						
Wetland						
Other land						
Land use change 2000-2001						
2000	3 247.70	1 782.39	730.39	244.15	448.35	4.32
Forest land		0.69		0.89		
Cropland			9.89			
Grassland	13.66					
Settlements						
Wetland						
Other land						
Land use change 2001-2002						
2001	3 259.79	1 773.20	726.61	245.04	448.35	4.32
Forest land		0.69		0.89		
Cropland			7.35			
Grassland	10.09					
Settlements						
Wetland						
Other land						
Land use change 2002-2003						
2002	3 268.30	1 766.53	723.87	245.92	448.35	4.32
Forest land		0.69		0.89		
Cropland			7.82			
Grassland	10.75					
Settlements						
Wetland						
Other land						

Changes	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
Land use change 2003-2004						
2003	3 277.47	1 759.41	720.94	246.81	448.35	4.32
Forest land		0.69		0.89		
Cropland			9.13			
Grassland	12.60					
Settlements						
Wetland						
Other land						
Land use change 2004-2005						
2004	3 288.49	1 750.97	717.47	247.70	448.35	4.32
Forest land		0.69		0.89		
Cropland			9.39			
Grassland	12.97					
Settlements						
Wetland						
Other land						
Land use change 2005-2006						
2005	3 299.88	1 742.26	713.90	248.59	448.35	4.32
Forest land		0.69		0.89		
Cropland			9.65			
Grassland	13.34					
Settlements						
Wetland						
Other land						
Land use change 2006-2007						
2006	3 311.64	1 733.30	710.21	249.48	448.35	4.32
Forest land		0.69		0.89		
Cropland			9.92			
Grassland	13.71					
Settlements						
Wetland						
Other land						
Land use change 2007-2008						
2007	3 323.77	1 724.07	706.43	250.36	448.35	4.32
Forest land		0.69		0.89		
Cropland			10.18			
Grassland	14.07					
Settlements						
Wetland						
Other land						
Land use change 2008-2009						
2008	3 336.27	1 714.58	702.53	251.25	448.35	4.32
Forest land		0.40		0.90		
Cropland			10.35			
Grassland	14.44					
Settlements						
Wetland						
Other land						
Land use change 2009-2010						

Changes	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
2009	3 349.41	1 704.63	698.45	252.15	448.35	4.32
Forest land		0.20		0.95		
Cropland			0.05			
Grassland	0.00					
Settlements						
Wetland						
Other land						
Land use change 2010-2011						
2010	3 348.26	1 704.78	698.49	253.10	448.35	4.32
Forest land		0.12		0.97		
Cropland			0.03			
Grassland	0.00					
Settlements						
Wetland						
Other land						
Land use change 2011-2012						
2011	3 347.17	1 704.87	698.52	254.07	448.35	4.32
Forest land		0.00		0.99		
Cropland			9.55			
Grassland	0.00					
Settlements						
Wetland						
Other land						
2012	**3 346.18**	**1 695.32**	**708.07**	**255.06**	**448.35**	**4.32**

Emissions from mineral soil due to conversion of forest land to other land use categories are estimated using Equation 3.3.3 of the IPCC GPG LULUCF 2003. Research data were used to estimate carbon losses due to conversion from forest land to cropland on mineral soils; the same factors of emission as for cropland on organic soil were used for converted organic soil. Default transition period of 20 years is assumed in calculations, except for conversion of grassland to forest land, where two rotation periods (150 years) were considered. Data about carbon stock in soil and litter in forest soil is taken as averages from the results of international forest soil inventory project BioSoil[102]. Average stock of dead wood in forests is estimated from the NFI database[103].

Knowledge about dynamics of dead wood in forest lands is insufficient, both in terms of mortality factors and decay periods, because forest management principles was significantly changed since 1990, for instance, in 80[ths] it was a common practice to debark stumps and to incinerate harvesting residues to reduce risk of distribution of pests. Nowadays this practice is not used any more in state forests and in very limited amount – in private forests. Instead of that collection of residues for biofuel production becomes more common. Comparison of different sources of information about dead wood (NFI and reports to the Timber Committee[104]) demonstrates constant increase of dead wood stock in forests during the last

102 Arta Bārdule et al., "Forest soil characteristic in Latvia according results of the demonstration project BioSoil (Latvijas meža augsņu īpašību raksturojums demontrācijas projekta BioSoil rezultātu skatījumā)," *Mežzinātne | Forest Science* 20 (53) (2009): 105–124; Andis Lazdiņš et al., *Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcas Efektu Izraisošo Gāzu Bilanci Pētījuma Programmas Izstrāde* Pārskats par pirmā etapa izpildi (Salaspils: LVMI Silava, 2010).

103 http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls

104 FAO Forestry Department, *Global forest resources assessment 2010. Country report - Latvia* (Rome: Forestry Department, Food and Agriculture Organization of the United Nations, 2010); FAO, *State of the world's forests 1997* (Rome: FAO, 1997); FAO Forestry Department, *Global Forest Resources Assessment 2000*, FAO Forestry Paper (Food and Agriculture Organization of the United Nations, 2000).

decade; however, it could be result of several extreme events. Mortality factors excluding extreme events were elaborated in 2012 on the base of the NFI data (sample plots measured in 2006 and 2012) for the FMRL calculations[105].

Emissions from drained forest soils are extended by calculation of N_2O emissions (separately from mineral and organic soils). Emissions of CO_2 from organic soils are calculated using default emission factors (0.68 tons C ha^{-1} annually in forest land, 3.7 ton C ha^{-1} in cropland, 1.6 tons C ha^{-1} in grassland and 0.2 tons C ha^{-1} in peatlands). The emission factors for cropland and grassland are borrowed from the Swedish GHG inventory considering similar soil and climate conditions. These factors are applied also in Estonia.

The key categories in LULUCF sector in 2012 in Latvia are summarised in Table 7.5Table 7.5. The most significant key category is CO_2 in Forest land remaining forest land contributing to 44.8% of level of the emissions and 63.7% to the trend. Harvested wood products included into the inventory in 2012 are also a key category by level of net emissions.

Table 7.5 Key categories in LULUCF sector

	IPCC GHG Source and Sink Categories	Gas	Identification criteria[106]
5.A.1	Forest Land remaining Forest Land	CO_2	L,T
5.A.1	Forest Land remaining Forest Land	N_2O	T
5.A.2	Land converted to Forest Land	CO_2	L,T
5.B.1	Cropland remaining Cropland	CO_2	L,T
5.B.2	Land converted to Cropland	CO_2	T
5.C.1	Grassland remaining Grassland	CO_2	T
5.C.2	Land converted to Grassland	CO_2	L,T
5.E.1	Settlements remaining Settlements	CO_2	T
5.E.2	Land converted to Settlements	CO_2	L,T
5.G	Other	CO_2	L,T

The sector reporting was considerably updated in 2013 due to development of national GHG accounting and projection model for LULUCF sector and implementation of results of several scientific studies. The most important improvements in this report are implementation of country specific wood density values, carbon stock in different fractions of biomass, BEFs, as well as recalculation of losses due to commercial harvesting and natural mortality in forests. Gains and losses in living and dead biomass are accounted for grassland and settlements, where NFI provides sufficient data to account dynamics of carbon stock in biomass.

7.2 FOREST LAND (CRF 5)

7.2.1 Source category description

There are 3 key source and sink categories in forest lands in Latvia – CO_2 in Forest Land remaining Forest Land and CO_2 in Land converted to Forest Land and N_2O in Forest Land remaining Forest Land. The accounting of N_2O from drained forest lands is not mandatory according to the IPCC GPG LULUCF 2003, but taking in account considerable area of forests on drained soils Latvia decided to account the N_2O using Tier 1 approach described in the Annex of the IPCC GPG LULUCF 2003 to avoid underestimation of the emissions. Lands converted to forest became a sink because of conversion of farmlands after 1990.

105 Lazdiņš, Donis, and Strūve, *Latvijas Meža Apsaimniekošanas Radītās Ogļskābās Gāzes (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju References Līmeņa Aprēķina Modeļa Izstrāde*.

106 L/T – level and trend assessment, L – only level assessment, T – only trend assessment.

The estimation of the area of forest land is based on the NFI[107]. Forest Land is divided in two categories: forest land remaining forest land and land converted to forest land. No forests are considered unmanaged. Removals and emissions are reported in the category forest land remaining forest and land converted to forest.
The NFI and research data are used to estimate time series for areas and gross increment. Mortality data are calculated on the base of the NFI data and mortality factors, considering linear correlation between the modelled mortality in 2004-2012 and actual mortality data for the whole period[108]. Distinction between forest land remaining forest land and areas converted to forest land is made according to age of dominant species in forests on afforested land – 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.

Carbon stock changes in above and below ground living and dead biomass are reported in the submission. Decay factor for dead wood including harvesting residues not incinerated on-site is considered 20 years. Changes of organic carbon in litter and soil organic matter in naturally dry and wet soils are assumed to be zero according to research data on carbon stock in forest soil in 2006 and 2012[109].

Carbon stock changes are reported separately on naturally dry and wet mineral and organic soils and drained mineral and organic soils. Soils are considered organic as defined in the NFI: a soil is classified as organic if the organic layer (H horizon) is at least 30 cm deep. Distribution of the forest site types according to the NFI is shown in Table 7.6.

Table 7.6 Distribution of drained, naturally dry and wet mineral and organic soils in Latvia's forests[110]

Year	Forest remaining forest at the end of year, 1000 ha	forest on dry mineral soils, 1000 ha	forest on drained mineral soils, 1000 ha	forest on wet mineral soils, 1000 ha	forest on drained organic soils, 1000 ha	forest on wet organic soils, 1000 ha
1990	3163.42	1540.52	610.65	306.42	432.75	273.08
1991	3160.92	1539.31	610.17	306.17	432.41	272.86
1992	3158.42	1538.09	609.69	305.92	432.07	272.65
1993	3155.92	1536.87	609.21	305.68	431.73	272.43
1994	3153.42	1535.66	608.72	305.43	431.38	272.22
1995	3150.92	1534.44	608.24	305.19	431.04	272
1996	3149.66	1533.23	607.76	306.18	430.7	271.79
1997	3148.4	1532.61	607.52	306.06	430.53	271.68
1998	3147.14	1532	607.27	305.94	430.36	271.57
1999	3145.87	1531.38	607.03	305.82	430.18	271.46
2000	3144.61	1530.77	606.79	305.69	430.01	271.35
2001	3143.03	1530.16	606.54	305.25	429.84	271.24
2002	3141.46	1529.39	606.24	305.1	429.62	271.11
2003	3139.88	1528.62	605.93	304.95	429.41	270.97
2004	3138.3	1527.85	605.63	304.8	429.19	270.83
2005	3136.72	1527.08	605.33	304.64	428.98	270.7

[107] http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls

[108] Lazdiņš, Donis, and Strūve, *Latvijas Meža Apsaimniekošanas Radītās Ogļskābās Gāzes (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju References Līmeņa Aprēķina Modeļa Izstrāde (Elaboration of calculation model for evaluation of GHG emissions and CO_2 removals due to forest management).*

[109] Lazdiņš et al., "Temporary Carbon Stock Changes in Forest Soil in Latvia"; Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2012. Gada Darba Uzdevumu Izpildi).

[110] http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls

Year	Forest remaining forest at the end of year, 1000 ha	forest on dry mineral soils, 1000 ha	forest on drained mineral soils, 1000 ha	forest on wet mineral soils, 1000 ha	forest on drained organic soils, 1000 ha	forest on wet organic soils, 1000 ha
2006	3135.14	1526.32	605.02	304.48	428.76	270.56
2007	3133.57	1525.55	604.72	304.33	428.54	270.42
2008	3131.99	1524.78	604.41	304.18	428.33	270.29
2009	3130.69	1524.15	604.16	304.05	428.15	270.18
2010	3129.54	1523.59	604.93	301.8	428.7	270.52
2011	3128.45	1523.06	606.44	297.99	429.77	271.2
2012	3127.46	1522.58	604.28	302.14	428.23	270.23

The carbon stock change in living biomass is estimated with the default method of the IPCC GPG LULUCF 2003, Equation 3.2.2 – carbon uptake and release of the living biomass correspond to the mean gross annual increment of forest growing stock, annual harvesting of trees and decay due to natural mortality.

Considerable part of non-CO_2 emissions is associated with incineration of harvesting residues in clear-cuts. The activity data for this calculation was based on an outdated study until 2010[111]. Now questionnaire of private forest owners about utilization of harvesting residues is used[112]. According to this questionnaire about 18 % of harvesting residues were incinerated during last 3 years.

The time series for annual increment of growing stock of trees on a forest land remaining forest are given in Table 7.7 and in the land converted to forest – in Table 7.8.

The total drain of trees is very much affected by commercial felling. The demand for timber products was low at the beginning of the 1990s; therefore, felling was also at a low level and the CO_2 sink of trees was high. The felling stock increased during nineties and reached top average in early 2000s. Updated figures of felling, including biofuel gathering, are shown in

Table 7.9.

The Land converted to forest land provides relatively small net increment of growing stock of trees – about 0.2 mill. m^3 in 2012. Taking in account that these forests are generally young stands no emissions from commercial felling are considered. Areas afforested 20 years ago (in 1990-1992) are moved to the forest land remaining forest land category.

Table 7.7 Annual increment of growing stock of trees on the forest land remaining forest, 1000 m^3

Year	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other	Pine	Total
1990	3548.96	1958.58	7459.94	3867.34	1605.45	270.82	511.97	6111.59	25334.65
1991	3546.16	1957.04	7454.04	3864.28	1604.18	270.61	511.56	6106.76	25314.63
1992	3543.36	1955.49	7448.15	3861.23	1602.91	270.4	511.16	6101.93	25294.62
1993	3540.55	1953.94	7442.26	3858.17	1601.65	270.18	510.75	6097.1	25274.6
1994	3619.44	2107.17	7582.5	4424.35	1758.81	277.62	453.47	6161.77	26385.13
1995	3616.57	2105.5	7576.49	4420.84	1757.42	277.4	453.11	6156.89	26364.22
1996	3615.12	2104.66	7573.46	4419.07	1756.71	277.29	452.93	6154.42	26353.67

111 Leonards Līpiņš, "Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resersu un to izmantošanas efektivitātes novērtējums)" (LLU, 2004), http://www.zm.gov.lv/index.php?sadala=258&id=803.

112 Lazdiņš, A., Lazdiņa, D., 2013. Meža ugunsgrēku un mežizstrādes atlieku dedzināšanas radītās siltumnīcefekta gāzu emisijas Latvijā (Greenhouse gas emissions in Latvia due to incineration of harvesting residues and forest fires), in: Referātu Tēzes. Presented at the Latvijas Universitātes 71. zinātniskā konference "Ģeogrāfija, ģeoloģija, vides zinātne", Latvijas Universitāte, Rīga, pp. 133–137.

Year	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other	Pine	Total
1997	3613.68	2103.82	7570.42	4417.3	1756.01	277.18	452.75	6151.96	26343.11
1998	3612.23	2102.97	7567.39	4415.53	1755.3	277.07	452.57	6149.49	26332.55
1999	3254.13	2168.46	7463.57	5119.54	1796.67	265.38	438.31	6333.42	26839.47
2000	3252.82	2167.59	7460.57	5117.49	1795.95	265.27	438.13	6330.88	26828.7
2001	3251.19	2166.5	7456.83	5114.92	1795.05	265.14	437.91	6327.7	26815.24
2002	3249.56	2165.42	7453.08	5112.35	1794.14	265	437.69	6324.53	26801.78
2003	3247.93	2164.33	7449.34	5109.78	1793.24	264.87	437.47	6321.35	26788.32
2004	2639.19	2287.95	6918.37	5580.53	1793.7	256.43	480.77	6258.27	26215.19
2005	2637.86	2286.8	6914.89	5577.73	1792.8	256.3	480.52	6255.12	26202.01
2006	2636.53	2285.65	6911.41	5574.92	1791.9	256.17	480.28	6251.97	26188.83
2007	2635.21	2284.49	6907.93	5572.11	1791	256.04	480.04	6248.83	26175.65
2008	2633.88	2283.34	6904.45	5569.31	1790.1	255.91	479.8	6245.68	26162.47
2009	2285.98	2438.2	6639.11	6038.54	1457.69	241.25	697.69	7153.77	26952.22
2010	2288.9	2441.31	6647.57	6046.24	1459.55	241.55	698.58	7162.89	26986.59
2011	2294.61	2447.4	6664.16	6061.33	1463.19	242.16	700.32	7180.77	27053.94
2012	2298.68	2451.74	6675.98	6072.08	1465.78	242.59	701.56	7193.5	27101.93

Table 7.8 Increment of growing stock of timber on the Land converted to forest[113]

Year	Net increment, m^3	Stem biomass, 1000 tons	Crown biomass, 1000 tons	Below-ground biomass, 1000 tons	Total biomass, 1000 tons
1990	136,26	0,06	0,02	0,02	0,09
1991	591,29	0,24	0,07	0,08	0,39
1992	1411,27	0,58	0,18	0,18	0,94
1993	2695,88	1,11	0,34	0,35	1,8
1994	4534,9	1,86	0,58	0,59	3,03
1995	7000,64	2,87	0,9	0,91	4,68
1996	10188,99	4,18	1,31	1,32	6,81
1997	14169,39	5,82	1,82	1,83	9,47
1998	18937,42	7,77	2,43	2,45	12,65
1999	24587,02	10,06	3,22	3,2	16,48
2000	31143,82	12,74	4,08	4,06	20,88
2001	38721,87	15,84	5,08	5,05	25,96
2002	47310,79	19,35	6,2	6,17	31,72
2003	56931,64	23,28	7,46	7,42	38,17
2004	67663,64	27,55	9,12	8,88	45,55
2005	79574,63	32,4	10,73	10,44	53,57
2006	92725,06	37,75	12,5	12,16	62,42
2007	107173,99	43,63	14,45	14,06	72,14
2008	122980,02	50,07	16,58	16,13	82,78
2009	140201,73	56,75	19,1	18,42	94,27
2010	158505,33	64,15	21,59	20,83	106,57
2011	177702,17	71,92	24,2	23,35	119,48
2012	197697,75	80,02	26,93	25,98	132,93

113 Andis Lazdiņš and Juris Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)" (LVMI Silava, 2010).

Table 7.9 Updated figures of harvesting stock, in 1000 m^3

Year	Total excluding deforestation	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other	Pine
1990	6 934	626	446	2 012	1 492	120	27	0	2 211
1991	6 102	551	392	1 771	1 313	106	24	0	1 945
1992	5 547	501	357	1 610	1 194	96	21	0	1 769
1993	6 657	601	428	1 932	1 433	115	26	0	2 122
1994	7 905	713	508	2 294	1 701	137	31	0	2 520
1995	9 569	864	615	2 777	2 060	166	37	0	3 051
1996	9 431	851	607	2 737	2 030	164	36	0	3 007
1997	12 343	1 114	794	3 582	2 657	214	48	0	3 935
1998	13 869	1 252	892	4 024	2 985	240	54	0	4 422
1999	14 978	1 352	963	4 346	3 224	260	58	0	4 775
2000	15 255	1 398	734	4 514	4 258	0	56	0	4 296
2001	15 533	1 472	708	4 305	4 045	278	41	0	4 684
2002	16 920	1 680	980	4 779	4 218	269	49	0	4 945
2003	16 226	1 638	1 107	4 384	3 668	258	54	0	5 117
2004	15 949	1 511	1 267	4 470	3 456	290	54	0	4 901
2005	15 671	935	926	3 967	4 087	288	92	0	5 377
2006	13 605	1 301	949	3 926	2 624	281	58	0	4 465
2007	13 882	1 283	1 172	4 196	2 775	277	70	0	4 109
2008	12 429	1 090	985	3 628	2 183	283	51	0	4 209
2009	14 878	1 337	845	4 359	2 373	281	61	0	5 622
2010	18 002	1 568	1 142	6 288	2 639	413	62	0	5 891
2011	17 822	1 588	1 388	4 865	3 047	312	93	12	6 517
2012	16 268	1 130	4 501	3 633	2 384	1 004	143	0	3 473

The aggregated net emissions from forest lands were -13099 Gg of CO_2 eq. in Latvia in 2012, excluding removals in harvested wood products. The most of the emissions are associated with commercial felling. Both, the harvesting related emissions and removals in living biomass increased during the reporting period Figure 7.1.

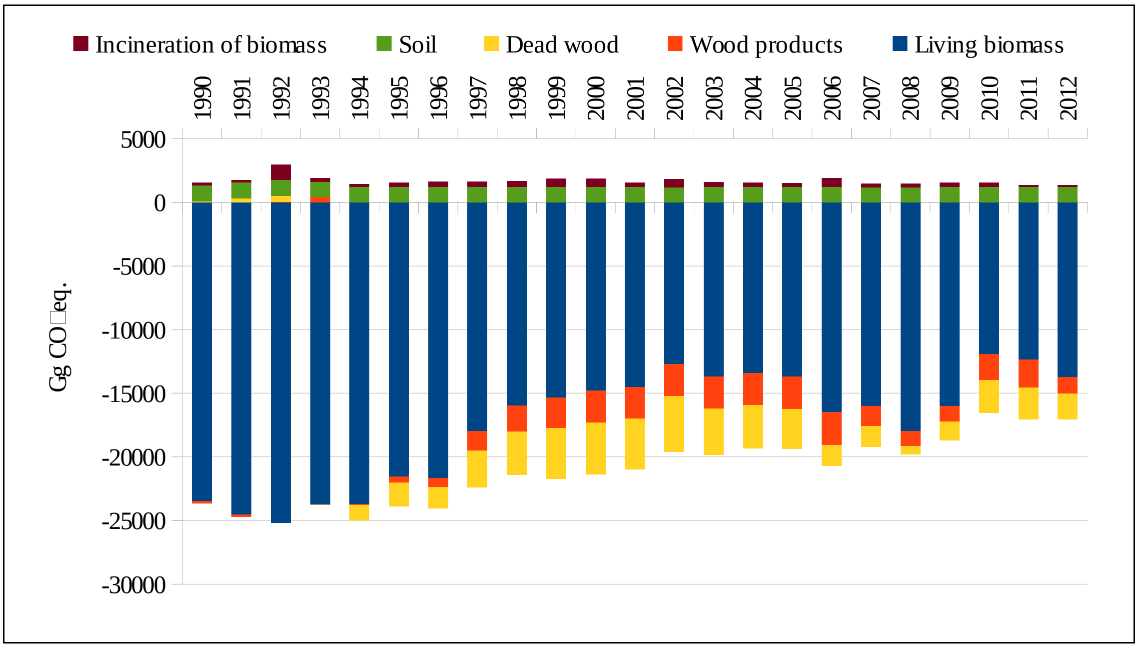


Figure 7.1 Structure of emissions in forest lands

In case of on-site incineration of harvesting residues during commercial harvesting, all emissions also are applied to the forest land remaining forest land's category, because no commercial felling takes place in young stands (younger than 20 years) on land converted to forest land.
Estimation of on-site incineration in 2012 is based on the questionnaire of private forest owners where they responded that only 18 % of harvesting residues are left for incineration in private forests and no harvesting residues are incinerated in state forests. Previous studies demonstrated that about 50 %[114] of harvesting residues were left for incineration and 66 % of them are actually incinerated[115]. Fraction of biomass oxidized on-site is assumed 90 % in average. Amount of the harvesting residues is calculated according to weighted average share of crown biomass in above-ground biomass.

7.2.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Forest land area and deforested area were estimated in 2009 using remote sensing approach – vegetation index were estimated in all the NFI points, including those outside forest lands in satellite image (LANDSAT) series from 1990, 1995 and 2000 to identify points where vegetation index permanently changed from values characteristic for forest lands to the one's characteristic for settlements, grassland and cropland.

Source data are provided by the NFI. The same rules are applied to the forest land remaining forest and land converted to forest. The last category is identified by the age of dominant tree species in the NFI category afforested lands – if age of the stand was above zero in 1990, it is moved to the Forest land remaining forest's category, and 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. The total area of the Land converted to forest is shown in Table 7.10. In 2010 it start to reduce, because are afforested in 1990-1992 in the convention reporting is moved to the forest land remaining forest category. The figures on land conversion to forest land will be updated as soon as the undated information will be available from the NFI.

Table 7.10 Total area of the land converted to forest

Year	Land converted to forest at the end of year, 1000 ha	forest on dry mineral soils, 1000 ha	forest on drained mineral soils, 1000 ha	forest on wet mineral soils, 1000 ha	forest on drained organic soils, 1000 ha
1990	5,14	3,77	0,67	0,35	0,35
1991	14,06	11,34	1,71	0,35	0,66
1992	20,62	16,89	2,72	0,35	0,66
1993	29,65	23,87	4,08	0,69	1,01
1994	39,23	31,73	5,8	0,69	1,01
1995	49,12	38,98	7,73	0,69	1,72
1996	60,47	47,98	9,4	0,69	2,4
1997	71,72	57,74	10,46	0,95	2,57
1998	80,73	65,29	11,22	1,29	2,93

114 30 % after 2001.
115 Līpiņš, "Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resersu un to izmantošanas efektivitātes novērtējums)."

Year	Land converted to forest at the end of year, 1000 ha	forest on dry mineral soils, 1000 ha	forest on drained mineral soils, 1000 ha	forest on wet mineral soils, 1000 ha	forest on drained organic soils, 1000 ha
1999	92,8	76,95	11,62	1,29	2,94
2000	103,09	85,51	12,66	1,99	2,93
2001	116,76	96,84	14,45	2,19	3,28
2002	126,85	104,92	15,45	2,54	3,94
2003	137,6	114,62	15,8	2,54	4,63
2004	150,2	125,72	17,96	2,56	3,95
2005	163,16	137,04	19,18	2,74	4,2
2006	176,5	148,73	20,39	2,92	4,46
2007	190,21	160,78	21,6	3,1	4,72
2008	204,28	173,2	22,81	3,28	4,99
2009	218,72	184,37	25,21	3,61	5,52
2010	213,58	180,81	24,39	3,24	5,13
2011	204,66	173,38	23,25	3,23	4,81
2012	198,1	167,9	22,19	3,22	4,79

7.2.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

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 the forestry purposes, which have to reach a crown density of 20 % or tree height of 5 m are accounted under forest land; as well as the 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. Area estimates are derived from the NFI data[116].

7.2.4 Methodological issues

Forest land remaining forest

Calculations of carbon stock changes and GHG emissions in forest lands are based on activity data provided by the NFI (area, living biomass and dead wood) and Level I forest monitoring data (soil). National statistics (State forest service) are used to estimate forest fires and commercial felling related emissions and removals. The calculation of GHG emissions and CO_2 removals in historical forest lands is based mainly on research report "Elaboration of the model for calculation of the CO_2 removals and GHG emissions due to forest management"[117] and factors and coefficients elaborated within the scope of the research program on impact of forest management on GHG emissions and CO_2 removals[118].

Changes of the carbon stock and GHG emissions are estimated according to the Tier 2 methods with country specific activity data. Default method (the carbon loss to be subtracted from the carbon removals for the reporting year) is used in calculations of removals and

116 http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls

117 Lazdiņš, A., Donis, J., Strūve, L., 2012. Latvijas meža apsaimniekošanas radītās ogļskābās gāzes (CO_2) piesaistes un siltumnīcefekta gāzu (SEG) emisiju references līmeņa aprēķina modeļa izstrāde (Elaboration of the model for calculation of the CO_2 removals and GHG emissions due to forest management) (No. 5.5-9.1-0070-101-12-91). LVMI Silava, Salaspils. Lazdiņš, A., Donis, J., Strūve, L., 2012b. Latvia's national methodology for reference level of forest management activities (English summary).

118 Lazdiņš et al., *Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO₂ Piesaisti Novērtējums (pārskats Par 2013. Gada Darba Uzdevumu Izpildi).*

emissions of CO_2 in living biomass according to the Equation 3.2.2 of the IPCC GPG LULUCF 2003.

Methodologies for estimation of carbon stock changes and GHG emissions are considerably improved since last reporting because of the efforts devoted to elaboration of the national forest management reference level. The methodologies are merged together into the "Forest data modelling tool", which is actually complex spreadsheet elaborated according to the LVS ISO/IEC 26300:2009 standards (fully compatible with open document standard). Separate versions (with different input data) are elaborated for convention and the Kyoto protocol reporting. In future these models will be merged to simplify calculations. The model is still under development, current working version can be downloaded from the website "Land use, land use change and forestry sector in Latvia"[119]. Currently the model is only in Latvian[120].

The concept of the "Forest data modelling tool":

1. land use and land use change data are elaborated separately to simplify model structure, the connection is organized as linked tables;
2. main input data – area under different growth and management conditions, species composition, gross annual increment, mortality per area, harvesting rate and species composition and others;
3. calculations are done on annual basis using periodic (5 years period) and annual input data;
4. historical data (1990-2004) – backward calculation on the base of the NFI data; for 1970-1989 research data and expert judgements are utilized;
5. all modules in the spreadsheet are merged together following to the forest management cycle (from growth to decay);
6. the model combines all land use categories; however; only convention of forest land to cropland and settlement, conversion of grassland to forest land and conversion of cropland to grassland and backward are implemented in the model.

Content of the model (separate calculation sheets):

- living biomass (annual increment of living biomass, summary of growing stock and characteristics of biomass);
- mortality (natural reduction of number and stock of living trees, estimation of decay of harvesting residues, calculation of dynamics of carbon stock in dead biomass);
- commercial harvesting (input to the harvested wood products, losses in above-ground and below-ground biomass);
- harvested wood products (carbon stock change in locally originated and consumed harvested wood products);
- emission from soils (CO_2 and N_2O from drained organic soils and N_2O emissions from drained mineral soils);
- fire (emissions of CO_2, CH_4 and N_2O due to incineration of harvesting residues and wildfires);
- deforestation (as a land use change to estimate area of managed forests);

119 https://sites.google.com/site/lvlulucf/activity/nir-1990-2011/Meza%20apsaimniekosana%20%28FMRL%2020120730%29.ods?attredirects=0&d=1

120 Lazdiņš et al., "Review of the National Forest Management Reference Level in Latvia."

- afforestation (carbon stock change in living biomass, dead wood and litter);
- cropland (emissions from soil, carbon stock change in living and dead biomass);
- grassland (emissions from soil, carbon stock change in living and dead biomass, wildfires);
- conversion of farmland (emissions or removals in soil);
- settlements (carbon stock change in living and dead biomass);
- wetlands (emissions from soil, carbon stock change in living and dead biomass).

Module for estimation of the gross annual increment of living biomass:

- increment figures on the base of the NFI (Table 7.11), historical recalculations (before 2004) was done together with mortality rate (Table 7.15) estimations in 2011 and 2012[121];
- species, age of stands and dimensions specific gross increment equations for the most common tree species (values specific for birch are used for other tree species);

species specific wood densities (Table 7.12), different BEFs (

- Table 7.13);
- average carbon stock in biomass is provided in Table 7.14.

Table 7.11 Average periodic gross increment of living trees (m^3 ha- 1 yr)[122]

Species	1970-1993	1994-1998	1999-2003	2004-2008	2009-2012
Aspen	16.0	16.3	14.7	12.0	10.4
Grey alder	7.0	7.6	7.8	8.3	8.9
Birch	8.6	8.8	8.7	8.1	7.8
Spruce	7.4	8.5	9.9	10.8	11.7
Black alder	10.8	11.8	12.1	12.1	9.9
Oak, ash	6.3	6.5	6.2	6.0	5.7
Other species	8.7	7.8	7.5	8.3	12.0
Pine	7.0	7.1	7.3	7.2	8.3

Table 7.12 Wood density[123]

Species	Density, tons m^{-3}
Aspen	0.40
Grey alder	0.41
Birch	0.47
Spruce	0.36
Black alder	0.41
Oak, ash	0.41

[121] Jānis Donis, *Latvijas Meža Resursu Ilgtspējīgas, Ekonomiski Pamatotas Izmantošanas Un Prognozēšanas Modeļu Izstrāde* (Salaspils: LVMI Silava, 2011), http://www.zm.gov.lv/doc_upl/MAF2011_S82.pdf; Lazdiņš, Donis, and Strūve, Latvijas Meža Apsaimniekošanas Radītās Ogļskābās Gāzes (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju References Līmeņa Aprēķina Modeļa Izstrāde.

[122] Lazdiņš, Donis, and Strūve, Latvijas Meža Apsaimniekošanas Radītās Ogļskābās Gāzes (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju References Līmeņa Aprēķina Modeļa Izstrāde.

[123] Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2013. Gada Darba Uzdevumu Izpildi).

Species	Density, tons m^{-3}
Other species (mostly *Salix* sp.)	0.41
Pine	0.38

Table 7.13 Coefficients for calculation of above ground biomass from stem biomass[124]

Species	Stem biomass to crown biomass	Stem biomass to below-ground biomass
Aspen	1.22	0.28
Grey alder	1.45	0.34
Birch	1.19	0.29
Spruce	1.58	0.43
Black alder	1.45	0.28
Oak, ash	1.45	0.18
Other species	1.45	0.27
Pine	1.27	0.31

Table 7.14 Average carbon stock in living biomass[125]

Species	C, kg in ton of dry biomass[126]
Aspen	508
Grey alder	522
Birch	521
Spruce	528
Black alder	522
Oak, ash	522
Other species	522
Pine	531

Mortality and decay:

- species specific coefficients of mortality (Table 7.15) not dependant of size of tree (dominant or undergrowth trees), depends from age of stand and average dimensions of trees;
- calculations on the base of NFI using backward calculation for 5 years period, assuming equal rate of commercial thinning in 90^{ths};
- 20 years decomposition period (mortality since 1970 considered as emissions);
- constant mortality values considered for periods before 1990.

Table 7.15 Average periodic mortality (m^3 ha^{-1} yr.)[127]

Species	1970-1993	1994-1998	1999-2003	2004-2008	2009-2012
Aspen	2.6	3.1	3.1	3.1	3.1

124 Ibid.

125 Ibid.

126 Dried at 105 °C temperature.

127 Lazdiņš et al., *Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2013. gada Darba Uzdevumu Izpildi)*; Lazdiņš, Donis, and Strūve, *Latvijas Meža Apsaimniekošanas Radītās Ogļskābās Gāzes (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju References Līmeņa Aprēķina Modeļa Izstrāde.*

Species	1970-1993	1994-1998	1999-2003	2004-2008	2009-2012
Grey alder	0.5	0.5	0.6	0.8	0.8
Birch	2.5	2.7	2.5	2.3	2.3
Spruce	2.6	2.8	3.1	3.3	3.3
Black alder	2.1	2.3	2.3	2.6	2.6
Oak, ash	3.6	4.2	4.2	4.6	4.6
Other species	1.2	1.0	1.1	1.2	1.2
Pine	1.8	2.0	2.2	2.4	2.4
Average	1.33	2.3	1.44	1.49	1.52

Summary of carbon stock in different forest carbon pools is shown in Figure 7.2. The most important carbon pool is soil; however the most of dynamics takes place in living biomass carbon pool.

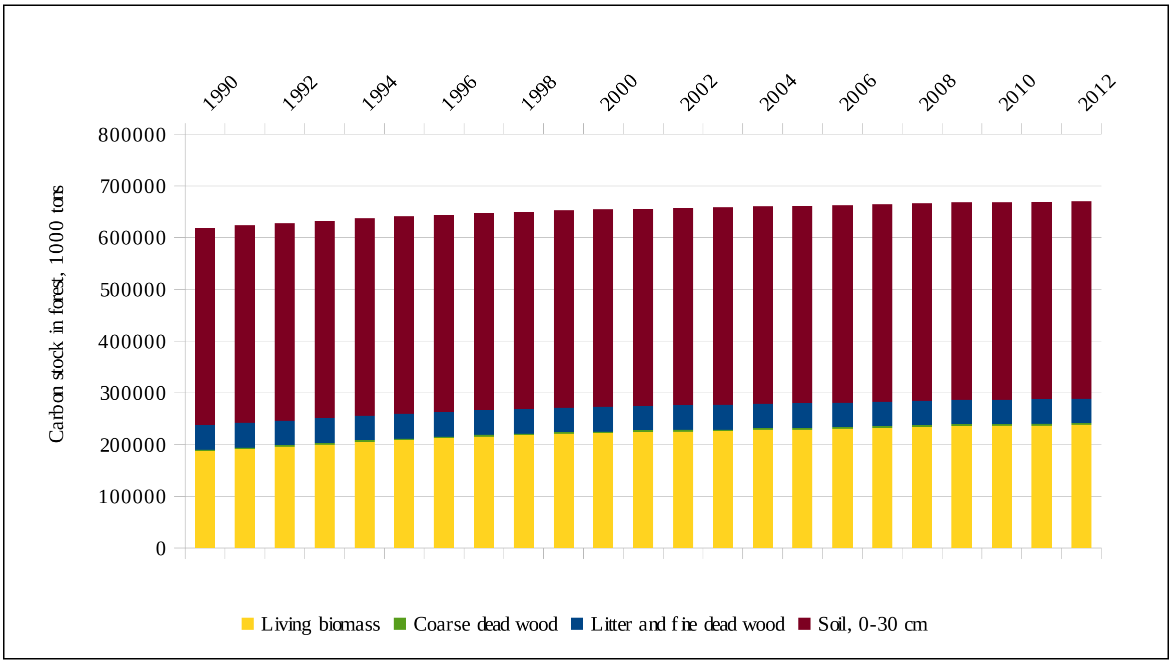


Figure 7.2 Carbon stock in different forest carbon pools

Alternative evaluation of carbon stock changes in dead wood using the NFI data (comparison of situation in 2004-2007 and 2009-2012) shows significant increase of dead wood stock in forest lands and no changes in grassland (Figure 7.3).

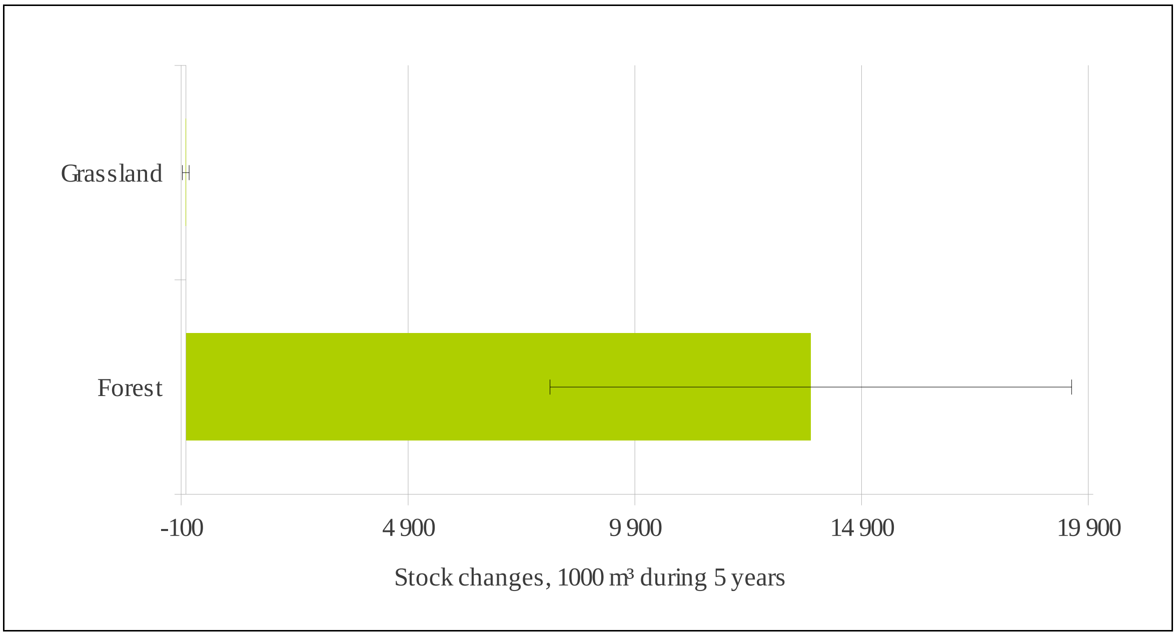


Figure 7.3 Stock changes of dead wood in forest land and grassland[128]

Commercial felling:

1. dominant species specific harvesting data since 1970 (1990-2012 Central statistical bureau, 1970-1989 research papers[129]);

decomposition of crown and underground biomass – 20 years; species specific wood densities and different BEFs for coniferous and deciduous trees (Table 7.12 and

2. Table 7.13).

The methodology for harvested wood products is based on Rüter, S., 2011. Projection of Net Emissions from Harvested Wood Products in European Countries, Johann Heinrich von Thünen Institute, Hamburg. More detailed description follows in further chapters.

Summary of emissions due to commercial harvesting is shown in Figure 7.4.

128 Source – NFI, unpublished database snapshot, 14.01.2013.

129 Zigurds Saliņš, *Mežs - Latvijas Nacionālā Bagātība* (Jelgava: Jelgavas tipogrāfija, 2002); Zigurds Saliņš, *Meža izmantošana Latvijā: stāvoklis, perspektīvas* (Jelgava [Latvia]: LLU Meza izmantosanas katedra, 1999).

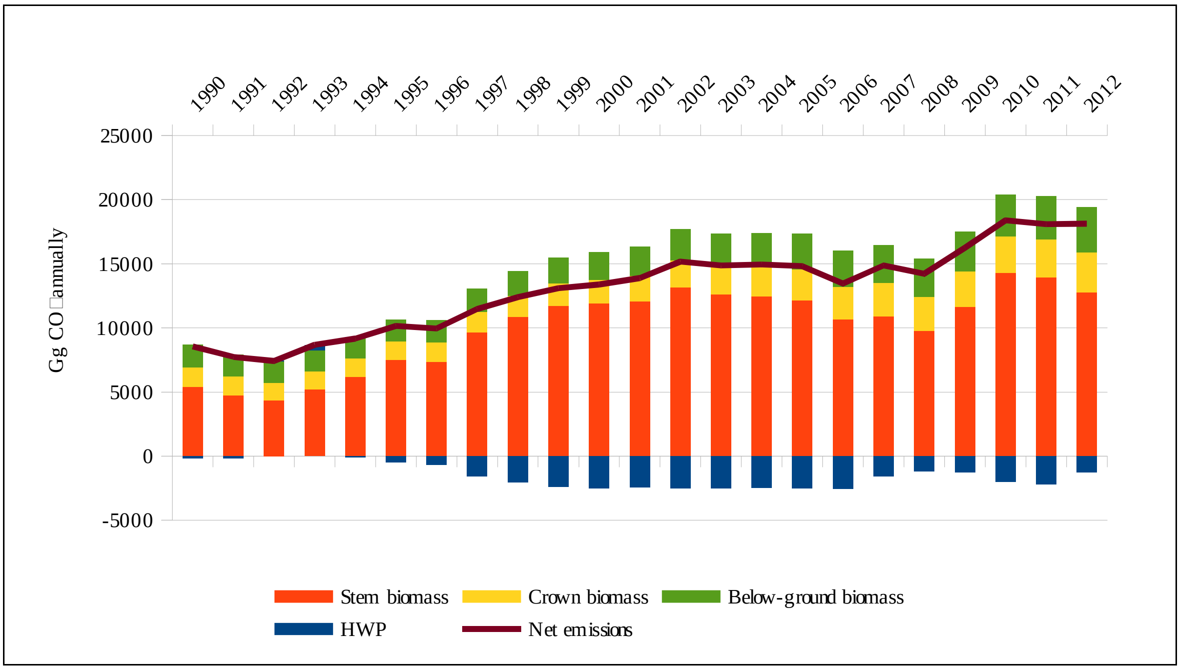


Figure 7.4 Summary of emissions due to commercial harvesting

Emissions from drained soils are accounted – 0.68 tons C ha^{-1} (Table 3.2.3 of the IPCC GPG LULUCF 2003) and 0.943 kg N_2O ha^{-1} annually from organic soils and 0.094 kg N_2O ha^{-1} annually from drained mineral soils. No CO_2 emissions are accounted for drained mineral soils, because the forest soil monitoring data shows no losses of carbon stock in drained mineral soils between 1990 and 2012[130]. Emissions of CO_2 from drained organic soils are calculated according to Equation 3.2.15 of the IPCC GPG LULUF. Emissions of N_2O from drained organic forest soils were calculated according to Equation 3a.2.1 and Table 3a.2.1.

Methodology for calculation of emissions due to wildfires and incineration of harvesting residues is described in chapter 7.8.4 Methodological issues; burnt biomass in forest fires is considered to be equal to stock of organic material in living biomass, dead wood and litter in a particular year, combustion factor is considered 0.45[131]. Incineration of harvesting residues is going down in Latvia and in 2012 LSFRI Silava has opportunity to collect information about incineration of harvesting residues in private forests; according to results of the questionnaire about 15 % of harvesting residues were left for incineration during last 3 years in private forests, in state forests no harvesting residues are left for incineration. Weighted average share of left for incineration residues is 7 %.

Area of organic soils in the forest lands is reported according to structure of distribution of the forest stand types. Total area of organic soils as well as total area of forests was updated according to research data on land use structure according to the NFI[132].

New project will be implemented in 2014 to estimate carbon stock change in organic forest soil due to establishment of drainage system. The empiric material will be collected in experimental trials established in early 60[ths].

130 Lazdiņš et al., *Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2012. gada Darba Uzdevumu Izpildi).*

131 TABLE 3A.1.12 COMBUSTION FACTOR VALUES (PROPORTION OF PREFIRE BIOMASS CONSUMED) FOR FIRES IN A RANGE OF VEGETATION TYPES

132 Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)."

Data from the BioSoil net (95 plots) have been elaborated for the years 2006 and 2012 putting together the mineral soil and litter pools and then analyzing the trend in changes of the total carbon stock and its significance. The result shows that there is no statistically significant difference in total carbon stock between 2006 and 2012.

The litter and soil pools have been analyzed altogether since the separation of humic layers in the year 2006 and in the year 2012 has not been done following the same methodology, so that data on litter and data on soil cannot be compared among those 2 years.

However, to the accumulation of litter the increase of humic layers always associates, vice versa, a decrease, or a removal of litter causes a decrease of humic layers and therefore of soil carbon stocks in the soil carbon pool, as defined in the 2003 IPCC GPG for LULUCF. Consequently, whether the litter stock increases also the soil stock increases and vice versa, to a decrease in litter stock a decrease in soil stocks (humic layers) follows.

Therefore, the analysis conducted on the sum of both pools giving information on the total trends gives also the needed information on the trend of both pools i.e. whether the sum of litter and soil is not a source then both, the litter and the soil are not a source.

Land converted to forest

In section lands converted to forest land all categories except grasslands converted to forest land are notated as NO because other conversions do not take place in practice. Grasslands converted to forest land are estimated using spatial approach – analysis of the NFI data about forests on former farmlands which afforested after 1990. Areas where trees did not reach 2 cm diameter at breast height were excluded from estimation and moved back to grasslands category to avoid accounting of extensively managed farmlands under forest land category. The year of afforestation of every single NFI plot selected for analysis were determined by subtraction of age of stand from a year when field measurements were done.

Gains in living biomass on afforested lands estimated using interpolation (stock change method assuming that the increment structure in areas afforested in different periods is similar)[133]. Weighed average wood density for a particular year in forest land remaining forest is used to convert stem volume to biomass. Similarly, average carbon stock in living biomass and BEFs characteristic for particular year was applied to calculation. 2014 is the first year, when, both, carbon stock change in living biomass in land remaining forest and land converted to forest is calculated using Tier 2 method.

Losses of living biomass in afforested lands notated as NO because no commercial felling takes place in these stands (the smallest commercially and legally valuable harvesting age is 30 years for grey alder).

Emissions from organic soils in afforested lands calculated using the same approach as for emissions from drained organic soils on lands remaining forest.

This is the first year, when dead wood and litter are accounted as sink categories in afforested lands. It is assumed that average stock of dead wood, and consequently in litter in historical forest lands and afforested lands becomes equal at certain stand age. The assumption is based on the NFI field measurements considering that increment of the dead wood stock in afforested areas will follow linear regression and will reach values characteristic for the forest land within 45 years. This assumption will be corrected in the next inventory compiling actual figures of the dead wood stock change in afforested lands.

133 L.U. Consulting, "Augšņu un reljefa izejas datu sagatavošana un Eiropas Komisijas izstrādāto augsnes un reljefa kritēriju mazā labvēlīgo apvidu noteikšanai piemērošanas simulācija (Projekta kopsavilkuma ziņojums)" *(Elaboration of soil and terrain data and simulation of application of the criteria elaborated by the European Commission for identification of less valuable regions (Summary of the project report))*, Latvijas Republikas Zemkopības Ministrija, 2010.

It is assumed in the calculation, that dead wood stock in afforested lands will reach 1.1 tons C ha^{-1} within 150 years. Values of average carbon stock is dead wood in 1990-2012 were used in calculation. These values might be updated after recalculation of the NFI data on the stock of dead wood in forest. Wood density is considered according to average values of the living biomass in forest land remaining forest in a particular year. Similarly, weighted average above-ground and below-ground biomass expansion factors and carbon content in living biomass for a particular year obtained in living biomass calculations are used to convert stem biomass to the total biomass.

Average carbon stock in litter is 15.1 tons C ha^{-1} according to the BioSoil project forest soil inventory data[134]. Considering the same transformation period of 150 years, average increment of carbon stock in the litter carbon pool is 0.1 tons C ha^{-1}. It is important to note, that BioSoil sampling method implemented in Latvia did not considered fine fraction of dead wood, therefore it is not accounted at all or partially included into the litter layer.

In the Kyoto protocol Article 3.3 and 3.4 reporting afforested as well as deforested areas are not changing land use category after completion of 20 years completion period, respectively carbon stock changes in dead biomass are accounted under these categories until they reach point of equilibrium with average stock in forest lands. In the convention report land converted to forest more than 20 years ago is moved for forest land remaining forest category.

No removals in soil are accounted due to conversion to forest land, because there are no scientific evidences of increase of carbon stock in soil after afforestation. The project started in 2012 on comparison of carbon stock in historical cropland and grassland shows no difference in carbon stock between grassland, recently afforest land and historical forest land in the upper soil layer (0-40 cm)[135]; however, there are evidences of statistically significant carbon stock changes in deeper soils layers after afforestation[136].

7.2.5 Uncertainties and time-series consistency

Uncertainties are estimated on the base the NFI, GHG inventory of Sweden (where coefficients from the inventory are used) and expert judgement. Summary of uncertainties is provided in Table 7.16.

Table 7.16 Summary of uncertainties

IPCC GHG Source and Sink Categories (LULUCF is included)		Uncertainty of activity data	Emission factor uncertainty	Combined uncertainty
5.A.1 Forest Land remaining Forest Land	CO_2	1,73%	20,00%	20,07%
5.A.2 Land converted to Forest Land	CO_2	3,40%	20,00%	20,29%
5.B.1 Cropland remaining Cropland	CO_2	0,78%	28,00%	28,01%
5.B.2 Land converted to Cropland	CO_2	35,00%	28,00%	44,82%
5.C.1 Grassland remaining Grassland	CO_2	0,92%	21,00%	21,02%
5.C.2 Land converted to Grassland	CO_2	50,00%	21,00%	54,23%
5.D.1 Wetlands remaining Wetlands	CO_2	0,53%	35,00%	35,00%

134 Bārdule et al., "Forest soil characteristic in Latvia according results of the demonstration project BioSoil (Latvijas meža augsņu īpašību raksturojums demontrācijas projekta BioSoil rezultātu skatījumā)."

135 Andis Lazdiņš, Atbalsts Klimata Pētījumu Programmai (starpziņojums Par 2012. Gada Darba Uzdevumu Izpildi) (Salaspils: LVMI Silava, 2012), https://sites.google.com/site/lvlulucf/research-projects/atbalstsklimatapetijumuprogrammaistarpzinojumspar2012gadarezultatiem.

136 R. Kasparinskis et al., "Long term impact of afforestation on soil morphology and properties, Lauksaimniecības zemju apmežošanās ilgtermiņa ietekme uz augsnes morfoloģiju un īpašībām," Forest science no. 24(57) p. 17–40 (2011), http://agris.fao.org/agris-search/search/display.do?f=2012%2FLV%2FLv1203.xml%3BLV2012000112.

IPCC GHG Source and Sink Categories (LULUCF is included)		Uncertainty of activity data	Emission factor uncertainty	Combined uncertainty
5.E.1 Settlements remaining Settlements	CO_2	0,37%	32,00%	32,00%
5.E.2 Land converted to Settlements	CO_2	19,00%	32,00%	37,22%
5.G. Other	CO_2	0,06%	30,00%	30,00%
5.A.1 Forest Land remaining Forest Land	CH_4	1,73%	70,00%	70,02%
5.C.1 Grassland remaining Grassland	CH_4	0,92%	75,00%	75,01%
5.A.1 Forest Land remaining Forest Land	N_2O	1,73%	50,00%	50,03%
5.B.2 Land converted to Cropland	N_2O	35,00%	100,00%	105,95%
5.C.1 Grassland remaining Grassland	N_2O	0,92%	70,00%	70,01%
5.D.2 Land converted to Wetlands	N_2O	90,00%	95,00%	130,86%

Uncertainty of activity data is usually calculated as relative standard error multiplied by 2 as percentage. Uncertainty of area is calculated as standard error of proportion with 95 % confidence interval. Uncertainties calculated according to IPCC GPG LULUCF, section 5.2 IDENTIFYING AND QUANTIFYING UNCERTAINTIES as twice the relative standard error. For harvesting stock uncertainty according to forest regulations is 10 %. BEFs utilized in calculations according to expert judgement have uncertainty level of 0.9-2.0 % for different species, 0.8 % in total according to the study results. Combined category uncertainty is calculated according to IPCC GPG LULUCF section 5.2.2.1 TIER 1 – SIMPLE PROPAGATION OF ERRORS.

7.2.6 Category-specific QA/QC and verification

Quality control procedures named in IPCC GPG LULUCF 2003, Table 5.5.1 were done for all calculations, including elaboration of country specific BEFs, wood density and carbon content factors. 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.

The NFI 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;
- 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 equations used in calculations in the NFI and development of verification tools continues therefore changes in the input data provided by the NFI are possible.

The NFI team applies a quality guidelines and QA/QC measures to the all work stages. Documentation is in Latvian with brief descriptions of NFI methods and measurements in English[137].

The data based on forest statistics were produced by the LSFRI Silava[138]. 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 Category-specific recalculations

The major improvement of the inventory were application of country specific BEFs, relative wood density and carbon content in biomass on the base of the study on evaluation of impact of different forest management measures on GHG emissions and CO_2 removals in commercial forests. In spite the absolute impact of the switching to the country specific coefficients was not statistically significant, we were able to report carbon stock changes using Tier 2 level methodology and uncertainty level considerably decreased (from 30 % to 0.8 % for BEFs).

Minor changes are introduced in NO_x and CO calculations due to incineration of biomass by application of the national GHG accounting model for LULUCF sector (EPIM) and harmonization of the country area in the land use calculations. The result contains minor numeric changes due to different activity data.

Recalculation of the forest area and area of drained organic soils in forest is done due to harmonization of the country area data for the whole period. Only minor changes are implemented. The area of drained organic soils in forest is estimated on the base of updated NFI data.

Recalculation of gains and losses in living biomass is done due to implementation of EPIM model in LULUCF sector and application of updated activity data (forest area). The EPIM model contains country specific density of biomass (Table 7.12), BEFs (

Table 7.13) and carbon content in biomass (Table 7.14). The average relative density value was applied to less common species (grey alder, black alder, oak, ash, willow). Losses in living biomass now includes natural mortality and updated figures on harvesting stock. Both, mortality and harvesting stock are updated according to results of the National forest inventory (NFI) second cycle. Linear increase of mortality and harvesting stock is applied to the whole period.

The gross increment (the potential increment projection of increment of living trees at the beginning of calculation period, including commercial felling and natural mortality) utilized in calculation is shown in Table 7.11. The updated figures of natural mortality are shown in Table 7.15**. Updated felling stock is shown in**

137 Zemkopības ministrija, "Meža statistiskās inventarizācijas veikšanas un mežaudzes sekundāro parametru aprēķināšanas metodika (instrukcija Nr. 10 no 17.03.2004.)" (Latvijas Republikas Zemkopības ministrija, 2004),https://sites.google.com/site/lvlulucf/literature/MSI_metodika_Instrukcija_%282004%29.pdf?attredirects=0&d=1; LSFRI Silava, "Methods utilized to recalculate historical forest increment data" (LSFRI Silava, 2007), https://sites.google.com/site/lvlulucf/literature/Recalculationsofhystoricalremovals2007.pdf?attredirects=0&d=1.

138 http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls

Table 7.9.

The EPIM model contains country specific density of biomass (Table 7.12), BEFs (Table 7.17) and carbon content in biomass (Table 7.14). The average relative density value was applied to less common species (grey alder, black alder, oak, ash, willow). Losses in living biomass now includes natural mortality and updated figures on harvesting stock. Both, mortality and harvesting stock are updated according to results of the National forest inventory (NFI) second cycle. Linear increase of mortality and harvesting stock is applied to the whole period.

Table 7.17 Species specific BEFs

Species	Stem biomass to crown biomass	Stem biomass to below-ground biomass
Aspen	1.22	0.28
Grey alder	1.45	0.34
Birch	1.19	0.29
Spruce	1.58	0.43
Black alder	1.45	0.28
Oak, ash	1.45	0.18
Other species	1.45	0.27
Pine	1.27	0.31

Table 7.18 Natural mortality (m^3 ha^{-1} year)

Year	1970-1993	1994-1998	1999-2003	2004-2008	2009-2012
Aspen	2.6	3.1	3.1	3.1	3.1
Grey alder	0.5	0.5	0.6	0.8	0.8
Birch	2.5	2.7	2.5	2.3	2.3
Spruce	2.6	2.8	3.1	3.3	3.3
Black alder	2.1	2.3	2.3	2.6	2.6
Oak, ash	3.6	4.2	4.2	4.6	4.6
Other species	1.2	1.0	1.1	1.2	1.2
Pine	1.8	2.0	2.2	2.4	2.4

Table 7.19 Updated figures on felling stock (m^3 year)

Year	Total felling stock	Felling excluding deforestation	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other species	Pine
1970	14 007 442	14 007 442	1 264 172	900 858	4 064 757	3 014 809	242 869	54 095	17	4 465 865
1971	12 897 942	12 897 942	1 164 040	829 503	3 742 796	2 776 012	223 631	49 810	16	4 112 134
1972	9 153 378	9 153 378	826 093	588 679	2 656 178	1 970 073	158 706	35 349	11	2 918 288
1973	6 657 002	6 657 002	600 795	428 130	1 931 766	1 432 780	115 423	25 708	8	2 122 392
1974	6 240 939	6 240 939	563 245	401 372	1 811 030	1 343 232	108 209	24 102	8	1 989 742
1975	5 824 877	5 824 877	525 695	374 614	1 690 295	1 253 683	100 995	22 495	7	1 857 093
1976	6 102 252	6 102 252	550 728	392 453	1 770 785	1 313 382	105 804	23 566	8	1 945 526
1977	6 240 939	6 240 939	563 245	401 372	1 811 030	1 343 232	108 209	24 102	8	1 989 742
1978	6 102 252	6 102 252	550 728	392 453	1 770 785	1 313 382	105 804	23 566	8	1 945 526
1979	6 240 939	6 240 939	563 245	401 372	1 811 030	1 343 232	108 209	24 102	8	1 989 742
1980	6 240 939	6 240 939	563 245	401 372	1 811 030	1 343 232	108 209	24 102	8	1 989 742

Year	Total felling stock	Felling excluding deforestation	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other species	Pine
1981	6 518 315	6 518 315	588 278	419 211	1 891 521	1 402 931	113 018	25 173	8	2 078 175
1982	6 379 627	6 379 627	575 762	410 292	1 851 275	1 373 081	110 613	24 637	8	2 033 959
1983	6 795 690	6 795 690	613 311	437 050	1 972 011	1 462 630	117 827	26 244	8	2 166 608
1984	6 518 315	6 518 315	588 278	419 211	1 891 521	1 402 931	113 018	25 173	8	2 078 175
1985	6 379 627	6 379 627	575 762	410 292	1 851 275	1 373 081	110 613	24 637	8	2 033 959
1986	7 073 065	7 073 065	638 344	454 889	2 052 501	1 522 329	122 637	27 315	9	2 255 041
1987	7 073 065	7 073 065	638 344	454 889	2 052 501	1 522 329	122 637	27 315	9	2 255 041
1988	7 350 440	7 350 440	663 377	472 727	2 132 991	1 582 028	127 446	28 386	9	2 343 474
1989	7 350 440	7 350 440	663 377	472 727	2 132 991	1 582 028	127 446	28 386	9	2 343 474
1990	6 934 377	6 934 207	625 812	445 958	2 012 206	1 492 443	120 229	26 779	9	2 210 770
1991	6 102 252	6 102 078	550 713	392 442	1 770 735	1 313 345	105 801	23 565	8	1 945 470
1992	5 547 502	5 547 324	500 646	356 764	1 609 753	1 193 945	96 182	21 423	7	1 768 603
1993	6 657 002	6 656 820	600 778	428 119	1 931 713	1 432 741	115 420	25 708	8	2 122 333
1994	7 905 190	7 905 004	713 427	508 393	2 293 918	1 701 387	137 061	30 528	10	2 520 281
1995	9 569 440	9 569 250	863 625	615 425	2 776 858	2 059 581	165 917	36 955	12	3 050 877
1996	9 430 753	9 430 560	851 108	606 506	2 736 612	2 029 731	163 512	36 419	12	3 006 660
1997	12 343 191	12 342 995	1 113 956	793 813	3 581 758	2 656 572	214 009	47 667	15	3 935 205
1998	13 868 754	13 868 556	1 251 638	891 926	4 024 454	2 984 917	240 460	53 558	17	4 421 586
1999	14 978 255	14 978 054	1 351 770	963 281	4 346 415	3 223 713	259 698	57 843	19	4 775 317
2000	15 255 630	15 255 428	1 397 887	733 914	4 513 667	4 258 064	0	55 543	0	4 296 352
2001	15 533 005	15 532 802	1 472 331	707 544	4 305 474	4 044 902	277 673	41 184	0	4 683 693
2002	16 919 880	16 919 676	1 680 352	980 003	4 778 894	4 217 734	268 954	48 639	0	4 945 099
2003	16 226 443	16 226 237	1 637 830	1 107 397	4 384 285	3 667 680	257 726	54 377	0	5 116 942
2004	15 949 067	15 948 861	1 510 812	1 266 763	4 469 922	3 456 403	290 493	53 840	0	4 900 629
2005	15 671 692	15 671 485	934 515	926 282	3 967 485	4 086 559	288 195	91 635	0	5 376 813
2006	13 605 248	13 605 039	1 301 343	948 876	3 926 376	2 624 310	281 462	57 934	0	4 464 738
2007	13 882 623	13 882 413	1 283 200	1 171 598	4 195 717	2 774 685	277 458	70 254	203	4 109 297
2008	12 429 039	12 428 827	1 090 368	984 599	3 628 022	2 183 286	282 894	50 782	0	4 208 876
2009	14 878 261	14 878 047	1 336 713	845 116	4 359 394	2 373 458	280 622	60 714	0	5 622 030
2010	18 002 644	18 002 430	1 568 010	1 141 615	6 287 811	2 639 431	412 638	62 177	0	5 890 748
2011	17 822 439	17 822 225	1 588 362	1 387 787	4 864 902	3 046 684	312 421	92 738	11 832	6 517 498
2012	16 268 049	16 267 834	1 129 763	4 501 454	3 632 980	2 384 013	1 004 163	142 595	0	3 472 867

Recalculation of emissions from drained organic soils in forest lands remaining forest is done due to changes in activity data, no emissions' factors are changed.

Recalculation of carbon stock change in dead biomass is done due to implementation of EPIM model, updating of activity data and natural mortality factors since 1970. The species specific mortality factors are utilized according to results of the second cycle of the National forest inventory. Decomposition period is considered 20 years for above and below ground biomass according to IPCC GPG LULUCF guidelines. The study on evaluation of decomposition of below-ground biomass, harvesting residues and litter is in the implementation phase. Preliminary results shows that decomposition period of all types of biomass will be slightly or considerably (for pine) longer.

Area of drained mineral and organic soils is updated according to recalculations due to harmonization of the country area. No accounting methods are changed. Notation key is changed to NA to CH_4 emissions due to drainage of soil, because no Tier 1 methodology is provided in IPCC GPG LULUCF (2003) to calculate CH_4 emissions.

Major changes are done in activity data for controlled biomass burning. Amount of harvesting residues is recalculated according actual harvesting data. The assumptions for share of incinerated biomass and calculation methods are not changed.

Considerable improvements are done to calculate emissions due to wildfires in forest lands. Instead of using default factors of incinerated biomass (IPCC GPG LULUCF), sum of average growing stock and dead biomass in a particular year is used as input to estimate emissions due to wildfires. The accounting method is not changing.

In the land converted to forest category distribution of the forest stand types is recalculated according to updated information on afforested lands (stand types are determined for several NFI plots in afforested lands, having only remark on afforestation and dominant species in the previous NFI cycle).

Recalculation of changes of carbon stock in living biomass is done according to updated activity data applying the same wood density values and BEFs as in forest land remaining forest. Minor recalculations were done due to inconsistency between Kyoto protocol Article 3.3 and the Convention reporting. Different approach in reduction of afforested areas (moving areas of lands afforested 20 years ago to forest land remaining forest category) after completion of 20 years transition period is applied.

Major changes were applied to calculation of carbon stock changes in dead biomass considering 150 years transition period (2 average rotations) instead of 20 years to reach values of dead wood stock characteristic for historical forest lands. The mathematical estimation of the conversion period based on field measurement data is going to be elaborated; however, not completed yet.

Wildfires in lands converted to forest are marked as not occurring, because no evidences of forest fires are found in the NFI lots representing afforested areas as well as in the State forest service (SFS) data base. Notation keys of emissions due to wildfires in lands converted to forest are updated to NO according to updated activity data.

7.2.8 Category-specific planned improvements

The most important planned improvements:

- estimation of decay period for dead wood (harvesting residues and below-ground biomass, planned to complete until report 1990-2013);

- estimation of carbon stock changes in drained organic soils in forest lands (2014);
- estimation of transition period for dead wood and litter carbon stock in afforested lands (2015);
- development of production version of EPIM model, including instantaneous calculation of uncertainties, broader representation of land use change options and integration of Kyoto protocol and the convention reporting;
- improvement and simplification of structure of land use change calculation model, including uncertainty estimates;
- improved quality control of utilized data and calculations by broader use of cross-checks and indicative values represented in different databases (like dead wood stock or growing stock of living biomass.

7.3 CROPLAND (CRF 5.B)

7.3.1 Source category description

Two key source categories are accounted under this category: CO_2 emissions from land converted to cropland and CO_2 emissions from cropland remaining cropland.

Under the cropland's category emissions from organic soils, lime applications and due to conversion to cropland (living and dead biomass, soil and N_2O emissions) are reported. Net aggregated emissions from cropland were 1381 Gg of CO_2 eq. in 2012. Lime applications were constant during the reporting period[139], except 2002 and 2003, when due to regulatory reasons (support for liming of farmlands) use of liming material considerably increased.

The total area of croplands is estimated using the approach described further in chapter Category-specific recalculations. Updated values split into cropland remaining cropland and cropland converted less and more than 20 years ago is shown in Table 7.20.

There is statistically significant increase of volume of growing stock of trees in cropland; however, uncertainty level is 60 %, therefore these figures are not used in calculations. Completion of the second round of the NFI in 2014 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.

Table 7.20 Area of Cropland

Year	Cropland remaining cropland at the end of year, 1000 ha		Land converted to cropland > 20 years ago at the end of year, 1000 ha		Land converted to cropland < 20 years ago at the end of year, 1000 ha	
	mineral soil	organic soil	mineral soil	organic soil	mineral soil	organic soil
1990	1745,0	95,3	0,0	0,0	1,7	0,3
1991	1738,5	95,0	0,0	0,0	3,3	0,5
1992	1733,6	94,7	0,0	0,0	4,9	0,8
1993	1727,0	94,3	0,0	0,0	6,6	1,0
1994	1720,0	94,0	0,0	0,0	8,2	1,3
1995	1712,8	93,6	0,0	0,0	9,9	1,6
1996	1705,0	93,1	0,0	0,0	10,6	1,7
1997	1697,2	92,7	0,0	0,0	11,2	1,8
1998	1690,9	92,4	0,0	0,0	11,9	1,9

139 https://sites.google.com/site/lvlulucf/activity/nir-1990-2010/Augsneskalkosana1995-2010.html?attredirects=0&d=1

Year	Cropland remaining cropland at the end of year, 1000 ha		Land converted to cropland > 20 years ago at the end of year, 1000 ha		Land converted to cropland < 20 years ago at the end of year, 1000 ha	
	mineral soil	organic soil	mineral soil	organic soil	mineral soil	organic soil
1999	1682,6	91,9	0,0	0,0	12,6	2,0
2000	1675,5	91,5	0,0	0,0	13,3	2,1
2001	1666,1	91,0	0,0	0,0	13,9	2,2
2002	1659,1	90,6	0,0	0,0	14,5	2,3
2003	1651,7	90,2	0,0	0,0	15,1	2,4
2004	1643,1	89,8	0,0	0,0	15,7	2,5
2005	1634,2	89,3	0,0	0,0	16,3	2,6
2006	1625,0	88,8	0,0	0,0	16,9	2,7
2007	1615,6	88,3	0,0	0,0	17,5	2,8
2008	1605,9	87,7	0,0	0,0	18,1	2,9
2009	1596,1	87,2	0,0	0,0	18,4	2,9
2010	1596,1	87,2	1,7	0,3	16,9	2,7
2011	1596,1	87,2	3,3	0,5	15,4	2,4
2012	1587,0	86,7	4,9	0,8	13,7	2,2

7.3.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Spatial approach is used to estimate deforested areas converted to croplands, interpolation of national statistics is used to determine changes in area of croplands since 1990[140]. Remote sensing (LANDSAT satellite image analysis) based research data are used to update cropland's area[141] based on frequency of changes of vegetation index and characterization of the particular piece of land in other databases. As a result area of croplands considerably increased and area of grasslands decreased, because extensively managed farmlands (biological farms, grasslands utilized in forage production) are moved to croplands category as well as lands, which at least once per 10 years characterizes with vegetation index values typical for cropland. Separate land use category – extensively managed cropland is established for land use review, however it is not reported separately in GHG inventory due to lack of the category specific emission factors.

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 NFI. Data provided by the Central statistical bureau (CSB) and Rural development service (RDS) are used to evaluate modelling results and assumptions utilized in the NFI data analysis. Notably, that total area of farmlands is equal according to NFI and RDS, but share of croplands is higher in recalculated NFI data, because of the extensively managed cropland area. The NFI data were also used to estimate area of land converted to forest[142]. The cropland

140 Central statistical bureau, table LIG014. LAUKSAIMNIECĪBĀ IZMANTOJAMĀS ZEMES IZMANTOŠANA (Use of agricultural lands, 2000-2011); Statistical Yearbook of Latvia, 2012, Central statistical bureau, ISBN 978-9984-06-420-4, p 500 (use of agricultural lands, 1990-2011).

141 Lazdiņš and Zariņš, Vēsturiskās (1990. Gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana; Lazdiņš et al., Atbalsts Klimata Pētījumu Programmai (Pārskats Par Projekta 2013. gada Darba Uzdevumu Izpildi); Lazdiņš and Čugunovs, Oglekļa Dioksīda (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju Un Zemes Lietojuma Veida Ietekmes Novērtējums Intensīvi Un Ekstensīvi Kultivētās Aramzemēs, Daudzgadīgos Zālājos Un Bioloģiski Vērtīgos Zālājos.

142 Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)"; Lazdiņš, "Harmonization of Land Use Matrix in Latvia according to Requirements of International Greenhouse

also includes animal feeding glades, which according to national land use classification belongs to forest land.

The decision support tree were elaborated in 2013 to simplify identification of land use changes in farmlands and due to conversion of farmland to forest land in the NFI data analysis (Table 7.21). The identification of transition in this case takes 10 years. Considering that there are still some unsolved issues, like interpretation of merged sectors with different initial land use and distribution of biomass located on converted sites, it is proposed to combine automated evaluation and following manual quality assurance.

Table 7.21 Decision support table to estimate conversion of grassland, cropland and forest land[143]

First NFI 2004-2008	Second NFI 2005-2013	Third NFI 2014-2019	Fifth NFI 2020-2024
Initial land use – *grassland*	Whole plot or sector is ploughed – *no land use change marked*	Whole plot or sector is ploughed – *ploughed area is marked as cropland since second NFI*	Whole plot or sector is ploughed – *the area remains cropland*
			No signs of ploughing – *the area remains cropland*
		No signs of ploughing – *the area remains grassland*	Whole plot or sector is ploughed – *the area remains grassland*
			No signs of ploughing – *the area remains grassland*
	No signs of ploughing – *the area remains grassland*	Whole plot or sector is ploughed – *the area remains grassland*	Whole plot or sector is ploughed – *ploughed area is marked as cropland since third NFI*
			No signs of ploughing – *the area remains grassland*
		No signs of ploughing – *the area remains grassland*	Whole plot or sector is ploughed – *the area remains grassland*
			No signs of ploughing – *the area remains grassland*

7.3.4 Methodological issues

Emissions from organic soils in croplands were calculated using equation 3.3.5 of the IPCC GPG LULUCF 2003. CO_2 emissions from liming have been calculated using equation 3.3.6 of the IPCC GPG LULUCF 2003.

For calculation of emission from organic soils emission factor is borrowed from Swedish GHG inventory report, considering average factor for the whole period – 3.7 ton C ha^{-1}

Gas Reporting System - Extending Outputs of National Forest Inventory Program"; Zariņš, Meža Statistiskās Inventarizācijas Parauglaukumu Mērījumu Interpolācijas Projekts, Izmantojot Satelītu Uzņēmumu Analīzes Iespējas (pāskats Par Meža Attīstības Fonda Pasūtīto Pētījumu); Lazdiņš et al., Mežu Zemes Izmantošanas Maiņas Matricas Izstrādāšana Un Integrēšanu Nacionālajā Siltumnīcefekta Gāzu Inventarizācijas Pārskatā Par Kioto Protokola 3.3 Un 3.4 Pantā Minētajiem Pasākumiem; Lazdiņš and Zariņš, Vēsturiskās (1990. Gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana.

143 Lazdiņš and Čugunovs, Oglekļa Dioksīda (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju Un Zemes Lietojuma Veida Ietekmes Novērtējums Intensīvi Un Ekstensīvi Kultivētās Aramzemēs, Daudzgadīgos Zālājos Un Bioloģiski Vērtīgos Zālājos.

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.

Emissions of N_2O due to disturbances from conversion of forest land to cropland calculated using equations 3.3.13, 3.3.14 and 3.3.15 of the IPCC GPG LULUCF 2003. Carbon stock changes for calculation of the emission's factor are estimated using the Equation 3.3.3 of the IPCC GPG LULUCF 2003. Initial carbon stock in deforested areas was considered according to results of the BioSoil project – 124 tons C ha^{-1} at 0-30 cm depth (average carbon stock in mineral forest soil with uncertainty of 43 %). Coefficients for the carbon stock change calculations were taken from Table 3.3.4 – FLU 0.71 (Long-term cultivated, Temperate wet); FMG 1.00 (Full tillage, Temperate dry and wet); FI 1.00 (Medium input, Temperate dry and wet). The carbon stock in cropland after transition period of 20 years according to the Equation 3.3.3 is 88 tons C ha^{-1} at 0-30 cm depth; respectively net reduction of carbon stock in mineral soils is 36 tons ha^{-1} or 1.8 tons ha^{-1} annually. For organic soils in forest lands converted to croplands the factor for cropland remaining cropland (3,7 tons C ha^{-1} annually) was used to estimate carbon stock changes. The data on emissions from mineral soils will be improved as soon as better information on carbon stock in cropland soil will be available. The project aimed to develop Tier 1 method to estimate carbon stock changes in mineral soil is initiated in 2014 and will provide statistically reliable information in the next inventory.

Activity data for calculations is taken from national statistics[144] (amount of liming material applied) and according to the national research data[145] (area of organic soils).

Area of land remaining cropland was estimated using remote sensing based research data[146]. Remote sensing analysis of satellite images was used to estimate forest area converted to cropland[147].

Changes related to transition of land use from land converted to cropland to category cropland remaining cropland after completion of 20 years transition period are done after 2009, as well as conversion of forest land to cropland according to a linear regression for the period before 1990.

According to the study data[148] area of organic soils in farmlands is 5.18 ± 0.5 %. This value characterizes area of cropland before 1990, because it is based on field measurements completed in 60ths, 70ths and early 80ths. It is assumed that proportion of organic soils in lands remaining croplands, lands converted to croplands and croplands converted to grasslands is equal until better data will be available. Therefore, the area of organic soils in cropland is linearly correlating in calculations with the total area of cropland. In 2012 according to this estimation there was 87,5 kha of organic soils in cropland remaining cropland and 2,2 kha in land converted to cropland[149]. Area of organic soil in land converted to cropland is changed because of different approach in calculation – instead of use of values of share of organic soils characteristic for the final land use the values characteristic for initial land use (forest in this case) are applied. The study data on distribution of organic soils shows that only about 2,2 %

144 https://sites.google.com/site/lvlulucf/activity/nir-1990-2010/Augsneskalkosana1995-2010.html?attredirects=0&d=1

145 L.U. Consulting, "Augšņu un reljefa izejas datu sagatavošana un eiropas komisijas izstrādāto augsnes un reljefa kritēriju mazā labvēlīgo apvidu noteikšanai piemērošanas simulācija (Projekta kopsavilkuma ziņojums)."

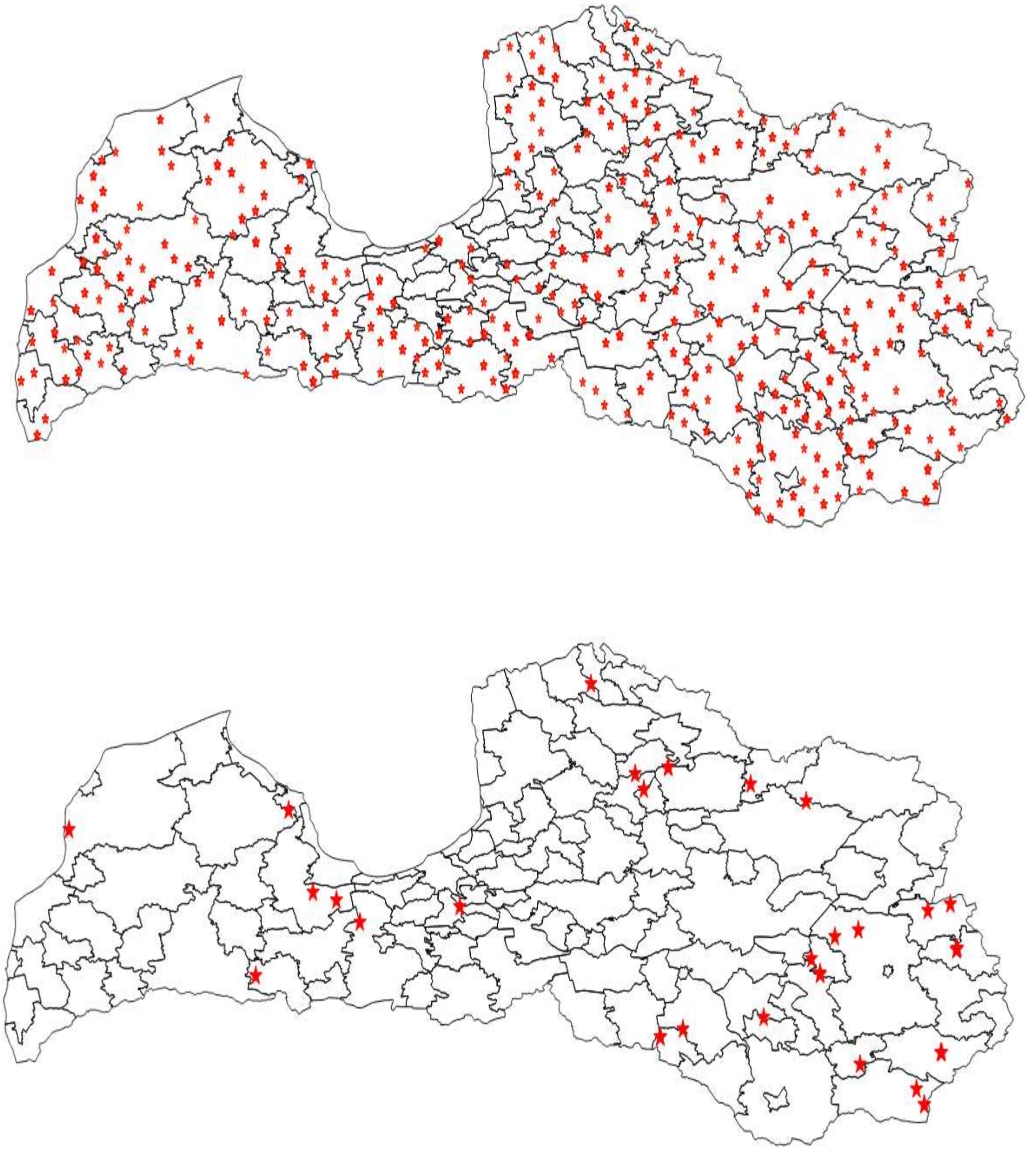
146 Lazdiņš and Čugunovs, Oglekļa Dioksīda (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju Un Zemes Lietojuma Veida Ietekmes Novērtējums Intensīvi Un Ekstensīvi Kultivētās Aramzemēs, Daudzgadīgos Zālājos Un Bioloģiski Vērtīgos Zālājos; Lazdiņš and Zariņš, Vēsturiskās (1990. Gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana.

147 Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)."

148 L.U. Consulting, "Augšņu un reljefa izejas datu sagatavošana un eiropas komisijas izstrādāto augsnes un reljefa kritēriju mazā labvēlīgo apvidu noteikšanai piemērošanas simulācija (Projekta kopsavilkuma ziņojums)."

149 Lazdiņš, Bārdule, and Stola, "Preliminary Results of Evaluation of Area of Organic Soils in Arable Lands in Latvia."

of farmlands are located on organic soils, including 1 % of cropland and 2,9 % of grassland; however, this study cannot demonstrate, how reduction of area of cropland on organic soils tooks place[150]. Only 40 % of the NFI plots on non-forest land are evaluated. (about 5000 plots Figure 7.5); therefore, further results will provide more reliable information on organic soils.



a)

b)

Figure 7.5 Location of plots sampled for analyse of content of organic carbon (a) and plots marked as located on organic soils (b)

Notation keys characterizing carbon stock change in living biomass and dead biomass in cropland remaining cropland is set to NO because carbon stock in these pools in cropland is negligible and do not result in actual emissions or removals. Exception is forest lands converted to cropland where losses in living biomass are calculated as average growing stock, similarly, losses in dead wood are accounted as average stock of dead wood in a particular

150 Lazdiņš et al., Atbalsts Klimata Pētījumu Programmai (Pārskats Par Projekta 2013. gada Darba Uzdevumu Izpildi).

year. Standard biomass expansion factors and wood density utilized previously in calculation of carbon stock change due to commercial felling in forest land was used in calculations losses in living biomass due to conversion of forest to cropland.

Net carbon stock changes in mineral soils in cropland are reported as not occurring because according to IPCC GPG LULUCF 2003[151] these emissions should be reported in case of changes in land management practice. Exception is forest land converted to cropland, where carbon stock changes in mineral soil are calculated using the Equation 3.3.3 of the IPCC GPG LULUCF 2003 as described above. Instant oxidation method is applied to living biomass, dead wood and litter layer.

Emissions from dolomite applications are notated as included elsewhere because they already accounted under the dolomite category using conversion factor 12 % (carbon per mass unit of liming material).

The notation key NO is used for other categories of land conversion to cropland because there are no evidences of such changes in the country.

7.3.5 Uncertainties and time-series consistency

Uncertainties for croplands are provided in Table 7.16. The same methodological approach as in forest lands is utilized.

Uncertainty of deforested area converted to croplands is 35 % expressed as percentage of standard error of mean of remote sensing results multiplied by 2. Uncertainty of average carbon stock in litter in forests is 6 %, uncertainty of carbon stock in mineral soil in forest land at 0-30 cm is 43 %, uncertainty of dead wood stock in forests is 2 %, uncertainty of carbon stock in dead wood according to the expert judgement is 30 %;.

Uncertainty of N_2O emissions due to disturbance of land following to transformation to cropland according to Swedish NIR is 100 %.

Consistency of time series of calculations is considerably improved due to implementation of empirically based data about area of organic soils before 1990 and because of switching to interpolation of cropland area instead of usage of statistical data which fluctuated a lot due to changing methods and definitions without actual changes of the cropland area.

7.3.6 Category-specific QA/QC and verification

The QA/QC plans for the cropland 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.

7.3.7 Category-specific recalculations

Major changes were done in this category due to implementation of research results on area of cropland and grassland as well as due to improvements in calculation of carbon losses due to deforestation.

151 Section 3.3.1.2.1.1 Choice of Method.

Notation key is changed for NO_x, CO and NMVOC to NO because no biomass burning takes place in cropland.

Major changes in area of cropland are applied due to implementation of research data about distribution of extensively managed cropland sometimes wrongly reported as grassland by NFI teams, because the area is rarely cultivated, but still used for crop production. These areas include cultivated grasslands (regenerated by ploughing every 5th to 10th year) and biological farms using longer rotation cycle. Area of organic soils in cropland is updated according to new data on croplands keeping the same share of organic soils in farmlands.

Emissions from organic soils are recalculated due to implementation of different emission's factor (according to expert recommendation the average value applied in Sweden – 3.74 tons C ha^{-1}) is used instead of default value (1 ton C ha^{-1}) and due to updated area of organic soils.

Minor changes are applied to forest area converted to cropland due to implementation of EPIM LULUCF sector. However, major changes are implemented in calculation of organic soils. It is assumed that share of organic soils in land converted to cropland is equal to share of organic soils in the initial land use category; respectively, if forest land is converted to cropland, share of organic soil in converted land is assumed to be equal to share of naturally wet and drained organic soil in forest land in the transition year.

Major changes are applied in calculation of losses in living biomass due to conversion of forest land to cropland. Carbon losses are calculated using instant oxidation method according to average growing stock of living biomass in a transition year. Similarly, major changes are applied to calculate losses in dead biomass; they are now calculated using instant oxidation method according to average growing stock of dead biomass in a particular year and average stock of litter in the whole period.

Losses in mineral soil are accounted considering that carbon stock in mineral soils in converted lands will reach values characteristic for cropland within 20 years. Country specific input data are applied (124 tons C ha^{-1} at 0-30 cm depth in forest land on mineral soils; 88 tons ha^{-1} at 0-30 cm depth in cropland, respectively losses in soil carbon stock are equal to 36 tons ha^{-1}; 20 years transition period is considered). For conversion of forest land to settlements weighted (by area) carbon stock in forest soils is used (244 tons ha^{-1} at 0-30 cm depth) considering that all soil carbon will transform into emissions within 20 years. For organic forest soil converted to cropland the same emission's factor as in cropland remaining cropland (3.7 tons C ha^{-1}) is applied. The changes in activity data (area of organic soils) is also considered in recalculation.

Recalculation of N_2O emissions due to disturbances caused by conversion of forest land to cropland is done due to methodological changes in calculation of CO_2 emissions from soils and activity data – area of organic soils, as described earlier.

7.3.8 Category-specific planned improvements

There are several major issues, which will be solved until the next inventory:

- updated area of organic soil in cropland according to the NFI study started in 2012[152]; the same values of share of organic soil will be used for land converted to cropland. Logarithmic regression will be used in time series to reduce share of organic soil in cropland before 1990 (5.18 %) to the actual value;

[152] Lazdiņš, A., 2012. Atbalsts klimata pētījumu programmai (starpziņojums par 2012. gada darba uzdevumu izpildi) (No. 020512/S68). LVMI Silava, Salaspils.

- updated carbon stock in cropland remaining cropland to estimate carbon losses in soil due to conversion of forest land to cropland as well as carbon stock changes in soil due to conversion to grassland and vice versa;
- updated CO_2 emissions from organic soils considering area changes and recent findings in Nordic and Baltic countries, particularly, doctoral thesis by Jüri-Ott Salm "Emission of greenhouse gases CO_2, CH_4, and N_2O from Estonian transitional fens and ombrotrophic bogs: the impact of different land-use practice"[153].
- updated N_2O emissions due to disturbances using new data on carbon stock changes in soil;
- carbon stock changes in living biomass and dead wood using updated conversion factors for density and carbon stock, as well as biomass expansion factors;
- Tier 1 methodology to estimate carbon stock changes in cropland considering changes of cropping practices since 1970.

7.4 GRASSLAND (CRF 5.C)

7.4.1 Source category description

The grassland's category is a key source of CO_2 emissions from organic soil and land converted to grassland is a net sink of CO_2 removals in mineral soil. After recalculation and implementation of research data grasslands are net source of CO_2 removals, generally, due to conversion of cropland to grassland, causing increase of carbon stock in soil. Total area of grassland in Latvia in 2012 was 708 kha, including 541 kha of grasslands remaining grasslands and 12 kha of cropland converted to grassland more than 20 years ago and 155 kha of cropland converted to grassland less than 20 years ago[154]. Emissions from organic soils and wildfires are reported under the grassland category. The net emissions from grasslands were -537 Gg in Latvia in 2012. 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. The CO_2 removals are accounted in living and dead biomass in forest lands not fulfilling criteria of forest definition. Increment figures for 2004-2012 are taken form the NFI, but for the historical data results of recalculation of increment of living biomass in grassland is considered155. Mortality factors are taken directly from forest land remaining forest assuming that mortality in grassland is equal to average mortality (in percent of increment of living biomass) in forest land in a particular year. Decay period for dead wood is considered 20 years.

Area of the grassland is estimated using research data[156] on the base of remote sensing data analysis. The area of historical grasslands is considerably decreased after implementation of research results, because extensively managed croplands, like biological farms and grasslands used in forage production (ploughed once per 5-7 years) are moved to cropland category.

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153 Salm, J.O., 2012. Emission of greenhouse gases CO_2, CH_4, and N_2O from Estonian transitional fens and ombrotrophic bogs: the impact of different land-use practice (Doctoral thesis). Tartu Ülikooli Kirjastus, Tartu.

154 Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)"; Lazdiņš, "Harmonization of Land Use Matrix in Latvia according to Requirements of International Greenhouse Gas Reporting System - Extending Outputs of National Forest Inventory Program"; Lazdiņš and Čugunovs, Oglekļa Dioksīda (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju Un Zemes Lietojuma Veida Ietekmes Novērtējums Intensīvi Un Ekstensīvi Kultivētās Aramzemēs, Daudzgadīgos Zālājos Un Bioloģiski Vērtīgos Zālājos.

155 Jansons, Methods Utilized to Recalculate Historical Forest Increment Data.

156 Lazdiņš and Čugunovs, Oglekļa Dioksīda (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju Un Zemes Lietojuma Veida Ietekmes Novērtējums Intensīvi Un Ekstensīvi Kultivētās Aramzemēs, Daudzgadīgos Zālājos Un Bioloģiski Vērtīgos Zālājos.

Information about area of organic agricultural soils is provided by the MOA (5.18 ± 11 % of total area of farmlands)[157]. These figures are based on soil mapping data and characterizes situation before 1990 (data utilized in calculation were obtained from 60^{ths} to early 80^{ths}). Dynamics of area of organic soils in grassland's used in calculations is shown in Figure 7.6. Increase of the area of organic soils is associated with conversion of cropland to grassland during 90^{ths} of the previous century and during the last decade. Opposite process – reduction of area of grassland – took place due to afforestation of farmlands.

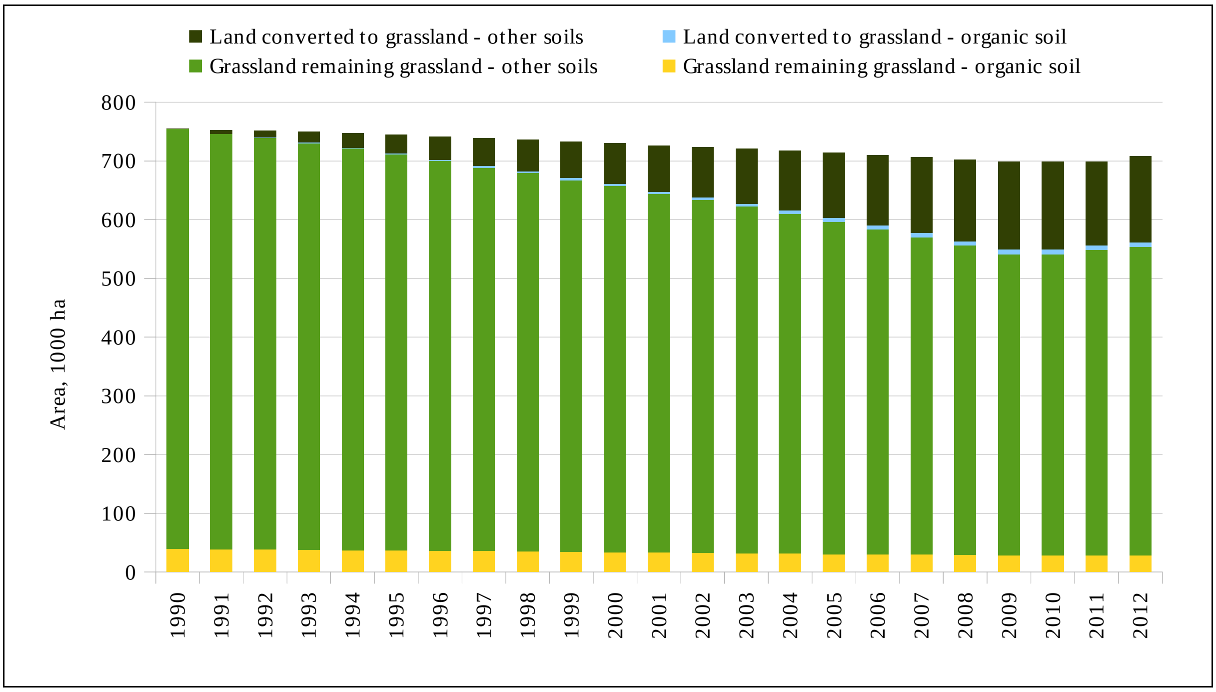

Figure 7.6 Area of organic and mineral soils in grasslands

All categories of land use change to grassland, except cropland to grassland, are reported as NO, because there are no evidences of such conversions. Conversion from cropland to grassland takes place due to abandonment of cropland. Grassland is reported in the managed lands category.

The most significant source of emissions is organic soils. The emission factor is updated (increased 6.4 times, to 1.6 tons C ha^{-1}) assuming that emissions from organic soils on grassland in Latvia is equal to the emissions in Sweden. The same approach is implemented one year earlier in Estonia. Due to emissions from soil grassland remaining grassland is considerable source of emissions (Figure 7.7).

157 L.U. Consulting, "Augšņu un reljefa izejas datu sagatavošana un eiropas komisijas izstrādāto augsnes un reljefa kritēriju mazā labvēlīgo apvidu noteikšanai piemērošanas simulācija (Projekta kopsavilkuma ziņojums)."

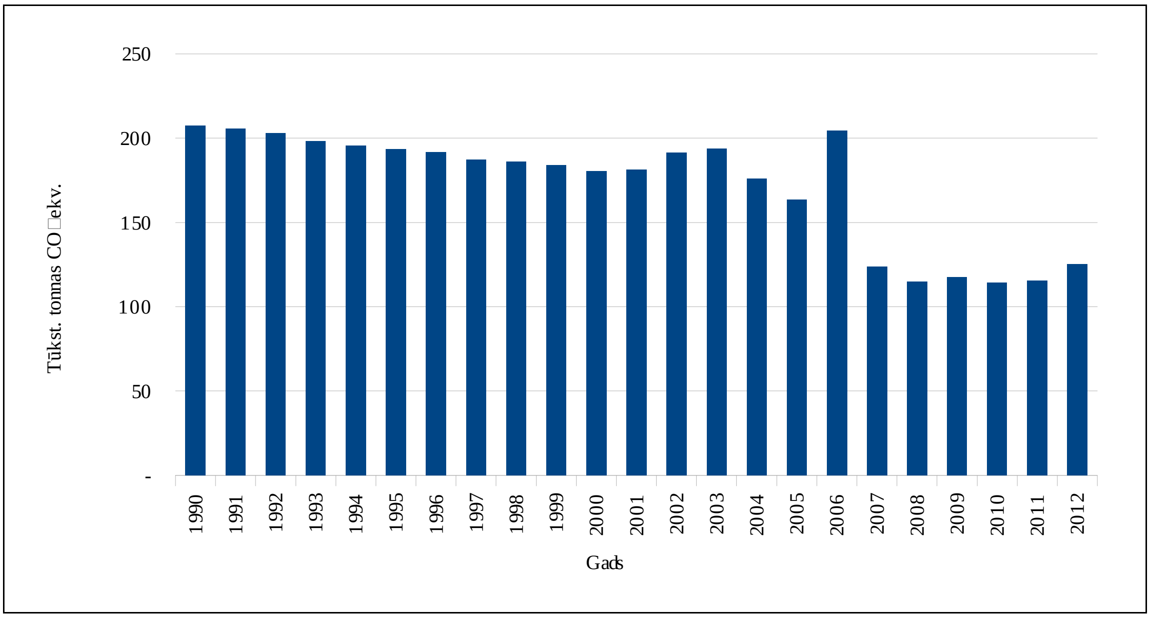

Figure 7.7 Net emissions from grassland remaining grassland

7.4.2 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The category consists of lands used as pastures, as well as glades and bush-land which do not fit to forest definition, including vegetated areas on non-forest lands complying to forest definition where land use type can be easily switched back to grassland without legal requirement of transformation of the land use, but except grassland used in forage production and extensively managed cropland. In the Latvia's GHG accounting non-forest lands with average diameter of trees at the breast height less than 2 cm are reported under grassland's category. No removals or emissions associated with living or dead biomass are reported for these lands to avoid overestimation of CO_2 removals.

7.4.3 Methodological data

Quantity of fuel burnt during incineration of grass was calculated according to the IPCC GPG LULUCF 2003 Table 3.4.2[158] (a value for cold temperate wet climate is used, 2 400 kg ha^{-1}). Information about fires on the Grassland was obtained from the State Fire and Rescue Service[159]. Emission factors corresponding to moist-infertile grassland from IPCC GPG LULUCF 2003 Table 3A.1.16[160] were used to calculate emissions (Table 7.22).

Table 7.22 Emission factors for moist-infertile grasslands

No	GHG	Emission factor
1	CO_2	1 498
2	CO	59
3	CH_4	2

158 Default estimates for standing biomass grassland (as dry matter) and aboveground net primary production, classified by IPCC climate zones.

159 https://sites.google.com/site/lvlulucf/activity/nir-1990-2011/Kulas%20ugunsgreki.pdf?attredirects=0&d=1

160 Emission factors (g kg^{-1} dry matter combusted) applicable to fuels combusted in various types of vegetation fires.

No	GHG	Emission factor
4	NO_2	4
5	N_2O	0.1

Fraction of the biomass combusted during grass burning was taken from the IPCC GPG LULUCF 2003 Table 3A.1.12[161]. Factor for peat-lands (0.5) was applied in the calculations.

CO_2 emissions from drained organic soils were estimated emission factor used in Sweden (1,6 tonnes C ha^{-1} yearly). CO_2 emissions from organic soils in cropland converted to grassland are accounted as removals, because of reduction of emissions from 3,7 to 1,6 tons C ha^{-1} annually (2,1 tons C ha^{-1} annually).

Using the same logics reduction of N_2O emissions from mineral and organic soils in cropland converted to grassland are accounted as removals. The reduction of N_2O emissions according to calculation linearly correlates to reduction of CO_2 emissions in organic soil and net increment of carbon stock in mineral soil. The methodology of calculation of N_2O emissions due to disturbances caused by conversion of forest land to cropland is applied. The results are not included into GHG inventory, because of lack of specific table for reduction of N_2O emissions in the CRF reporter. The methodological base for calculations should also be extended in future to demonstrate all aspects of conversion of cropland to grassland or reduction of intensity of management of cropland leading to reduction of emissions of N_2O.

Carbon stock changes in mineral soils in croplands converted to grasslands is reported as net removals, because there are research evidences, that carbon stock in grasslands in average at 0-30 cm depth is significantly higher than in cropland[162] and the difference is 22.2 tons C $ha^{-1.}$ These data are based on comparison of 80 NFI sample plots and will be updated in future by continuous monitoring of carbon stock change in soil.

The calculations are done in EPIM model, which is still in development stage; therefore some calculations, like emissions from organic soils are not fully implemented and should be done manually. The assumptions used in EPIM model are shown in Table 7.23, default 20 years decay period is considered for dead wood. Calculated net carbon stock changes in living and dead biomass are shown in Figure 7.9.

Table 7.23 Assumptions for calculation of carbon stock changes in living and dead biomass in grassland

Year	Grassland with woody vegetation, 1000 ha	Gross increment of living biomass		Wood density, kg m^{-3}	Natural mortality, m^3 ha^{-1}	BEFs		Carbon content, kg ton^{-1}
		mill. m^3	m^3 ha^{-1}			stem to crown	stem to below-ground	
1990	19,13	0,02	0,97	0,41	0,26	0,31	0,31	523
1991	19,44	0,02	0,95	0,41	0,25	0,31	0,31	523
1992	19,75	0,02	1	0,41	0,26	0,31	0,31	523
1993	20,07	0,02	0,99	0,41	0,26	0,31	0,31	523
1994	20,38	0,02	0,99	0,41	0,27	0,31	0,32	523
1995	20,69	0,02	0,97	0,41	0,26	0,31	0,32	523
1996	21	0,02	0,96	0,41	0,26	0,31	0,32	523
1997	21,32	0,02	0,96	0,41	0,26	0,31	0,32	523
1998	21,63	0,02	0,94	0,41	0,26	0,31	0,32	523
1999	21,94	0,02	0,98	0,41	0,27	0,32	0,32	523

161 Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types, dimensionless.

162 Lazdiņš, Bārdule, and Stola, "Preliminary Results of Evaluation of Carbon Stock in Historical Cropland and Grassland"; Lazdiņš et al., *Atbalsts Klimata Pētījumu Programmai (Pārskats Par Projekta 2013. gada Darba Uzdevumu Izpildi).*

Year	Grassland with woody vegetation, 1000 ha	Gross increment of living biomass		Wood density, kg m^{-3}	Natural mortality, m^3 ha^{-1}	BEFs		Carbon content, kg ton^{-1}
		mill. m^3	m^3 ha^{-1}			stem to crown	stem to below-ground	
2000	22,26	0,02	0,97	0,41	0,27	0,32	0,32	523
2001	22,57	0,02	0,96	0,41	0,27	0,32	0,32	523
2002	22,88	0,02	0,94	0,41	0,26	0,32	0,32	523
2003	23,19	0,02	0,93	0,41	0,26	0,32	0,32	523
2004	23,51	0,02	0,92	0,41	0,26	0,33	0,32	524
2005	23,82	0,02	0,91	0,41	0,26	0,33	0,32	524
2006	24,13	0,02	0,89	0,41	0,26	0,33	0,32	524
2007	23,54	0,05	2,12	0,41	0,61	0,33	0,32	524
2008	23,54	0,05	2,12	0,41	0,61	0,33	0,32	524
2009	23,54	0,05	2,12	0,4	0,59	0,34	0,32	524
2010	23,54	0,05	2,12	0,4	0,59	0,34	0,32	524
2011	23,54	0,05	2,12	0,4	0,59	0,34	0,32	524
2012	23,76	0,04	1,87	0,4	0,52	0,34	0,32	524

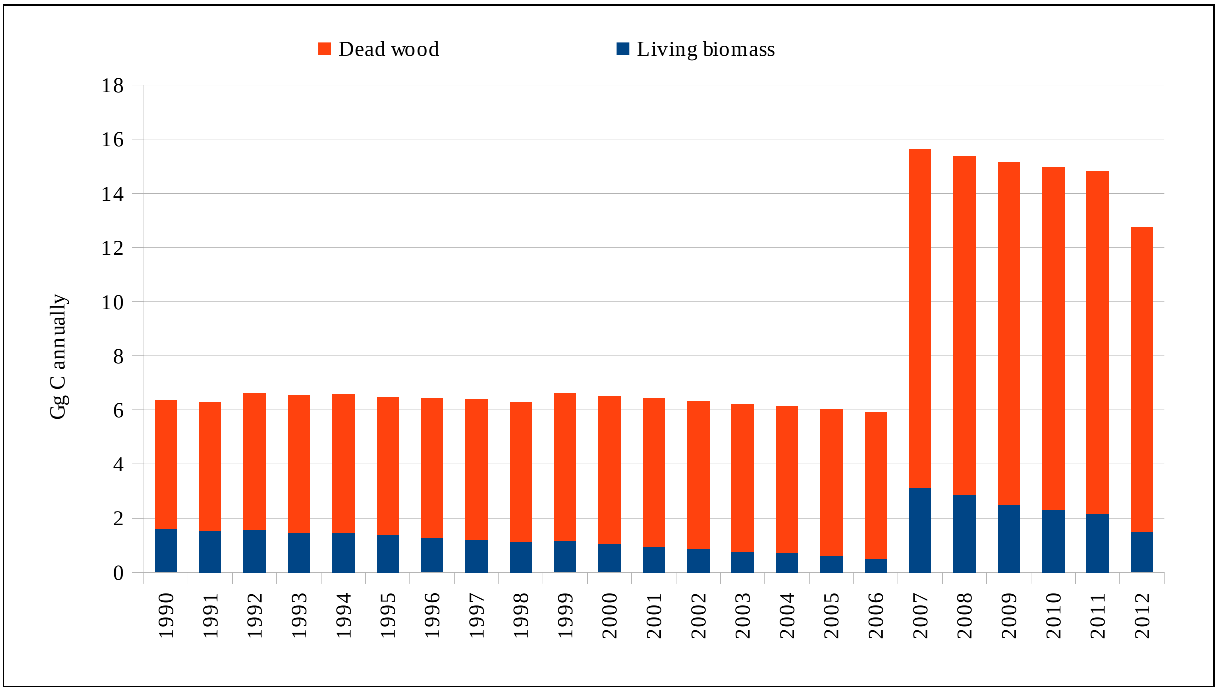

Figure 7.8 Net emissions from grassland remaining grassland

Organic and mineral soil in cropland converted to grassland is considered as sink due to increase of carbon stock in soil to the level characteristic in grassland (for mineral soil) and due to reduction of GHG emissions from organic soil; respectively, removals in mineral soil in 20 years period are equal to 1.1 ton C ha^{-1} annually in 20 years period and reduction of emissions in organic soil (carbon sink) is 2.14 tons ha^{-1} with no time limit.

7.4.4 Uncertainties and time-series consistency

Uncertainties for croplands are provided in Table 7.16.

The same methodological approach as in forest lands and cropland is utilized.

Uncertainty in the area of organic grassland was estimated at 11 % as standard error of proportion. The uncertainty estimate for the CO_2 emission factor for organic soils is 90 %

according to the IPCC GPG LULUCF 2003. For biomass burned uncertainty was estimated at 100 % based on expert judgement (variation of growing stock of wild grasses harvested for pellet production).

The time series of emissions from grasslands is consistent; however, overestimation is possible due to lack of knowledge about current area and distribution of organic soils. Recent studies shows that area of organic soils in grassland is less than 1.5 %[163]. Area of organic soils in afforested grasslands is about 3 % of total area of grasslands converted to forests according to the NFI[164].

7.4.5 Category-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.

7.4.6 Category-specific recalculations

Major changes in area of grassland are applied due to implementation of research data about distribution of extensively managed cropland sometimes wrongly reported as grassland as described earlier. Area of organic soils is updated according to new data on grassland keeping the same share of organic soils.

Calculation of carbon stock in grassland (areas covered with trees, but not complaining with thresholds of forest land definition) is implemented into the inventory after completion of the most of measurements in the 2nd cycle of the NFI, demonstrating that grasslands is net sink of CO_2 removals in living biomass. The removals are calculated according average increase of growing stock depending from age of woody vegetation for the period before 2006 (middle of the 1st NFI cycle), on the base of actual data for the period between 2006 and 2010 (comparing the 1st and the 2nd NFI cycle) and using extrapolation for 2011-2012. BEFs, wood density and carbon content values applied to the forest land are used for grassland too.

Losses of carbon in living biomass are calculated as mortality rate applying average mortality rate (share of increment) in forest land in a particular year. Losses in dead biomass are accounted as decomposition of dead wood applying 20 years transition period.

Major changes are applied to calculation of carbon stock change in soil due to updated activity data and emission factor. Average losses of carbon stock in grassland on organic soils applied in Sweden (1.6 tons C ha^{-1}) are used instead of default value (0.25 tons C ha^{-1} annually); respectively, CO_2 emissions from organic soil in grassland increased several times.

Limestone is not used in grassland, except cultivated grassland used for fodder production, which are now moved to cropland category; therefore, the notation key is changed to NO.

No biomass burned is reported under controlled burning because the emissions reported under controlled burning are now moved to wildfires category. No controlled burning of grassland takes place in Latvia, because it is illegal. Grassland fires are now reported under wildfires category, just like forest fires to harmonize GHG inventory. Biomass burned previously

163 Lazdiņš, Atbalsts Klimata Pētījumu Programmai (starpziņojums Par 2012. Gada Darba Uzdevumu Izpildi).

164 http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls

reported under controlled burning is moved to wildfires category. The mistake in representation of measurement units (previously tons instead of kg were entered) is corrected. Biomass burning in 1990-1992 is extrapolated from average values in 1993-1997.

Area of cropland converted to grassland is recalculated according to research data on distribution of extensively managed cropland, which was wrongly reported as conversion of cropland to grassland and backward. The recalculation considerably reduced previously overestimated conversion of cropland to grassland and backwards. The conversion of cropland to grassland and grassland to cropland is considered to be fully compensating each other, respectively only net changes are reported for calculation of GHG emissions and CO_2 removals.

Area of organic soil converted to grassland is recalculated according to changes in total converted area. Share of organic soils is not changed.

Net removals of carbon stock in mineral soils in cropland converted to grassland are calculated as difference of carbon stock in cropland and grassland, considering 20 years transition period. Country specific data are used for carbon stock in cropland and grassland. The net removals of CO_2 in mineral soils due to conversion of cropland to grassland are considered equal to 1.1 ton C ha^{-1}. The reduction of emissions due to conversion of organic soil in cropland to grassland is considered as difference of CO_2 emissions in cropland and grassland (2.1 ton C ha^{-1}), reduction of emissions of N_2O due to conversion of cropland to grassland is calculated as a proportion, considering reduction of CO_2 emissions from soil due to the conversion.

7.4.7 Category-specific planned improvements

Grassland is significant potential source or removals; therefore, the most of attention will be paid to improve knowledge about carbon stock change in grassland; particularly, in historical grasslands due to different management of grasslands as well as due to land use conversion from and to grassland. The most important improvements proposed for the future inventories are:

- evaluation of carbon stock in historical grassland, cropland and forest land representing similar growth condition to estimate carbon stock changes in soil due to land use change;
- recalculation of carbon stock changes in living and dead biomass and soil carbon pools due to land use changes;
- recalculation of carbon stock changes in all carbon pools in grassland areas covered by woody vegetation.

7.5 WETLANDS (CRF 5.D)

7.5.1 Source category description

Wetlands remaining wetlands is a key source category of CO_2 emissions due to commercial peat extraction. According to the IPCC GPG LULUCF 2003 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. Total area of wetlands (448 kha) is reported according to the research results.

Latvia reports CO_2 emissions associated with industrial peat extraction in this category. Default activity data (area of industrial peatlands) provided in Table 3a.3.3 of the IPCC GPG LULUCF 2003 is used in calculation of emissions. This method allow to avoid underestimation of emissions raised by alternative approach – calculation of industrial peatlands assuming that the peat extraction rate is 0.016 mill. tons km^{-2}. According to the Table 3a.3.3 of the IPCC GPG LULUCF 2003 the default value for area of industrial peatlands in Latvia is 27 kha every year; using extraction rate method calculations results in 3 kha in 2009. Taking into account considerable annual fluctuations in peat production, more conservative default method is used in calculations. 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 2003.

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 do not exist. N_2O contributes to about 7 % of net emissions from peatlands. No removals are reported in this category. Net removals in the wetlands category can be expected, if carbon stock changes in living and dead biomass are considered (Figure 7.9).

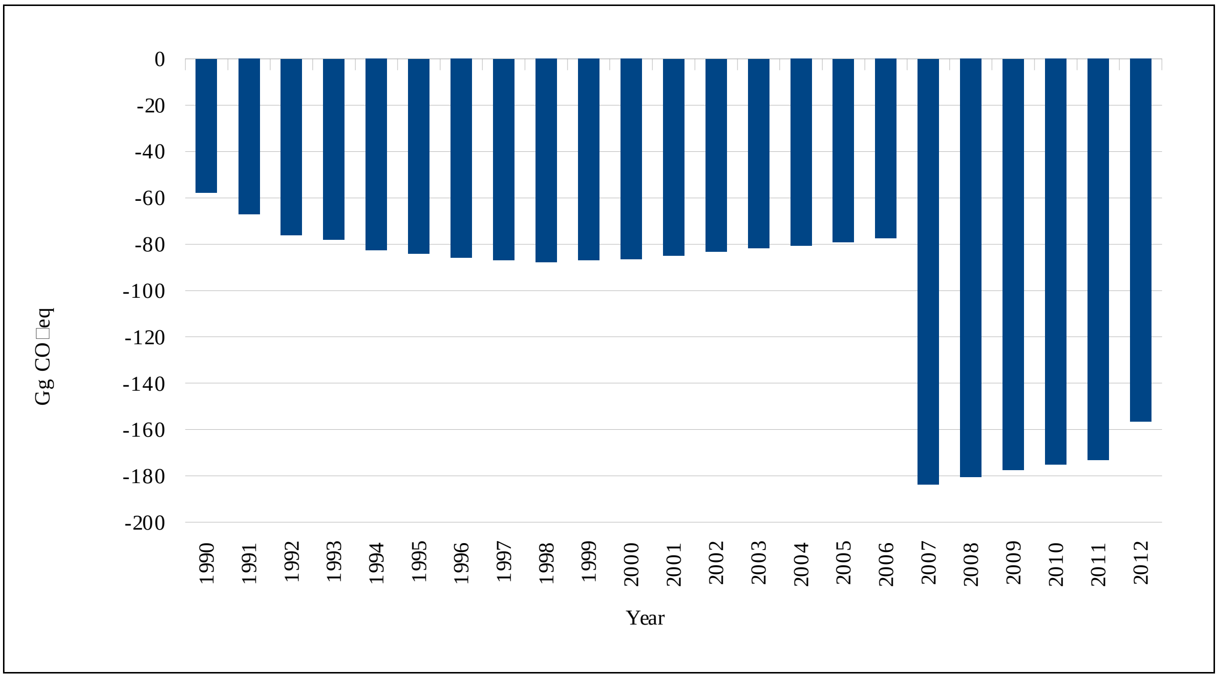

Figure 7.9 Net emissions from wetlands if living and dead biomass is considered

7.5.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Spatial approach is used to represent area of wetlands. Activity data are provided by the NFI[165]. No changes in land use are considered since 1990.

7.5.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Wetlands category includes all inland water bodies (rivers, ponds, lakes, and ditches), swamps (constantly wet areas where height of trees cannot reach more than 5 m in height and ground vegetation consists mostly of sphagnum and different sword grasses), flood-lands (small areas) and alluvial lands (larger flood-lands).

7.5.4 Methodological issues

Activity data – area of peatlands prepared for extraction – is taken from TABLE 3a.3.3[166] of the IPCC GPG LULUCF 2003. Emission factor for carbon stock changes due to drainage is taken from Table 3A.3.2[167] of the IPCC GPG LULUCF 2003. Emission factor for N_2O emissions due to drainage is taken from Table 3A.3.4[168] of the IPCC GPG LULUCF 2003. Coefficients for poor sites are considered because mostly poor sphagnum bogs are prepared for extraction historically.

7.5.5 Uncertainties and time-series consistency

Uncertainties for croplands are provided in Table 7.16.

The same methodological approach as in forest land, cropland and grassland is utilized.

Uncertainty level of CO_2 and N_2O emission factors assumed 95 %[169] according to the IPCC GPG LULUCF 2003. Uncertainty level of area estimations assumed 90 % according to the expert judgement.

Complete consistency of the time-series is secured by use of single source of data for estimation of area and emissions for the whole time period. Emissions associated with peat extraction might be considerably overestimated because this industry is considerably reduced during last decades[170] and area of peatlands prepared for extraction is reduced as well. However there are no statistically verifiable data about technical status of peat quarries therefore default values of activity data based on situation before 1990 are used in calculations.

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165 Lazdiņš, "Harmonization of land use matrix in Latvia according to requirements of international greenhouse gas reporting system - extending outputs of National Forest inventory program."

166 Estimates of peatland areas and use for tier 1 in 1000 hectares

167 Emission factors for CO_2-C and associated uncertainty for organic soils after drainage, coefficient for nutrient poor soils – 0.2 tons C ha^{-1} yearly.

168 Default emission factors for N_2O emissions from wetlands, coefficient for nutrient poor soils – 0.2 tons N_2O-N ha^{-1} yearly.

169 According to log-normal distribution.

170 http://data.csb.gov.lv/Dialog/varval.asp?ma=DR0060&ti=DR06%2E+SVAR%CEG%C2KO+DER%CEGO+IZRAKTE%D2U+KR%C2JUMI+GADA+BEIG%C2S+&path=../DATABASE/visp/Ikgad%E7jie%20statistikas%20dati/Dabas%20resursi/&lang=16

7.5.6 Category-specific QA/QC and verification

Quality control procedures named in IPCC GPG LULUCF 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 Category-specific recalculations

Area of wetlands is updated due to harmonization of the country area in the whole reporting period. Carbon losses in living biomass are not reported due to lack of accurate date of mortality in wetlands. Similarly, no gains in living biomass are not reported due to lack of accurate date of increment in wetlands. The figures are going to be updated in the NFI to report in further inventories.

No Tier 1 method is provided in IPCC GPG LULUCF to calculate CH_4 emissions; therefore, the notation key is changed to NO.

7.5.8 Category-specific planned improvements

The increment in living biomass will reported for managed wetlands, like drainage ditches, riversides and lakes. The activity data will be obtained from the NFI. Trees and bushes growing on ditches are not accounted under grassland, cropland or forest land category, because they are not fulfilling threshold criteria for these land use categories, therefore all vegetation on ditch sides is accounted under wetlands. Only in state forest length of drainage ditches is about 48000 km, which means about 48 kha area[171]. The same could be accounted in private forests and even more – in farmlands.

Non-CO_2 GHG might be considerable part of emissions from wetlands, therefore, it is necessary to develop method for estimation impact of ditches and other types of wetlands on N_2O and CH_4 emissions. Considering growth of peat extraction for energy purposes from abandoned peatlands and forests on wet organic soils, it is important to be able to calculate impact of drainage on non-CO_2 emissions as well as to be able to separate wetlands on organic soils (high N_2O emissions) and mineral soils (low N_2O emissions). Wetlands is one of the priorities in further development of GHG inventory in LULUCF sector in Latvia.

7.6 SETTLEMENTS (CRF 5.D)

7.6.1 Source category description

Land converted to settlements is a key source of CO_2 emissions according to trend and level assessment due to losses in carbon stock in living biomass, dead wood, litter and soil carbon pool. The land remaining settlements is a key source of CO_2 removals due to accumulation of carbon in living biomass. The role of conversion of forest land to settlements is increasing with a growth of economic activity and road construction in rural regions, because more than half of the country area is covered by forests, so that any new constructions are always associated with conversion of forest lands. Conversion of abandoned farmlands at the same time is more intensive; however, young forests on farmlands cannot fully compensate emissions due to the conversion of forest lands.

[171] Accoding to the Joint stock company "Latvia state forests".

Under the settlements category emissions from soils, litter, living and dead biomass due to conversion of land use type are reported. Summary of emissions due to conversion of forest lands to settlements are shown in Figure 7.11. In 2012 removals in living and dead biomass are accounted using the NFI data on increment of growing stock in settlements, which is represented mostly by overgrowing of roadsides, power lines and other infrastructure. Net emissions from settlements remaining settlements in 2012 was -110 Gg CO_2 (Figure 7.10). However, removals in woody vegetation and dead biomass was compensated by emissions due to land use change. Net emissions from settlements in 2012 were 897 Gg CO_2 eq. Total area of settlements in 2012 was 255 kha, including 16,8 kha of land converted to settlements after 1990.

The total area of settlements is estimated according to the information provided by the NFI. Increase of area of settlements during last 20 years took place due to conversion of forest lands. Increase of area of settlements (deforestation) is generally associated with road construction. All roads, including forest roads including buffer zones and drainage systems around roads are reported in the settlements category; therefore, the deforested area is considerably higher than official statistics, where forest roads are not accounted as deforested area and still belongs to forest land.

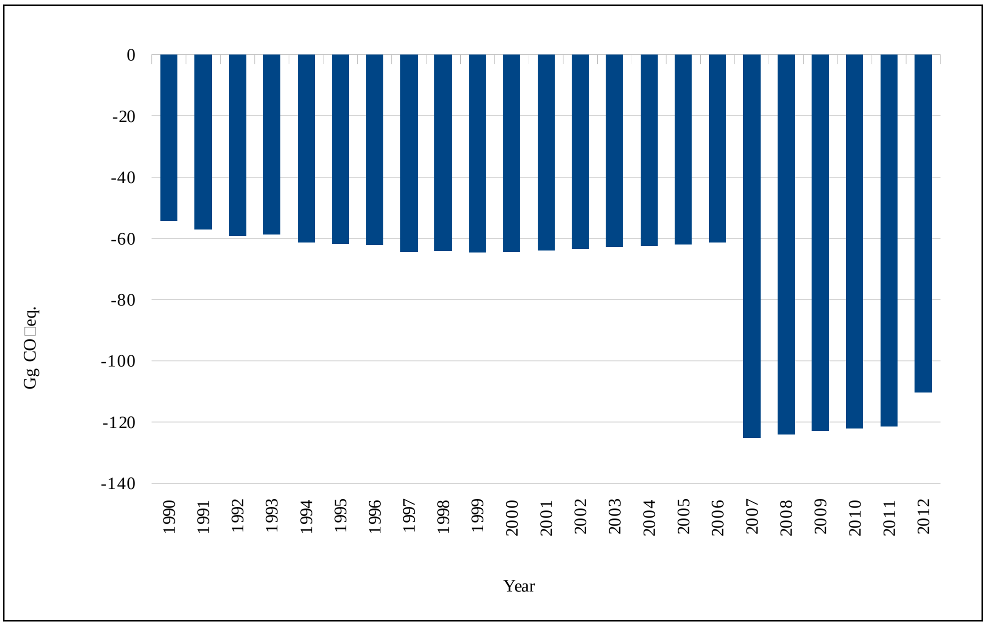

Figure 7.10 Net carbon stock changes in settlements remaining settlements

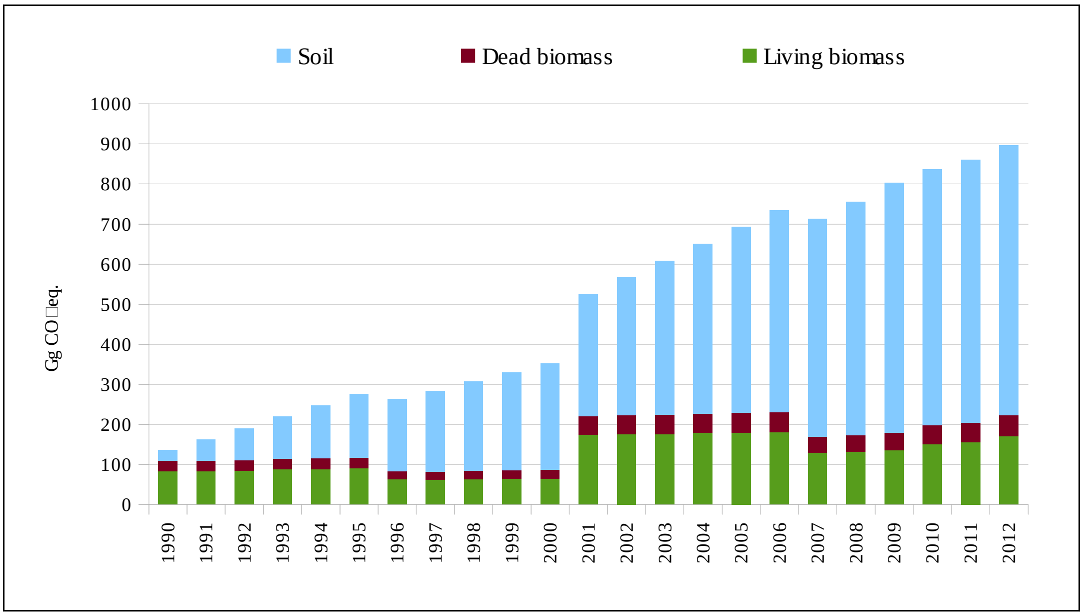

Figure 7.11 Net carbon stock changes in settlements

7.6.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Spatial approach is used to represent area of settlements. Activity data are provided by the NFI. Area of lands converted to settlements presented is estimated using LANDSAT satellite images within the scope of the project "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities"[172].

7.6.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

According to the IPCC GPG LULUCF 2003 settlements includes land under buildings including infrastructure necessary to maintain those buildings, like industrial networks, roads and other types if land use if they are not already accounted under other land use categories, for instance, in forest lands (parks and green parts of forests). According to national definitions updated for the GHG reporting settlements means:

- land under buildings including yards and gardens as well as land necessary to maintain and to access those buildings;
- land under roads including buffer zones;
- forest infrastructure excluding ditches and other wetlands, but including seed orchards, forest nurseries and fire-breaks;
- other infrastructure – buffer zones of industrial networks, quarries etc.

[172] Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)."

7.6.4 Methodological issues

Area of lands converted to settlements is estimated by evaluation of vegetation index of the NFI points (23 thousands of plots across the country) in series of satellite images produced in 1990, 1995 and 2000. Final land use was considered according to empiric data obtained during field visits. Points where the vegetation index changed from forest to non-forest lands were marked as potentially deforested. Then logical selection were used to separate those points where removal of woody vegetation is not associated with land use change (for instance, cleaning of roadsides outsides forest lands and buffer zones of railways) or changes in vegetation index were not permanent (for instance, forest in 1990, non-forest in 1995, forest in 2000 and settlement with woody vegetation in 2004-2008 according to the NFI), and the rest of points, mostly forest roads, were noted as deforested.
Linear regression was used to elaborate prognosis for conversion of forest land to other land uses in 2010-2012 (Figure 7.12). Obtained data (1.0 kha) were validated according to actual statistics of forest road construction in state forests and other deforestation activities planned for 2010-2012.

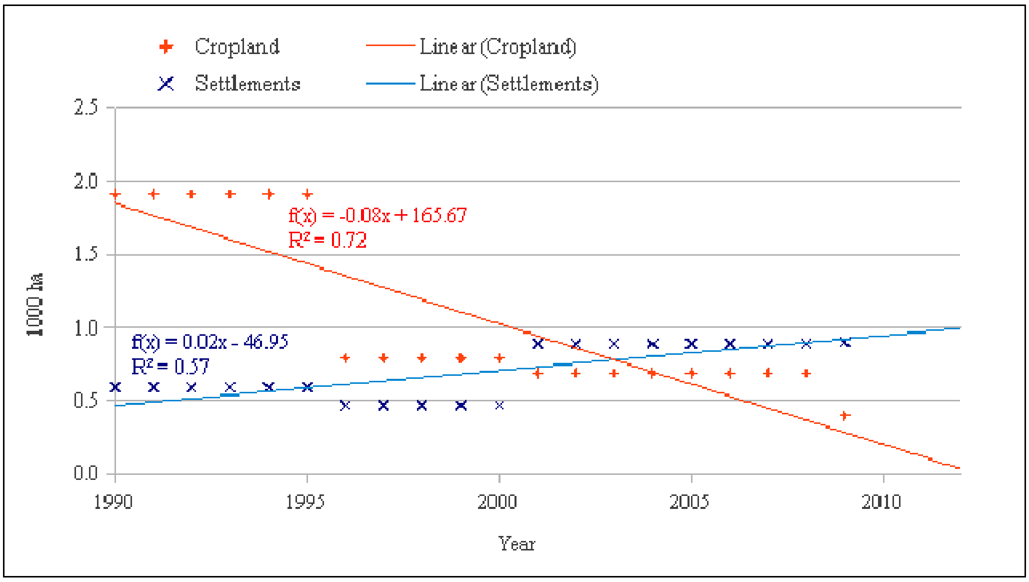

Figure 7.12 Linear regression used to elaborate prognosis of deforestation

Area of land remaining settlements is assumed constant until 2009 (239 kha) according to the NFI data. In 2010-2012 areas converted to settlements in 1990-1992 are moved from the temporary land use subcategory (land converted to settlement to the settlements remaining settlements. Area of land converted to settlement since 1990 is estimated using satellite image analysis. Total area of land converted to settlements in 2012 is 15,1 kha. Dynamics of area of settlements is shown in Figure 7.13.

There are only evidences in national statistics about conversion of forest land to settlements, and not of other land use types; therefore, the rest of categories of land converted to settlements are reported as not occurring.

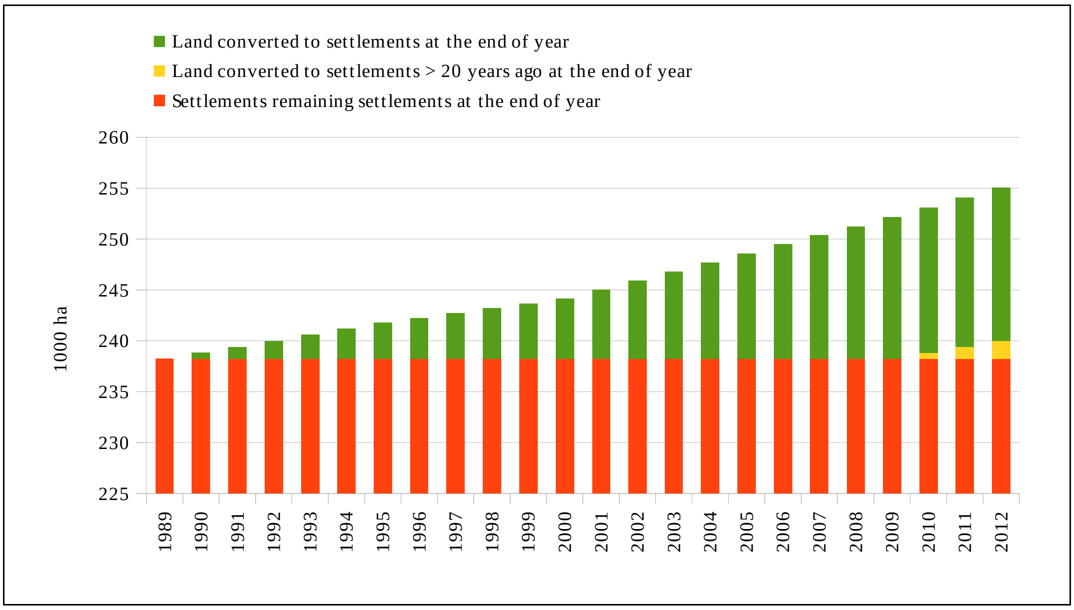

Figure 7.13 Area of settlements

The CO_2 removals are accounted for living and dead biomass categories in settlements remaining settlements based on the NFI data. Removals are accounted based of weighted (by area) gross increment, mortality factors, BEFs, carbon content and wood density in a particular year in forest land remaining forest. For emissions from dead wood pool in settlements remaining settlements 20 years transition period is considered. Age of woody vegetation on settlements is accounted backwards and as soon as age of trees reach "0", it is considered, that there is no more vegetation and no increment calculations are done. Harvesting, if any takes place, is reported under forest land remaining forest, because it is not possible to separate harvests by land use category as far as it is forest land. EPIM model is used in calculations.

The emissions (losses in carbon pools) are reported under category forest land converted to settlements. Carbon stock changes associated with commercial felling, including removal of woody vegetation on forest infrastructure (roadsides, ditches etc.) are accounted considering that losses in living biomass are equal to average growing stock in forest land remaining forest. Similarly, dead wood stock in forest land remaining forest in a particular year is considered as carbon losses from dead wood due to conversion of forest land to settlements. Instant oxidation method is considered for living and dead biomass carbon pools. Emission from soil due to land use change to settlement is considered according to average carbon stock in forest soil (both, mineral and organic soils) assuming that all carbon accumulated in upper 30 cm (244 tons C ha^{-1}) turns into emissions within 20 years (12 tons C h^{-1} annually).

Carbon stock changes in dead biomass are accounted using instant oxidation method considering that all dead biomass converts to emissions in the year of conversion. Average carbon stock in dead biomass (20.9 tons C ha^{-1} in litter and 6.0 tons C ha^{-1} in dead wood) is used in calculations. Dead wood is considered as average carbon stock in coarse dead biomass in a particular year of conversion.

Losses due to commercial felling in forest areas converted to settlements are accounted considering that the losses are equal to average growing stock of living biomass in forest land remaining forest in the year of conversion (BEFs, carbon content and wood density are considered as weighted (Figure 7.14) by total biomass distribution between species) averages in a particular year of conversion.

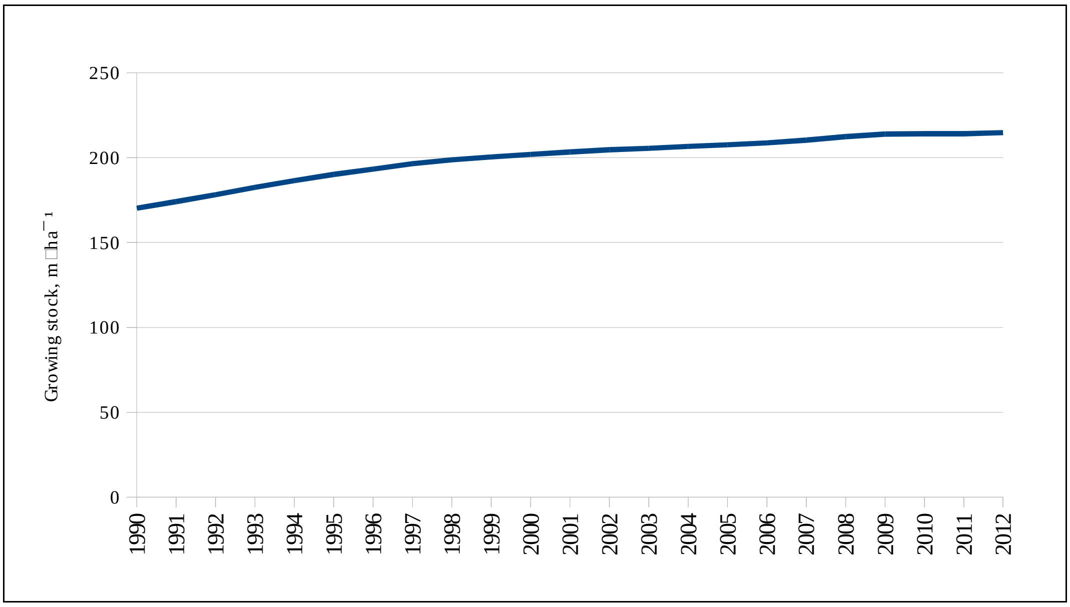

Figure 7.14 Assumption for average growing stock of living biomass in forest areas converted to settlements

7.6.5 Category-specific planned improvements

Lack of knowledge about distribution of settlements with vegetation coverage and without it leads to overestimation of soil emissions, because all settlement's are is considered for loosing soil carbon, in spite certain area is continuing to sequestrate carbon (like buffer zones around roads); therefore it is important to elaborate method to calculate proportion of settlements with and without vegetation coverage and different methods for calculation of soil carbon losses in these areas. It is planned to use satellite images with high resolution in several pilot areas (representing different economic activity and dominant type of vegetation) in this study.

In spite of ability to calculate carbon stock changes in living and dead biomass since 2004, historical figures cannot be easily restored. It is planned to use high resolution satellite images to evaluate dynamics of carbon stock in living biomass in certain pilot areas since 1990 and to extrapolate obtained results to all NFI plots to avoid potential overestimation of removals of CO_2 in living biomass.

7.6.6 Uncertainties and time-series consistency

Uncertainties for croplands are provided in Table 7.16.

The same methodological approach as in forest lands is utilized. Uncertainty of forest area converted to settlements is 19 % on the base of remote sensing results. Uncertainty of average carbon stock in litter in forests is 6.1 %, uncertainty of carbon stock in soil layer 0-30 cm is 15.6 %, uncertainty of dead wood stock in forests is 1.7 %, and uncertainty of carbon stock in dead wood is 30 %. Combined uncertainty of carbon stock in dead wood is 30 %. Combined uncertainty of carbon stock change is 14.6 %.

Consistency of time series is secured by using the same activity data (NFI) for the whole period. Extrapolation is used to elaborate prognosis of deforestation for 2009.

7.6.7 Category-specific QA/QC and verification

The QA/QC plans for the settlements' category includes the QC measures based on the IPCC (IPCC 2000, Table 8.1, p. 8.8-8.9). These measures are implemented first time during this 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.

7.6.8 Category-specific recalculations

Area of settlements is updated due to harmonization of the country area in the whole reporting period. Calculation of carbon stock in settlements (areas covered with trees, but not complaining with thresholds of forest land definition, like roadside buffer zones) is implemented into the inventory after completion of the most of measurements in the 2nd cycle of the NFI, demonstrating that settlements is net sink of CO_2 removals in living biomass. The removals are calculated according average increase of growing stock depending from age of woody vegetation for the period before 2006 (middle of the 1st NFI cycle), on the base of actual data for the period between 2006 and 2010 (comparing the 1st and the 2nd NFI cycle) and using extrapolation for 2011-2012. BEFs, wood density and carbon content values applied to forest land are used for settlements too.

Losses in living biomass are calculated as mortality rate applying average mortality rate (percentage of increment) in forest land in a particular year. Losses in dead biomass are accounted as decomposition of dead wood applying 20 years transition period.

Minor changes in area converted to settlement due to implementation of the EPIM model and harmonization of the country area in the whole reporting period.

Major changes are applied to calculation of GHG emissions due to conversion of forest land to settlements; losses in living biomass are calculated using instant oxidation method according to average growing stock of living biomass in forest land in a particular year. Losses in dead biomass are calculated using instant oxidation method according to average growing stock of dead biomass in a particular year and average stock of litter in forest land in the whole period.

Losses in soil are accounted considering that carbon stock in soil in upper 30 cm layer will be lost within 20 years. Country specific input data on average carbon stock in forest soil is considered. More detailed description was provided earlier in Cropland's section.

7.7 OTHER LANDS (CRF 5.F)

7.7.1 Source category description

According to the IPCC GPG LULUCF 2003 other lands are territories without vegetation like rocks, glaciers as well as the rest of unmanaged lands which are not included in other land use categories. According to the national land use statistics other lands includes unmanaged lands, wetlands and settlements (1 459.3 mill. ha in 2008). Instead of the official statistics since 2009 the NFI is used to estimate area of other lands. It is assumed that other lands are dunes and recultivated lands where land use type cannot be determined yet. Total area of these lands is considered constant for the whole reporting period (4.3 kha).

No emissions or removals are reported in this category.

7.7.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Spatial approach is used to represent land areas. Activity data are provided by the NFI. Area of other lands presented in this report is estimated within the scope of the project "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities"[173].

7.7.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The NFI land use classification system is used to identify other lands. The other lands are moorlands, dunes and recultivated lands where land use type cannot be determined yet. No emissions or removals are reported in this category.

7.7.4 Methodological issues

No emissions or removals are calculated treating the other lands as the unmanaged areas.

7.7.5 Uncertainties and time-series consistency

The uncertainty of activity data calculated as standard deviation of mean according to the NFI is 0,06 %. No emissions or removals are calculated in this category, therefore no conversion factors and uncertainties of the conversion factors are elaborated.

7.7.6 Category-specific QA/QC and verification

Category other lands remaining other lands is reorganized in this submission. The total area reported under this category is considerably reduced and moved to grassland's category; however, it does not affect GHG balances because no emissions or removals are reported just like in previous report.

7.7.7 Category-specific recalculations

Area of other land is updated due to harmonization of the country area in the whole reporting period. Moorlands are moved to grasslands category; however, it didn't affected area of other lands due to the fact that no NFI sample plots were identified as moorlands.

[173] Lazdiņš, "Harmonization of land use matrix in Latvia according to requirements of international greenhouse gas reporting system - extending outputs of National Forest inventory program"; Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)."

7.7.8 Category-specific planned improvements

No improvements are planned for this category. Changes in land use will be reported according to empirical data provided by the NFI every 5th year, respectively, land use changes will be recalculated every 5th year applying average figures to every year in the period.

7.8 BIOMASS BURNING (CRF 5 (V))

7.8.1 Source category description

This source category includes greenhouse gas emissions (CO_2, CH_4, N_2O) and other emissions (NO_x and CO) from biomass burning on forest land comprising wildfires and controlled burning as well as wildfires in grassland. The area statistics on forest wildfires are compiled by the State forest service and they are based on information given by the local units.

Figure 7.15 shows that the most of forest fires are located around large cities and roads. The situation is about the same every year.

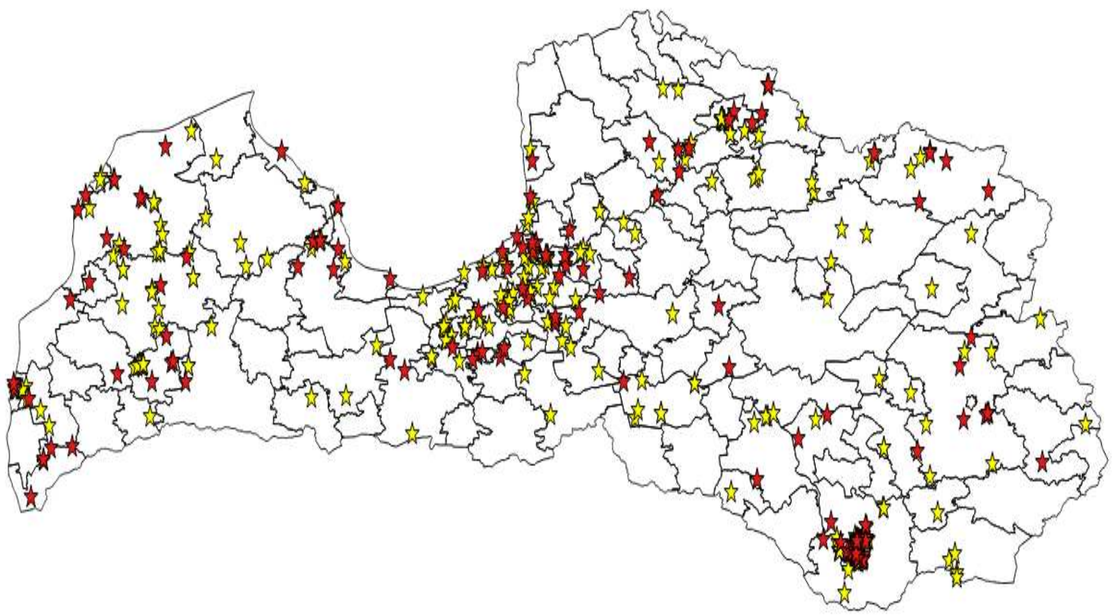

Figure 7.15 Forest fires in Latvia in 2011 (yellow) and 2012 (red).

Wildfires in grasslands are more common in south eastern part of the country and around Riga (Figure 7.16). Concentration of wildfires in the south-east correlates with area of abandoned farmlands.

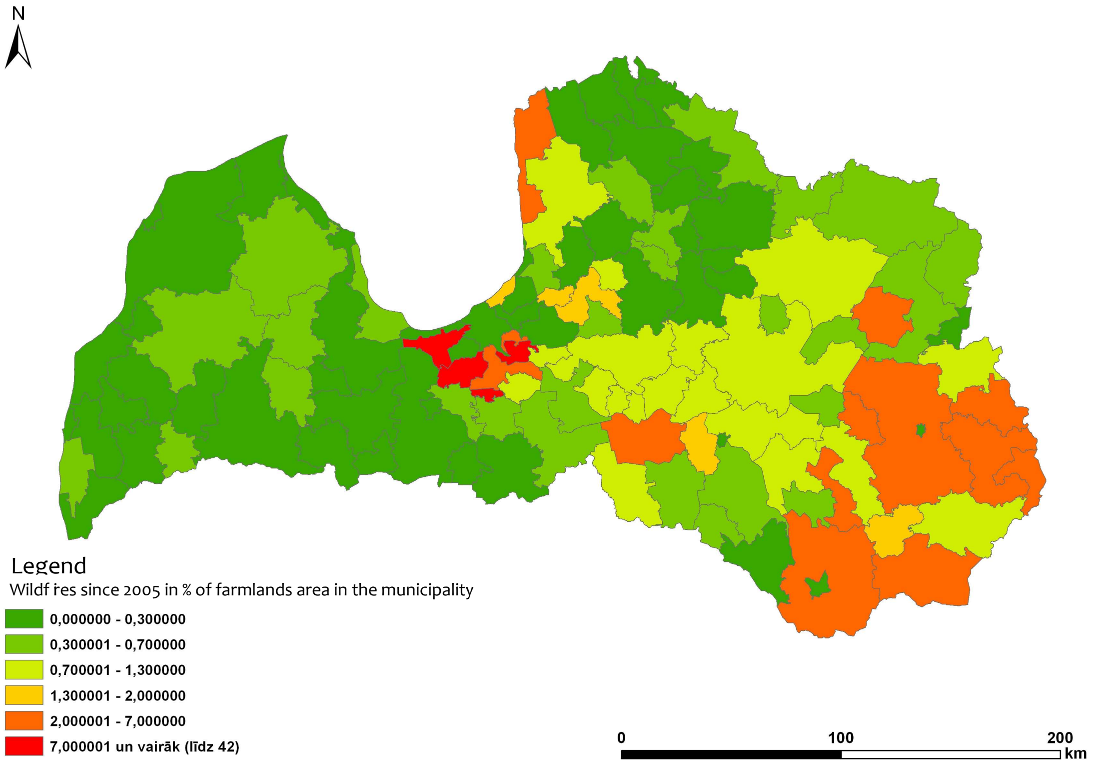

Figure 7.16 Wildfires in grasslands in Latvia since 2005

Emissions from biomass burning are represented by incineration of harvesting residues during forest logging operations. The information until 2010 was based on the study and for the 2011-2012 the information source is changed to questionnaire of private forest owners and state forest management company. This switch lead to reduction of emissions in 2011.

Total aggregated emissions from biomass burning in 2012 were 301 Gg of CO_2 eq. (Figure 7.17).

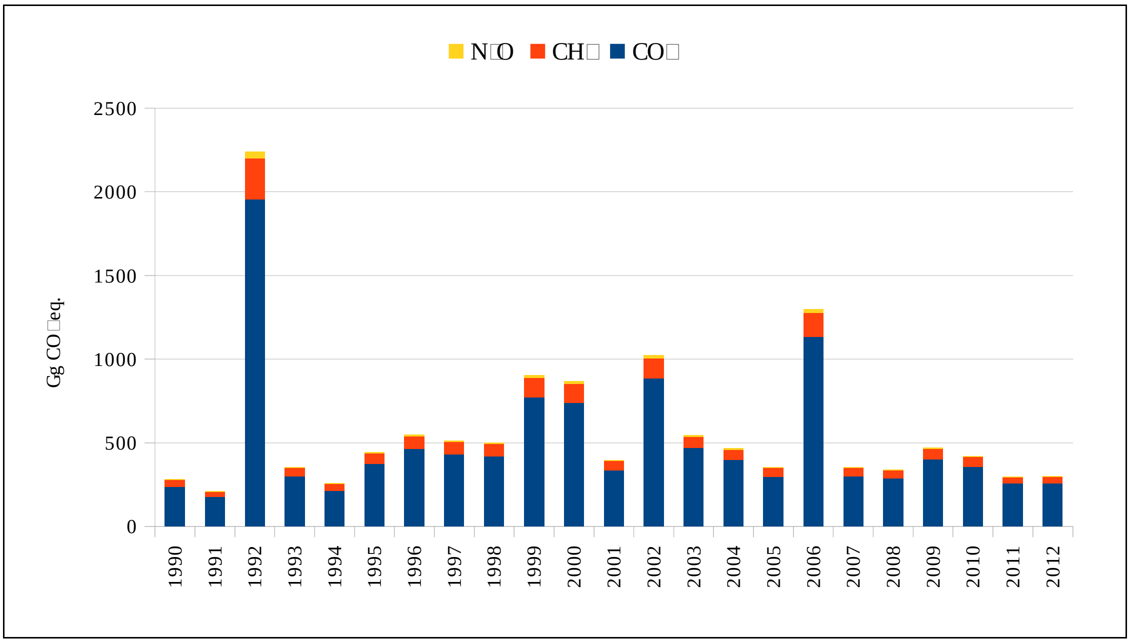

Figure 7.17 Aggregated emissions from biomass burning

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 2012 is provided by the SFS , area of grassland burning is provided by the State fire safety service (SFSS), cartographic information about location of wildfires in grasslands since 2005 is provided by Rural development service. Total area of burnt grassland is shown in Table 7.24. For 1990-1992 no statistical information exists. It was decided to use average burnt area of following 5 years period for 1990-1992 instead of notification key NO. Area of forest fires and biomass in burnt area is shown in Figure 7.18.

Table 7.24 Burnt area in m^2 and ha

Year	Area in m^2	Area in ha
1993	209 802	21
1994	980 830	98
1995	5 259 604	526
1996	12 242 331	1 224
1997	5 761 460	576
1998	12 548 425	1 255
1999	26 853 597	2 685
2000	22 615 262	2 262
2001	48 003 708	4 800
2002	115 474 701	11 547
2003	143 350 432	14 335
2004	67 170 270	6 717
2005	20 268 245	2 027
2006	258 059 968	25 806
2007	40 481 186	4 048
2008	11 698 738	1 170
2009	44 620 699	4 462
2010	24 950 477	2 495
2011	16 180 607	1 618
2012	18 716 832	1 872
Total	895 447 174	89 545

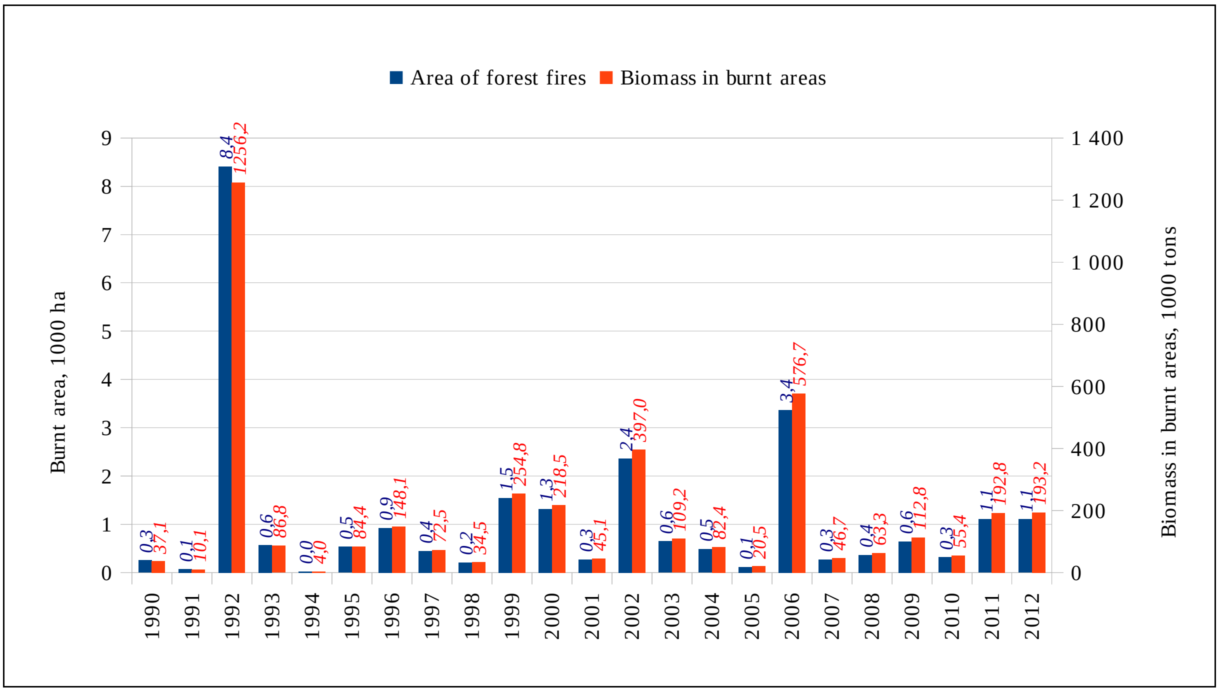

Figure 7.18 Aggregated emissions from biomass burning

7.8.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Biomass burning occurs in forest land and grassland. Taking in account that wetlands (swamps) belongs to forest land according to national land use definitions emissions associated with wildfires in wetlands cannot be separated and are reported under forest lands remaining forests. No evidences of forest fires or grassland wildfires are found in land converted to forest in the NFI plots having special forest land category – burnt forest; therefore it is considered that no forest fires takes place in afforested area. The approach used in the Latvia's NIR (reporting emissions under land use categories according to national statistics) secures that emissions from biomass burning are not overlapping.

7.8.4 Methodological issues

Tier 1 and 2 methods of calculation provided in the IPCC GPG LULUCF 2003 were utilized. Emissions from wildfires were calculated using equation 3.2.20 of the IPCC GPG LULUCF 2003[174].

Amount of burned biomass is considered according to average growing stock of living biomass, dead wood and litter in a particular year.

Figure 7.18 can be used to calculate amount of available biomass if forest fire sites. Combustion efficiency or fraction of biomass combusted (dimension-less) is considered 0,34 according to TABLE 3A.1.12 of IPCC GPG LULUCF[175]. Factors of emissions are shown in Table 7.25.

174 Ed. Penman et al. (2003) Good Practice Guidancefor Land Use, Land-Use Change and Forestry (IPCC GPG LULUCF).

175 Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types.

Table 7.25 Emission factor for each GHG (g kg⁻¹ dm)[176]

Gas	CH_4	CO	N_2O	NO_x	CO_2
Emission factor	7,1	112	0,11	0,7	1531

Emissions from wildfires in grassland were calculated using equation 3.2.19 and emission ratios were taken from Table 3A.1.15 of the IPCC GPG LULUCF 2003. Mass of available fuel in grassland's fires[177] – 2400 kg dm ha^{-1}, fraction of the biomass combusted 0.5. Factors of emissions for grassland fires are shown in Table 7.26.

Table 7.26 Emission factors for grassland's wildfires

No	Gas	Factor, g kg^{-1} dry matter combusted
1.	CO_2	1498
2.	CO	59
3.	CH_4	2
4.	NOx	4
5.	N_2O	0,1

Emissions from controlled fires were calculated considering average stock of harvesting residues (BEF for conversion of stem biomass to above-ground biomass), which considerably increased due to increase of estimates of harvesting stock. Fraction of biomass oxidized on-site 0,9. Factors of emissions and coefficients for calculations are shown in Table 7.27.

Table 7.27 Emission factor for each GHG (g kg^{-1} dm)[178]

No	Gas	Factor
1.	CH_4	0,01
2.	CO	0,06
3.	N_2O	0,01
4.	N/C conversion for N_2O	0,01
5.	NO_x	0,12
6.	N/C conversion for NO_x	0,01

The following assumptions have been made for harvesting residues calculation, which was burned:

- 1990 to 2000 – 50 % of harvesting residues felt for incineration and 67 % incinerated, the rest left to decay;
- starting from 2001 – 30 % of harvesting residues left for incineration and 67 % incinerated and 70 % left to decay;

176 Table 3a.1.16 Emission factors (g kg^{-1} dry matter combusted) applicable to fuels combusted in various types of vegetation fires

177 According to IPCC GPG LULUCF Table 3.4.2.

178 Table 3a.1.15 Emission ratios for open burning of cleared forests.

- starting from 2011 – 7 % of harvesting residues left for incineration and 100 % burned on-site, the rest left for decay or extracted for bioenergy production.

CO_2 emissions are calculated only from wildfires taking in account that carbon located in harvesting residues is already accounted as losses in living biomass. Incinerated residues are extracted from removals in dead wood.

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 2003 default values.

7.8.6 Category-specific QA/QC and verification

Quality control procedures named in IPCC GPG LULUCF 2003 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 Category-specific recalculations

Major changes were applied to this category due to utilization of improved data on harvesting residues and available biomass in forest wildfires. No significant changes are applied to emissions' factors.

7.8.8 Category-specific planned improvements

A new methodology on estimation of incineration efficiency in forest fires is under development in the LSFRI Silava. Information provided by the State forest service will be used for quality assurance. Harvesting residues burning will be evaluated by forest owners questionnaires.

7.9 NON – CO_2 EMISSIONS (CRF 5 (I-III))

7.9.1 Source category description

Direct N_2O emissions from fertilization of forest land are reported as not occurring because no forest fertilization takes place in Latvia. It is forbidden by the FSC and PEFC forest certification systems as well it is economically non-feasible in forests with ordinary rotation period. Emissions from applications of fertilizers on farmlands in reported in the agriculture's section. The category includes N_2O emissions from drained soils in forest lands and wetlands as well as N_2O emissions associated with land use change to croplands.

7.9.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The land area currently used as cropland is estimated according to empirical data provided by the NFI, historical areas of the new croplands (land converted to cropland) is estimated using interpolation on the base of research data[179]. Area of constructed wetlands (areas prepared for peat extraction) is taken from the default values of the IPCC GPG LULUCF 2003. Area of drained forest soils is estimated using spatial approach on the base of information about distribution of forest stand types characteristic for drained mineral and organic soils.

7.9.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The NFI land use definitions are merged into the LULUCF categories of land use. Harmonized approach (single source of information) is used in all of the LULUCF categories to represent current land use data with exception of croplands which is extrapolated according to the national statistics of the managed croplands area.

7.9.4 Methodological issues

Methods utilized to estimate N_2O emissions due to conversion of land use to croplands are described in Chapter 7.3.4.

7.9.5 Uncertainties and time-series consistency

Uncertainties described in Chapter 7.3.4.

7.9.6 Category-specific QA/QC and verification

Procedures relevant to specific land use categories are applied.

7.9.7 Category-specific recalculations

No recalculations done.

7.9.8 Category-specific planned improvements

The research is started in 2011-2013 to evaluate carbon stock in grasslands to elaborate methodology for estimation of net emissions from conversion between forest lands and grasslands. Similar study is initiated in 2012 to estimate carbon stock in croplands. These data will be used to evaluate emissions of CO_2 and N_2O due to conversion of forest lands to cropland.

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179 Lazdiņš, "Harmonization of land use matrix in Latvia according to requirements of international greenhouse gas reporting system - extending outputs of National Forest inventory program."

7.10 HARVESTED WOOD PRODUCTS (CRF 5.G)

7.10.1 Source category description

Harvested wood products is a key source of CO_2 removals. Increase of removals in the harvested wood products during the last decade is associates with increase of harvesting rate and implementation of more advanced timber processing technologies.

Net emissions due to production of the harvested wood products are calculated on the base of the methodology elaborated in 2011 by S. Rüter for estimation of the forest management reference level for the 2013-2020 reporting period of the Kyoto protocol[180].

The net emissions in harvested wood category in 2012 was -1273 Gg CO_2. The net emissions during the reporting period are shown in Figure 7.19.

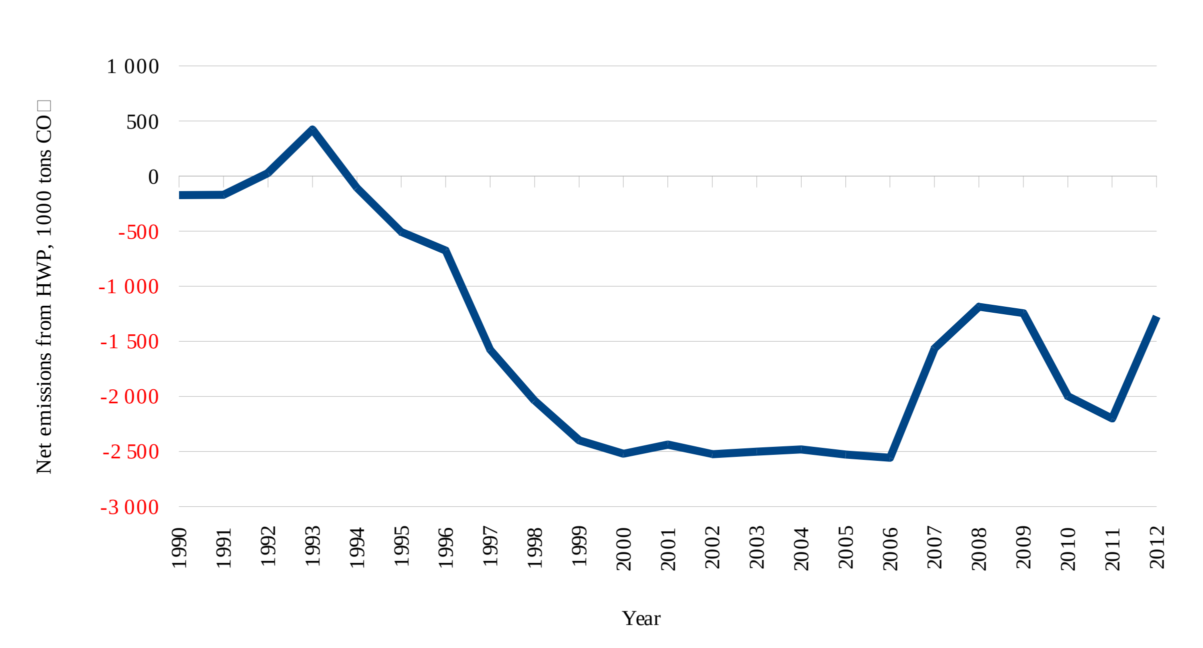

Figure 7.19 Net emissions from harvested wood products

7.10.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The calculation is based on harvesting statistics collected by the State forest service and production statistics by the Forest industry association and FAO. Linkage to land area extracted in the commercial felling is secured through the State forest service stand wise forest inventory system, where all commercial harvesting activities are recorded.

Only locally originated and consumed (including primary processing) wood is accounted.

[180] Rüter, S., 2011. Projection of Net-Emissions from Harvested Wood Products in European Countries (No. Work Report No. 2011/x of the Institute of Wood Technology and Wood Biology). Johann Heinrich von Thünen Institute (vTI), Hamburg.

7.10.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

The proportion is calculated to estimate share of harvesting stock extracted due to deforestation. This proportion is applied to HWP to estimate, how much HWP could be produced from wood obtained in deforested areas. Instant oxidation is applied to the proportion of HWP potentially produced from the wood obtained in deforested areas.

7.10.4 Methodological issues

The net emissions from the harvested wood products are calculated according to the methodology elaborated by S. Rüter, 2011.

Historical data on production, import and export of HWP as well as share of different types of the products are used in calculation. The coefficients and numeric values used in calculation are provided in Table 7.28 and Table 7.29. Input data in calculation are counted down to 1900. Net emissions due to decay of harvesting residues are accounted separately considering 20 years transition period for above and below ground biomass. Instant oxidation is considered for the firewood assortment.

Table 7.28 Assumptions for estimation of carbon stock in harvested wood products

ID	Assortment	Density, g cm^{-3}	Gg C 1000 m^{-3}
1.2.C	Industrial rdw - Coniferous	0.45	0.23
1.2.NC	Industrial rdw Non-Coniferous	0.67	0.34
5.C	Sawnwood -Coniferous	0.45	0.23
5.NC	Sawnwood - Non-Coniferous	0.67	0.34
6 1	Veneer sheets	0.59	0.30
6 2	Plywood	0.48	0.24
6 3	PARTICLE BOARD (including OSB)	0.63	0.29
6.4.1	HARDBOARD	0.85	0.42
6.4.2	MDF (MEDIUM DENSITY)	0.73	0.32
6.4.x	Fibreboard compressed	0.79	0.34
6.4.3	INSULATING BOARD	0.27	0.11
10	PAPER AND PAPERBOARD	0.90	0.45

Share of locally originated wood in harvested wood products is calculated using equation No. 1.

$$ratio_{INDRW\ consumption\ from\ dom\ harvest} = \frac{(Production_{INDRW} - Export_{INDRW})}{(Production_{INDRW} + Import_{INDRW} - Export_{INDRW})} \quad (1)$$

Organic carbon in harvested wood products originated from local wood is calculated using equation No. 2.

$$Production_{HWP\ from\ dom\ harvest} = Production_{HWP} \cdot ratio_{INDRW\ consumption\ from\ domestic\ harvest} \quad (2)$$

The rate of the CO_2 emissions and removals in harvested wood products is calculated using equations No. 3 and 4.

$$C(i+1) = e^{-k} \bullet C(i) + \left[\frac{(1-e^{-k})}{k}\right] \bullet Inflow(i) \qquad \text{with } C(1900) = 0.0$$

$$\Delta C(i) = C(i+1) - C(i)$$

(3)

$$k = \frac{\ln(2)}{HL}$$ (4)

Table 7.29 Common coefficients to estimate balance between CO_2 emissions and removals in harvested wood products

Coefficients	Numeric value		
Common coefficients			
e	2.718282		
ln(2)	0.6931		
Assortment specific coefficients:			
Assortment	**Sawnwood**	**Platewood**	**Pulpwood**
HL	35	25	2
k	0.02	0.03	0.35
e^{-k}		0.98	0.97
0.71 $\frac{1-e^{-k}}{k}$	0,99	0,99	0.85

The methodology is still under development to represent more accurate impact of species distribution in the harvesting stock as well as to simplify representation of different products (to reduce them to sawn products, plate wood and pulp wood).

The equations of calculation of the harvested wood products are included into the National model for calculation of the net emissions due to forest management as separate module.

7.10.5 Uncertainties and time-series consistency

Uncertainty level for the whole time series for CO_2 emissions or removals is assumed 15 % (212 Gg CO_2) in 1990-2012.

7.10.6 Category-specific QA/QC and verification

Harvesting rate and production of harvested wood products used in the calculations is compared with other data sources, particularly statistics collected by the Latvia Forest industry federation.

7.10.7 Category-specific recalculations, if applicable, including changes made in response to the review process

Minor changes in accounting of harvested wood products (HWP) due to implementation of EPIM model in LULUCF sector. Harvesting due to conversion of forest land to other land use categories is accounted as average growing stock in a particular year. Double accounting of emissions (as instant oxidation under land converted from forest to other land use categories and as emissions from HWP) is avoided by applying proportion principle to estimation of HWP originated due to commercial felling and conversion of forest land.

7.10.8 Category-specific planned improvements

Major changes will we applied to activity data, when new IPCC methodology will be adopted and more detailed information on structure of the roundwood assortments will be available from industry. Impact factors of species composition on structure of assortments will be included into the calculations in the next inventory.

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8. WASTE (CRF 6)

8.1 OVERVIEW OF SECTOR

8.1.1 Quantitative overview

Waste management has acquired prior 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 11 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[181] "3-Wastes", "2-Water" 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 and the assessments 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 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 was developed by LEGMC as well. Data of water abstraction and use, 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 reported by all enterprises which have issued permits on water use, water resources use or mineral deposits quarry use, or IPPC permit. 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 Sewage Sludge, N_2O emission from Industrial Waste Water Handling and NMVOC emission, and CSB for CH_4 emission from industrial waste water handling and N_2O from Domestic Waste Water Handling.

8.1.2 Description

GHG emissions from Waste sector have been fluctuated from 1990-2012. In 2012, emissions were approximately 2% higher than in 1990. In 2012, emissions from the Waste sector were 600.07 Gg CO_2 equivalents; it contributes about 5.4% of total GHG emissions (excluding LULUCF).

[181] http://parissrv.lvgmc.lv/public_reports

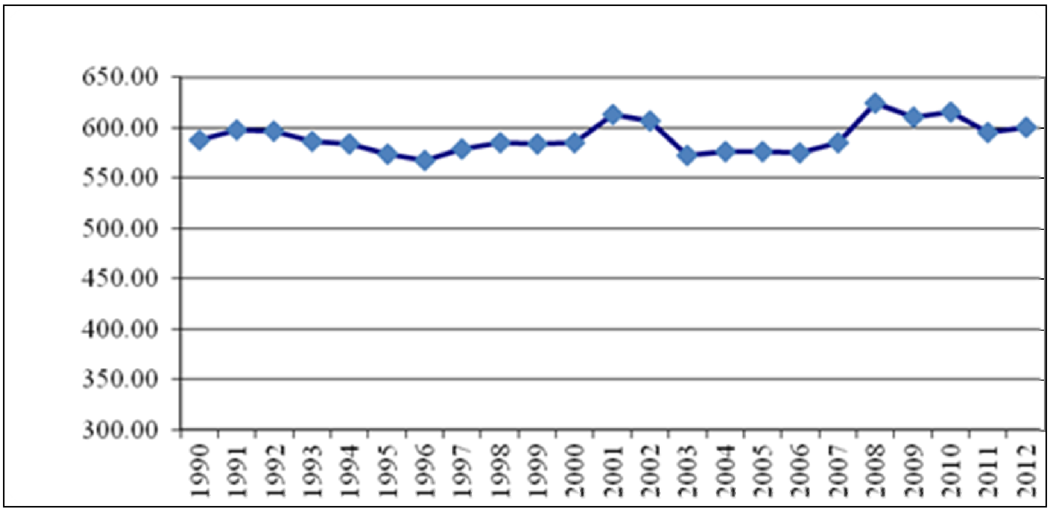

Figure 8.1 Total emissions from Waste sector in CO_2 equivalent (Gg)

Fluctuations in total GHG emissions in waste sectors could be explained with changes of economical situation in last 20 years (Figure 8.1). 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.

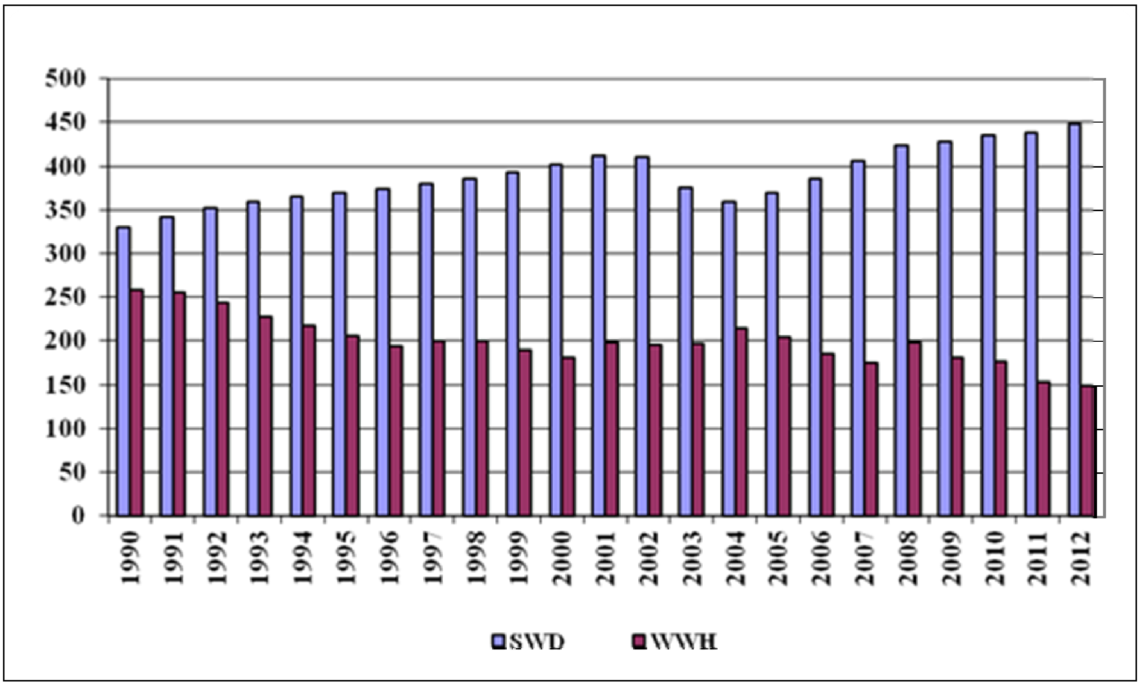

Figure 8.2 Emissions from SWD and WWH sectors in CO_2 equivalent (Gg)

Emissions from Waste Incineration (WI) and Composting (Comp.) in last year's, when emissions from these sectors were calculated, are very small in comparison with other sectors – Solid waste disposal (SWD) and Waste water handling (WWH) (Figure 8.2, Figure 8.3).

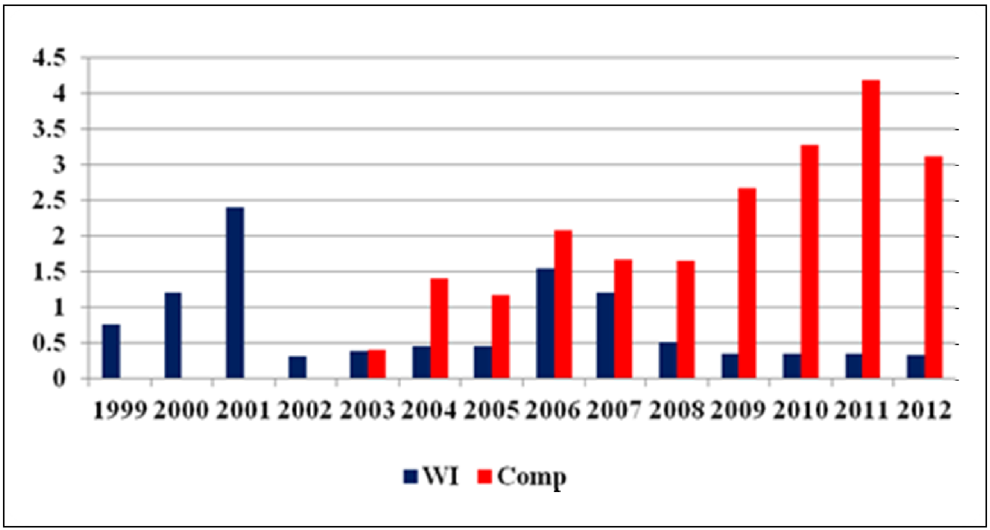

Figure 8.3 Emissions from WI and composting sectors in CO_2 equivalent (Gg)

According to the information from LEGMC[182] the total generated amount of waste are shown in Table 8.1.

Table 8.1 Generated wastes in Latvia (Gg)

Year	Municipal (all non-hazardous) wastes	Hazardous wastes	Total
2006	1420.46	54.372	**1474.832**
2007	1386.57	41.605	**1428.175**
2008	1368.79	46.400	**1415.160**
2009	1033.91	55.563	**1089.473**
2010	1131.404	55.089	**1186.493**
2011	1535.057	58.476	**1593.533**
2012	1799.440	85.121	**1884.561**

N_2O is emitted as the release from sewage purification system and waste incineration.

Data on CO_2 and N_2O emissions from waste incineration are available only since 1999, for earlier years no information available 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.

8.2 SOLID WASTE DISPOSAL ON LAND (CRF 6.A)

8.2.1 Source category description

Methane emission is calculated from SWD (Table 8.2). It is main GHG source from waste sector in Latvia.

[182] http://www.meteo.lv/public/28759.html

Table 8.2 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	CH_4, NMVOC
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. The base year for disposed amount estimation is 1996, when research[183] about biggest landfills was done. All calculations are done according to 1996 year amount. In that research total generated solid municipal waste amount is estimated as 2 379 829 m^3. It is assumed that outstanding part of these wastes is going to landfills. Amount of disposed tons are calculated - 2 379 829 m^3*0.2 = 475 965 tons. Waste amounts 1997 – 2001 was estimated like equal growth between 1996 and 2002 amount. Amounts 1970 – 1995 were estimated according to GDP and population changes.

Table 8.3 Estimated Disposed amounts from 1970 – 2002

Year	Population	Disposed solid waste amount (Gg)	GDP/inhabitant (LVL - 2000 prices)	Disposed wastes from urban areas (Gg)	Disposed wastes from rural areas (Gg)
1970	2351903	409.59	1230	249.95	159.65
1971	2368671	419.60	1286.4	260.15	159.45
1972	2385439	429.60	1342.8	266.35	163.25
1973	2402207	439.61	1399.2	276.95	162.65
1974	2418975	449.61	1455.6	283.25	166.36
1975	2435744	459.62	1512	294.15	165.46
1976	2452512	469.62	1568.4	300.56	169.06
1977	2469280	479.62	1624.8	311.76	167.87
1978	2486048	489.63	1681.2	318.26	171.37
1979	**2502816**	499.63	1737.6	332.18	167.46
1980	2508728	508.59	**1794**	335.67	172.92
1981	**2514640**	517.55	1850.4	348.50	169.05
1982	2529255	527.35	1906.8	353.32	174.02
1983	2543870	537.15	1963.2	365.26	171.89
1984	2558486	546.94	2019.6	371.92	175.02
1985	2573101	556.74	**2076**	384.15	172.59
1986	**2587716**	572.04	2169.4	393.01	179.03
1987	2607822	587.87	2262.8	405.63	182.24
1988	2627928	603.70	2356.2	416.55	187.15
1989	2648034	619.53	2449.6	430.06	189.47
1990	**2668140**	635.36	**2543**	439.97	195.39
1991	2634628	599.65	2324.6	415.62	184.02
1992	2601116	563.93	2106.2	389.90	174.03
1993	2567604	528.22	1887.8	362.42	165.80
1994	2534092	492.50	1669.4	339.96	152.54
1995	**2500580**	456.79	**1451**	314.36	142.43
1996	**2469531**	**475.96**	**1600**	326.98	148.98
1997	**2444912**	506.30	1693.75	347.36	158.94

[183] "Research about solid waste management in Latvia", 1998, Ltd GEO Consultants

Year	Population	Disposed solid waste amount (Gg)	GDP/inhabitant (LVL - 2000 prices)	Disposed wastes from urban areas (Gg)	Disposed wastes from rural areas (Gg)
1998	**2420789**	536.64	1787.5	368.00	168.64
1999	**2399248**	566.98	1881.25	387.30	179.68
2000	**2377383**	597.32	**1975**	406.73	190.59
2001	**2364254**	627.66	**2149**	426.81	200.85
2002	**2345768**	**658.00**	**2304**		

Figures in bold is primary data from National statistics[184] (Table 8.3). 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 calculated according to available amounts in nearest years. GDP data from 1970 – 1979 are estimated like the same decrease from 1985 - 1980.

Landfills from 1970 – 2001 are estimated as unmanaged[185]. Disposed amount are divided between rural and urban areas, according population proportion between these areas. Methane correction factors (MCF) for CH_4 emissions calculations in urban areas (deep sites - 0.8) and rural areas (shallow sites - 0.4) are used.

Data about waste disposal on land for 2002 - 2012 are taken from database "3-Wastes" (Table 8.4). Starting from year 2002, according to data base information, biggest sites could be estimated as managed sites (polygons) and MCF-1 is starting to use. For each year (2002-2012) in polygons disposed amount are determine according to disposing site profile from "3-Wastes" data base.

Table 8.4 Disposed solid waste amounts from 2002-2012 (Gg)

Year	Total disposed solid waste amount	Disposed in polygons (MCF-1)	Disposed in deep unmanaged sites (urban area, MCF-0.8)	Disposed in shallow unmanaged sites (rural area, MCF-0.4)
2002	658.0	217.46	303.97	136.57
2003	578.9	207.74	256.07	115.05
2004	631.7	282.84	240.71	108.15
2005	610.9	370.43	165.89	74.53
2006	670.0	454.39	148.78	66.84
2007	775.1	553.27	153.09	68.78
2008	704.8	566.89	95.12	42.74
2009	637.5	549.5	60.71	27.28
2010	605.4	586.9	12.73	5.72
2011	548.7	543.5	2.6	2.6
2012	529.524	525.568	1.98	1.98

According to information in landfill research, number of active waste disposal sites decreased from 558 in 1997 to 15 in 2012. All calculations are done for unsorted wastes, because 95% of disposed wastes are reported as unsorted.

[184] Statistical Yearbook of Latvia 2004, CSB, 2005
[185] "Degradable organic carbon in disposed wastes", 2011, Ltd Virsma

According to Waste management plan 2006 – 2012, in Latvia operates 11 waste disposing polygons, all other waste disposal sites are planned to close. In 2012 – 11 solid waste polygons operates, all these sites are estimated as managed. When this plan will be realized, data collection about disposed municipal wastes amounts and its composition will become more accurate. Disposed solid waste amounts in Latvia are shown in Figure 8.4.

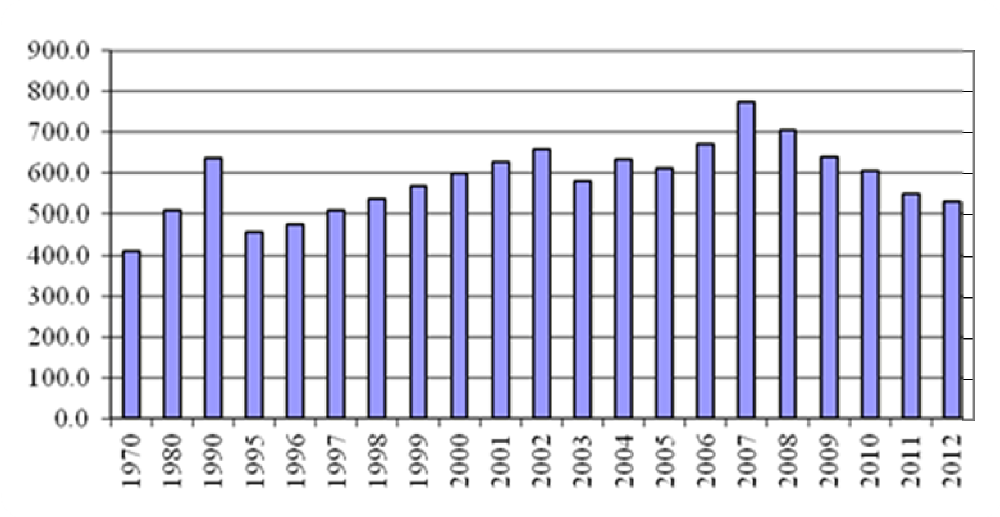

Figure 8.4 Disposed waste amounts in Latvia (Gg)

Since October 2002 CH_4 recovery from landfills are in progress. For 2010 only in three waste facilities (SIA Getlini EKO, SIA Liepajas RAS, SIA ZAAO Daibe) CH_4 recovery was realized. In SIA Getlini EKO polygon methane was collected from old waste disposing area and from new waste disposing cells, which is specially build for waste disposing with biogas collection. In SIA Liepajas RAS methane collection also is developed in old landfill Skede and in new polygon Kivites. In SIA ZAAO polygon Daibe methane collection was started in the middle of 2009. In total 6.46 Gg of CH_4 was collected and recovered in 2012. Recovered methane amount is presented in Figure 8.5.

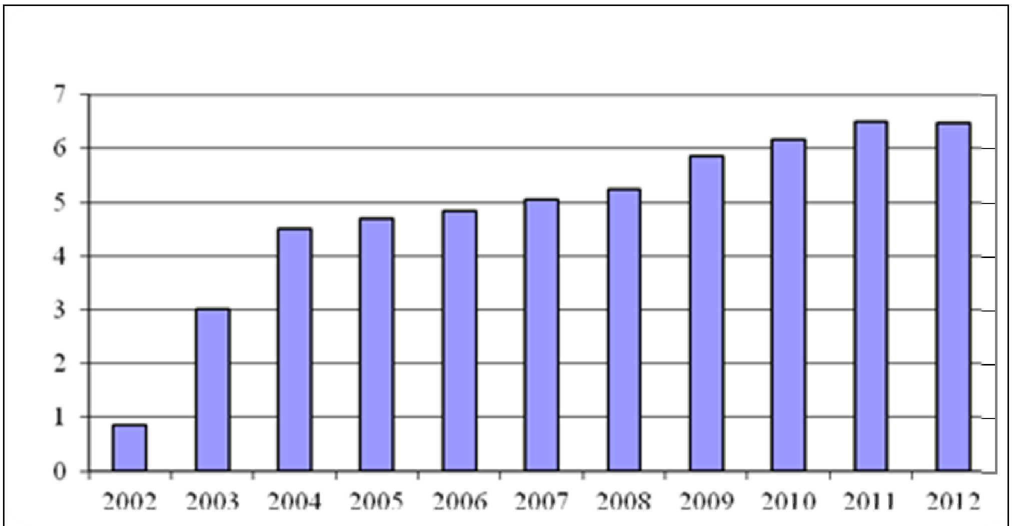

Figure 8.5 Recovered CH_4 from waste disposing (Gg)

According to Latvia's Waste Management plan 2006-2012, CH_4 recovery from landfills is one of priorities in waste management. CH_4 emission from waste disposing in SWD sites is presented in Figure 8.6.

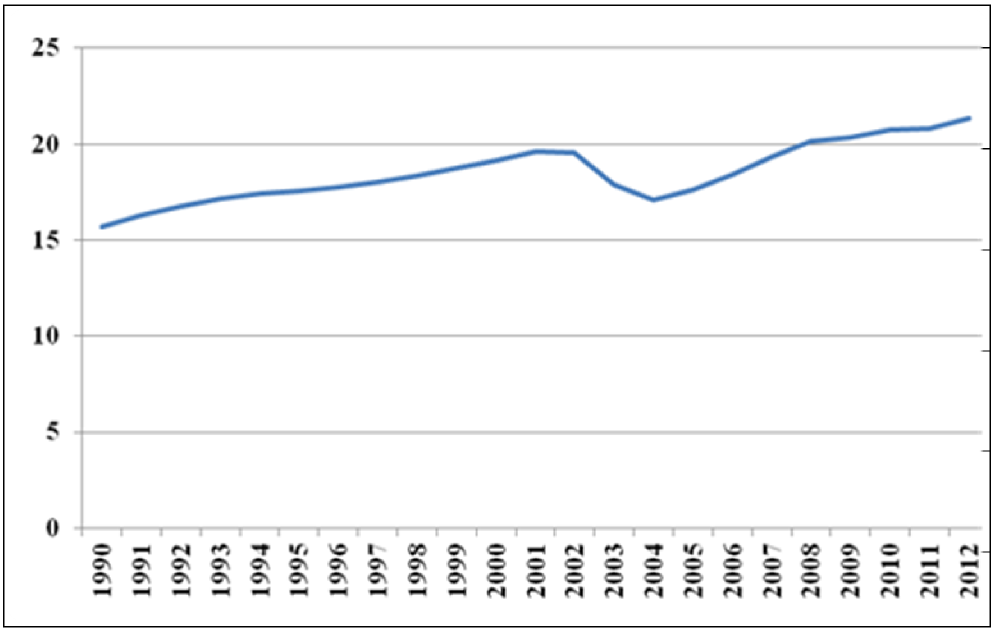

Figure 8.6 CH_4 emissions from waste disposing (Gg)

8.2.2 Methodological issues

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

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

$$CH_{4\ \text{generated in year t (Gg/yr)}} = \sum_x \left[(A*k*MSW_{L(x)}*Lo(x))*e^{-k(t-x)} \right]$$

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

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
Deep unmanaged sites - 0.8
Shallow unmanaged sites - 0.4
DOC *– degradable organic carbon (0.17);*
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)*

3 separate calculations are done for 3 types of landfills:

1. polygons (MCF-1),
2. deep unmanaged sites (MCF-0.8)
3. shallow unmanaged sites (MCF-0.4)

Total methane emission is counted together from 3 values.

Fraction of CH_4 in landfill gas is estimated as 0.5 according to information, which is received from methane collection enterprises. Methane collection enterprises provide information about collected methane amount and also about methane concentration in landfill gas. Methane concentration is mutable, it diversifies from 0.47 – 0.54 depending on time frame and weather conditions.

DOC value is used as 0.17, according to research what is carried out in Latvia ("Degradable organic carbon in disposed wastes", 2011, Ltd Virsma). All other factors are default from IPCC guidelines.

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 2002.

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.

Disposed waste amount from year 2002 is taken from waste data base "3-Wastes". Data in this data base are checked and approved by Regional Environmental Boards.

8.2.5 Source-specific recalculation

No recalculations are done.

8.2.6 Source specific planned improvements

For waste polygons is planned to start calculate emissions with specific DOC values for each of them according to disposed waste content.

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 8.5 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, NMVOC
6.B 2	Domestic and commercial waste water	CH_4, N_2O
6.B 3	Other	Not occurring

LEGMC data show that 529 million m³ of wastewater in 2012 was discharged, from which 379 million m³ were treated by different wastewater treatment plants, ~79 % from which were biological plants (Table 8.5).

Fluctuation of amount of 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.

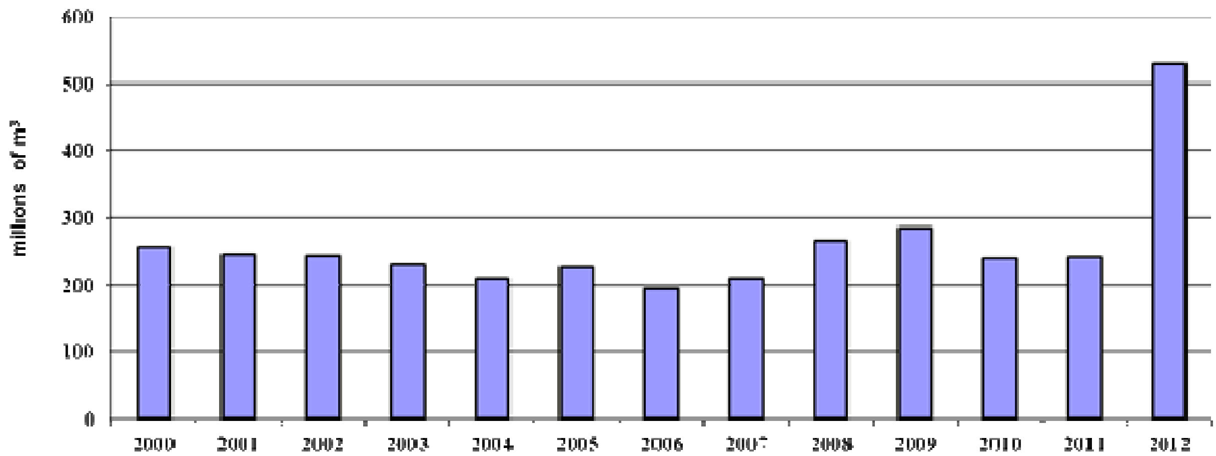

Figure 8.7 Amount of discharged waste water (mio m3)

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 their 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 for Domestic Waste Water Handling. Instead, some amount of methane is recovered from Sewage Sludge.

Domestic Waste Water Handling is the main source of the CH_4 emissions from Wastewater Handling sector, reaching 79 % (2012) from total CH_4 emission from Waste Water Handling sector. CH_4 emissions from Industrial Waste Water Handling and Sewage Sludge are lower, contributing accordingly 12 un 9 % from total emission.

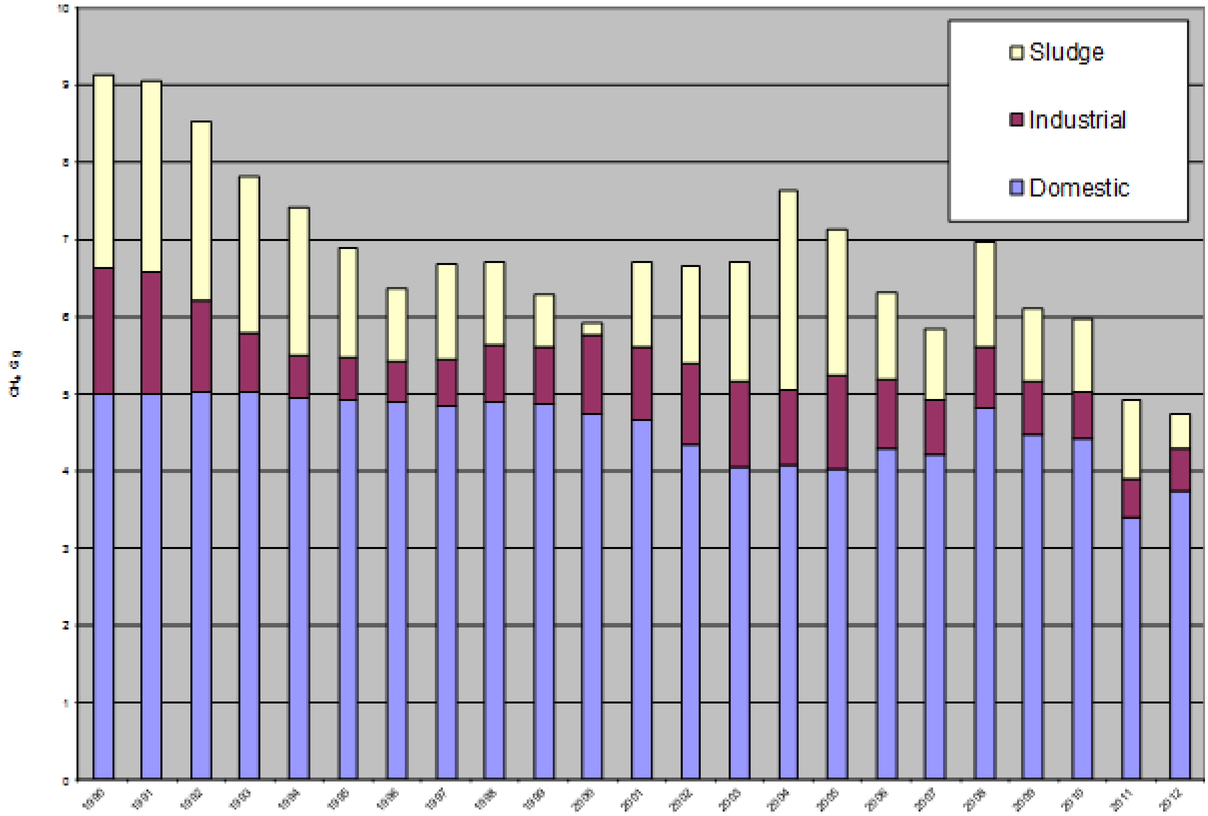

Figure 8.8 Emissions of methane from Waste Water Handling (total), Gg

Fluctuations of methane emission from Industrial Waste Water Handling (Figure 8.8) are connected with fluctuations of amount of production produced. Significant decrease in methane emission in period 1993 – 1999 is due to decrease of economic activity after collapse of Soviet Union.

Domestic Waste Water Handling (Human Sewage) is main source of emissions of N_2O from Waste Water Handling (Figure 8.9), contributing 99.8 %. Emission of N_2O, produced by Industrial Waste Water Handling, is neglibigle.

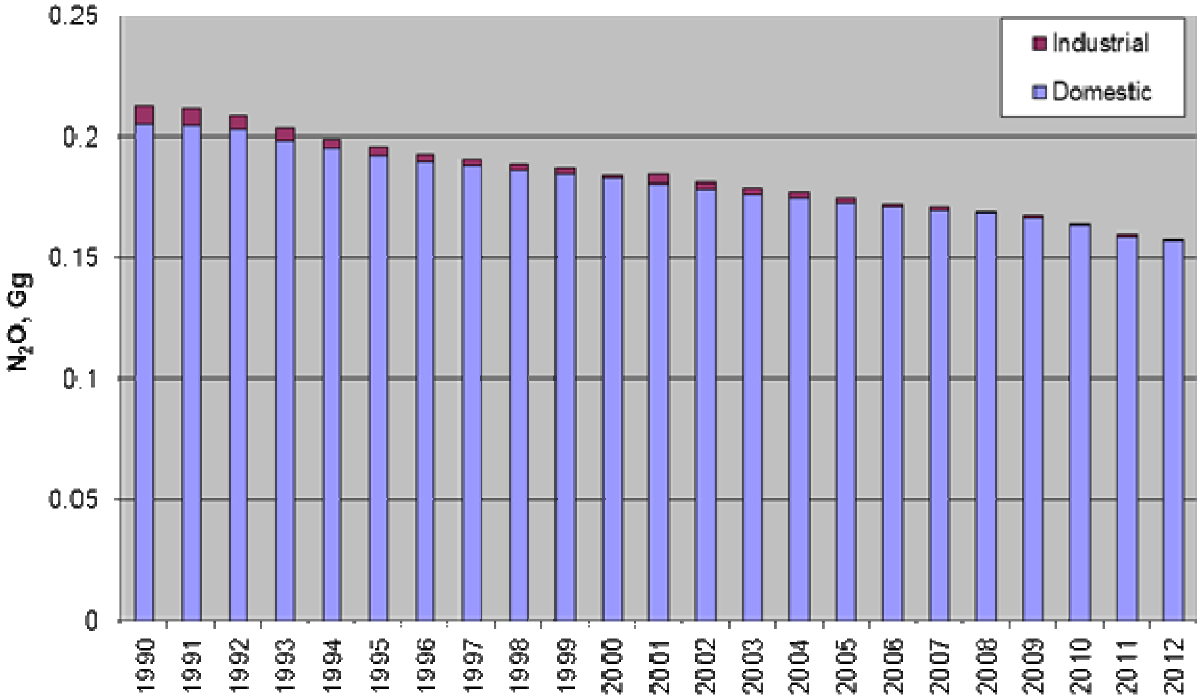

Figure 8.9 Emissions of N_2O from Waste Water Handling (total), Gg

8.3.2 Methodological issues

Calculation of methane emission from Domestic Waste Water Handling is based on amount of BOD_5 (biochemical oxygen demand, 5-day test) produced by national population. However, different methane conversion factors (MCFs) are applied depending of type and level of treatment of certain treatment plant. Mechanically treated 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 formulas („Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual"; chapter 6.3.5 „Methodology for Estimating Emissions from Wastewater Handling") report was used for calculation of CH_4 emission from Domestic Waste Water Handling sector:

$$TOW_{dom} = PxD_{dom}x(1 - DS_{dom})$$

$$TOS_{dom} = PxD_{dom}xDS_{dom}$$

where:

TOW_{dom} – total domestic/commercial waste water in kg BOD/yr

TOS_{dom} – total domestic/commercial sludge in kg BOD/yr

P – population in 1000 persons

D_{dom} – domestic/commercial degrabale organic component in kg BOD/1000 persons/yr

DS_{dom} – fraction of domestic/commercial degradable organic component removed as sludge

$$WM = \sum_i (TOW_i x EF_i - MR_i)$$

where:

WM – total methane emissions from waste water in kg CH_4

TOW_i – total organic waste for waste water type i in kg BOD/yr

EF_i – emission factor for waste water type i in kg CH_4/kg DC

MR_i – total amount of methane recovered of flared from waste water type i in kg CH_4

$$SM = TOSxEF - MR$$

where:

SM – total methane emissions from sludge in kg CH_4

TOS – total organic waste for sludge in kg DC/yr

EF – emission factor for sludge in kg CH_4/kg DC

MR – total amount of methane recovered or flared from sludge

Total emission of CH_4 from domestic waste water and sludge:

$$TM = WM + SM$$

Methane Conversion Factors (MCFs) were applied depending of treatment type and level (Table 8.6) IPCC Guidelines 2006 were used as source of MCF values; however, expert judgement was performed to choose values applicable for Latvian conditions.

Table 8.6 MCF values applied depending on type and level of treatment

Treatment type and level	MCF
Biological treatment with secondary or higher treatment level	0
Biological treatment with treatment level lower than secondary	0.3
Mechanical and chemical treatment	0.8
No treatment	0.5

Organic load – 60 g of BOD per person per day – is determined by national legislation (Cabinet Regulations No. 34 "Regulations regarding Discharge of Polluting Substances into Water", 22 January 2002).

Example of methane emission calculation from 2012:

Table 8.7 Calculation of CH_4 emission from domestic waste water handling (2012)

Treatment type	Population, persons	Total DC (Gg BOD/yr)	DC WW w/o sludge (Gg BOD/yr)	Maximum CH_4 producing capacity Bo	MCF	Emission factor	Emission (Gg of CH_4)
Well managed biological	1407309	30.820	28.585	0.6	0	0	0
Poor managed biological	109055	2.388	2.215	0.6	0.3	0.18	0.400
Non-biological	31106	0.681	0.632	0.6	0.8	0.48	0.303
No treatment	497343	10.892	10.102	0.6	0.5	0.30	3.031
Total:	2044813	44.781	41.533				3.733

Some amount of sewage sludge is treated or stored in anaerobic conditions in Latvia, causing formation of CH_4. Methane emission from sewage sludge is calculated using following formula from „Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories:

Reference Manual" chapter 6.3.5 „Methodology for Estimating Emissions from Wastewater Handling".

Assumptions regarding sewage sludge are shown in following table.

Table 8.8 Characteristics of sewage sludge in Latvia

Characteristic	Value
Average content of dry solids in sludge, %*	14**
Average content of COD in dry solids, %	43***

**Is used to estimate content of dry solids for years where statistic data are not available (1998-2002)*
****"Notekūdeņu dūņas un to izmantošana" („Sewage Sludge and Disposal"), Gemste I., Vucāns A., Jelgava, 2002.*
****Average data of 1996*

Extrapolation was used to estimate amount of sewage sludge produced and treated anaerobically for period 1990 – 1997, where statistic data is not available. Based on statistics available (1998 – 2008), assumption was made the part of anaerobically treated sludge is 53%.

Data on recovery of CH_4 from sewage sludge are plant specific data from treatment plant "Daugavgrīva", operated by largest Latvian water supply and waste water Treatment Company "Rīgas ūdens". 0.362 Gg of methane was recovered from sewage sludge in 2012.

Table 8.9 Calculation of CH_4 emission from sludge (2012)

Total DC sludge (Gg BOD/yr)	Emission factor for sludge (kg CH_4/ kg COD)	Emission of sludge (Gg CH_4)	Methane recovery from sludge (Gg CH_4)	Methane net emission from sludge (Gg CH_4)
3.248	0.25	0.812	0.362	0.450

Thus, total methane emission from domestic waste water handling and sewage sludge in 2012 is 3.733 + 0.450 = 4.183 Gg of CH_4.

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: Reference Manual"; Chapter 6.3.5 „Methodology for Estimating Emissions from Wastewater Handling":

$$WM = \sum_i P_i x V_i x C_i x PFM x MCF_i x 10^{-6}$$

where:

WM – total methane emission from industrial waste water handling in Gg

P_i – amount of certain industry production in t

V_i – amount of waste water generated per certain unit of industry production in m^3 per t

C_i – organic load in waste water of certain industry sector in kg COD/m^3

PFM – emission factor of methane in kg CH_4/kg COD

MCF_i – methane conversion factor for certain industry

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 8.10 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
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

Plant specific survey was performed during 2012, to obtain MCF values for certain industries. The average weighted MCF for each industry were estimated depending of level of contribution of said industry in terms of amount of waste water generated and its fate (level of treatment or transfer to certain urban waste water treatment plant). Results are shown in the following table:

Table 8.11 MCF values for calculation of CH_4 emission from Industrial Waste Water Handling

Industry type	**Weighted MCF value (rounded to 2 decimal positions)**
Milk	0.10
Meat	0.15
Fish	0.05
Beer	0.04
Fruits and vegetables	0.13
Sugar	0.50
Plastics	0.14
Organic chemicals	0.03

Example of emission calculation from industrial waste water handling is shown in the next table:

Table 8.12 Calculation example for 2012 of emission of CH_4 from Industrial Waste Water Handling (3 types of production) – activity data, assumptions, emission factors and results

Product name	**Amount of production, 1000 t/yr**	**Amount of waste water per production unit, m^3/t**	**Amount of waste water, 1000 m^3/yr**	**Conc.of COD in waste water, g/l**	**Load of COD, t/yr**	**Emission factor, kg CH_4/ kg COD**	**MCF**	**Emission of CH_4, t/yr or Mg/yr**
	a	b	c = a*b	d	e = c*d	f	g	h = e*f*g
Milk	194	7	1359	2.7	3668	0.25	0.10	92
Meat	125	13	1630	4.1	6684	0.25	0.15	249
Fish	67	13	874	2.5	2184	0.25	0.05	27

Amount of N_2O emission from Domestic Waste Water Handling is calculated, using IPCC default equation from „Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual"; chapter 6.4. „Nitrous Oxide from Human Sewage". 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 country specific value of protein consumption (83.7 g/person/day or 30.551 kg/person/yr) is obtained from national food consumption research[186], accessible on Web address http://www.lvaei.lv/?lang=1&menu=51&itemid=94.

When compared with similar data from Latvian neighbour countries (Lithuania and Estonia), Latvian data shows consistent value:

Table 8.13 Comparison of Latvian protein consumption data with data from neighbour countries (Lithuania and Estonia)

Country	g/person/day	kg/person/yr
Latvia	83.7	30.551
Lithuania	77.4…78.1*	28.251…28.507**
Estonia	101*	36.865**

**Data taken from Lithuanian and Estonian NIRs (2010)*
***Recalculated for comparison*

$$WM = PxOxEFxFrac_{Nprot}x\frac{44}{28}x10^{-6}$$

where

WM – total emission of nitrous oxide from Human Sewage in Gg N_2O

P – national population in persons

O – amount of protein, produced by population, in kg protein/person/yr

EF – emission factor in kg N_2O-N/kg N

$Frac_{Nprot}$ – nitrogen fraction in protein in 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 gives emission 0.157 Gg of N_2O (2012).

N_2O emission from Industrial Waste Water Handling was calculated, using Tier 1 method from "2006 IPCC Guidelines for National Greenhouse Gas Inventories", chapter 6.3.1 "Nitrous Oxide Emissions from Wastewater. Choice of Method". Calculation is based on load of nitrogen in the industrial waste water:

$$WM = N_{ef}xEFx\frac{44}{28}x10^{-6}$$

where

WM – total emission of nitrous oxide from industrial waste water handling in Gg N_2O

N_{ef} – load of nitrogen, kg/yr

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.

N_2O emission from Industrial Waste Water Handling is negligible – 0.0003 Gg/yr (i.e. 0.336 Mg/yr (2012)).

[186]Latvian State Institute of Agrarian Economy

Emission of NMVOC was calculated and using default EMEP emission factor from „EEA Emission Inventory Guidebook 2009" was used for this calculation – 15 mg of NMVOC per m^3 of waste water produced, what gives 7.94 Mg/yr of NMVOC (2012).

8.3.3 Uncertainties and times series consistency

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

Table 8.14 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 Industrial Waste Water Handling is significant source of CH_4 emssions and amount of production, which is activity data for it, 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. However, CH_4 emissions from sludge also fluctuates a lot.

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);
- Amount of CH_4 recovery from sewage sludge was checked by comparing data from Energetic sector on amount of sludge gas burned in waste water treatment facility;
- Protein consumption data were compared with values from neighbour countries of Latvia – Lithuania and Estonia;
- Comments in CRF tables were checked in process of entering data of calculation and recalculation results in CRF tables;
- Recommendations from experts of ERT team during In Country Review in september 2013 were taken into consideration and full recalculation of entire Domestic and Commercial Wastewater Handling (and sludge) was made.

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, 30 differences were found, mostly regarding emission from Industrial Waste Water Handling sector. The differences are caused by fluctuations of activity data.

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 for entire period due to change of methodology (IPCC default method was applied instead of „check method" used previously) and update of activity data (data on national population was updated).
- Methane emissions from domestic sludge were recalculated for period 2008 – 2011 due to update of activity data.
- Methane emisions from industrial waste water handling were recalculated for periods 1990 – 1996 and 2000 – 2011 due to update of MCF values.
- Nitrous oxide emissions were recalculated for entire due to changes of activity data (data on national population was updated).

8.3.6 Source specific planned improvements

No improvements are planned.

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 8.15 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, N_2O, 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*. 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 last years incinerated amount of waste decrease due to hazardous waste incineration facility do not work in full capacity and some of them are closed. CO_2 emissions from Waste Incineration are presented in Figure 8.10.

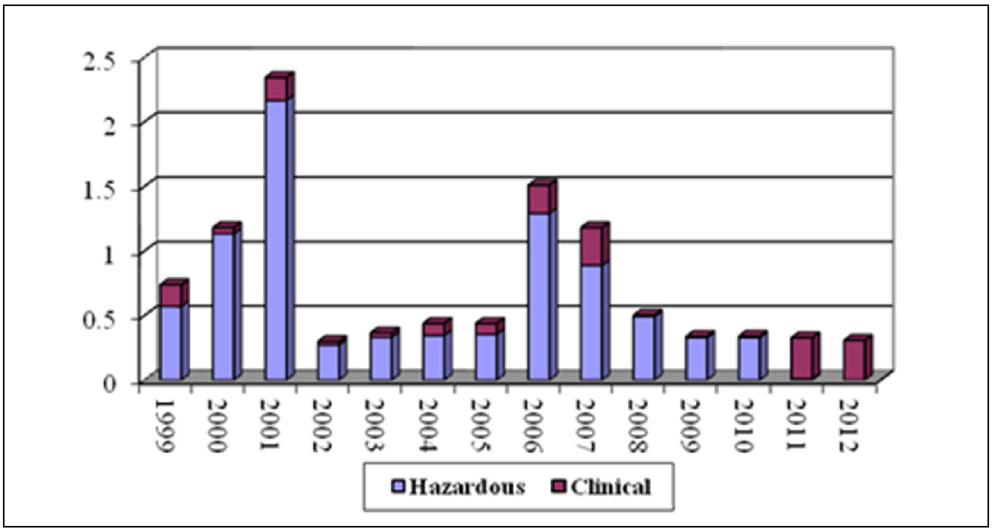

Figure 8.10 CO_2 emissions from Waste Incineration by waste type (Gg)

Data about burned bodies available from Riga crematorium since 1994, and calculations of its emissions are being made in accordance with the EMEP/EEA guidebook 2009 methodology. The crematorium is being under operation since December 22nd, 1994. 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 (Table 8.16).

Table 8.16 Burned bodies in Riga crematorium

Year	Burned bodies
1994	54
1995	564
1996	819
1997	817
1998	869
1999	982
2000	1127
2001	1297
2002	1293
2003	1389
2004	1391
2005	1529
2006	1630
2007	1959
2008	2227
2009	1977
2010	2102
2011	2158
2012	1970

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:

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

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

There are no national factors for carbon and fossil carbon amounts in each type of waste; therefore default factors from the IPCC GPG 2000 were used (Table 8.17).

Table 8.17 Default emission factors for CO_2 emission calculation

	Clinical waste	Hazardous waste
C contents in waste (CCW)	0.6	0.5
Fossil C contents in waste (FCF)	0.4	0.9
Incineration effectiveness (EF)	0.95	0.995

N_2O emissions from Waste incineration are calculated according to IPCC Guidelines 2006 Volume 5 Table 5.6. Factor 100 (g N_2O/ t waste) is used. This factor is determined for Industrial waste in wet weight. Latvia's incinerated hazardous wastes are mostly used oils, solvents and other liquids. Clinical wastes are not dried before burning. The same factor also is used for clinical wastes N_2O emissions calculation.

Table 8.18 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
2009	0.20000	0.011663	0.211663
2010	0.20000	0.012843	0.212843
2011	0.0063	0.37883	0.38513
2012	0	0.36691	0.36691

Indirect gases (NMVOC, CO, SO_2, NOx) are calculated from waste incineration according to EMEP/EEA emission inventory guide book 2009 (

Table **8.19**).

Table 8.19 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

Indirect GHG emissions from cremation were calculated by multiplying the number of bodies burned with the corresponding emission factor. Calculations were based on emission factors given by the EMEP/EEA emission inventory guide book 2009 (Table 8.20).

Table 8.20 Emission factors for indirect gases from cremation

Indirect GHG	Emission factor (kg/body)
NMVOC	0.013
CO	0.141
SO_2	0.544
NOx	0.309

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 are checked and approved by Regional Environmental Boards.

8.4.5 Source-specific recalculations

No recalculations are done.

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 (Table 8.21). 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 8.21 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 8.11).

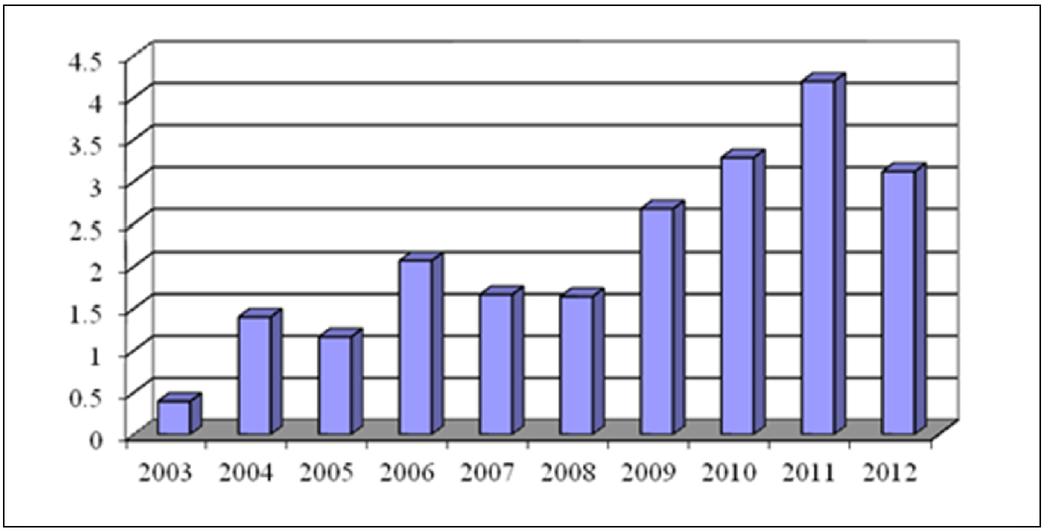

Figure 8.11 Total emissions from waste composting in CO_2 equivalent (Gg)

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 (Table 8.22). 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 8.22 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
2009	15.11	0.06044	0.004533
2010	18.55	0.0742	0.005565
2011	23.699	0.094796	0.0071097
2012	17.62	0.07048	0.005286

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 are checked and approved by Regional Environmental Boards.

8.5.5 Source-specific recalculations

No recalculations.

8.5.6 Source specific planned improvements

New waste recovery clasiffication in Latvia comes in force in 2013. Determination of composting will be more precise, because special R code will be used for composting.

8.6 REFERENCES

- Data bases „3-Wastes", „2-Water" and „2-Air": http://parissrv.lvgmc.lv/public_reports
- Data bases of Latvian Central Statistical Bureau: http://www.csb.gov.lv/dati/statistikas-datubazes-28270.html
- Latvian State Institute of Agrarian Economy, national food consumption research: http://www.lvaei.lv/?lang=1&menu=51&itemid=94
- Cabinet Regulations No. 319 "Regulations on waste recovery and disposal operations", 26 April 2011

- Cabinet Regulations No. 302 "Regulations on waste classification and characteristics what make waste as hazardous", 19 April 2011
- Cabinet Regulations No. 34 "Regulations regarding Discharge of Polluting Substances into Water", 22 January 2002
- "Overview of municipal solid waste management in Latvia", SIA Geo Consultant, 1998
- "Notekūdeņu dūņas un to izmantošana", Gemste I., Vucāns A., Jelgava, 2002
- "Degradable organic carbon in disposed wastes", Ltd Virsma, 2011

9. OTHER (CRF 7)

Latvia does not report any emissions under the Other sector.

10.RECALCULATIONS AND IMPROVEMENTS

10.1 EXPLANATIONS AND JUSTIFICATIONS FOR RECALCULATIONS, INCLUDING KP-LULUCF INVENTORY

10.1.1 GHG inventory

The changes in inventory since the previous submission to the UNFCCC were done according to:

- IPCC Good Practice Guidance`s (IPCC 2000; IPCC 2003);
- Recommendations by ERT during Centralized review (2011, 2012);
- Recommendations by ERT during Incountry review (ICR, September 2013);
- Suggestions from the third part experts not directly involved in the preparation of national inventory;
- Corrections of activity data by CSB and corrections of input mistakes.

Table 10.1 Overall impacts of recalculations on national emissions

		Previous submission	**Latest submission**	**Difference**	**Difference**
		CO_2 equivalent (Gg)			**(%)**
1990	Total CO_2 Eq Emissions with LULUCF	4 006.39	6 346.23	2 339.85	58.40
	Total CO_2 Eq Emissions without LULUCF	26 312.45	26 212.92	-99.52	-0.38
1991	Total CO_2 Eq Emissions with LULUCF	1 374.49	3 340.70	1 966.21	143.05
	Total CO_2 Eq Emissions without LULUCF	24 413.11	24 298.68	-114.43	-0.47
1992	Total CO_2 Eq Emissions with LULUCF	-3 442.79	178.32	3 621.11	-105.18
	Total CO_2 Eq Emissions without LULUCF	19 673.59	19 568.81	-104.78	-0.53
1993	Total CO_2 Eq Emissions with LULUCF	-5 894.94	-3 600.48	2 294.46	-38.92
	Total CO_2 Eq Emissions without LULUCF	15 917.27	15 818.01	-99.25	-0.62
1994	Total CO_2 Eq Emissions with LULUCF	-8 892.88	-6 682.39	2 210.49	-24.86
	Total CO_2 Eq Emissions without LULUCF	13 991.01	13 893.49	-97.52	-0.70
1995	Total CO_2 Eq Emissions with LULUCF	-9 019.36	-6 089.17	2 930.19	-32.49
	Total CO_2 Eq Emissions without LULUCF	12 599.09	12 502.58	-96.51	-0.77
1996	Total CO_2 Eq Emissions with LULUCF	-9 471.28	-6 668.85	2 802.43	-29.59
	Total CO_2 Eq Emissions without LULUCF	12 619.87	12 517.29	-102.58	-0.81

		Previous submission	Latest submission	Difference	Difference
		CO_2 equivalent (Gg)			(%)
1997	Total CO_2 Eq Emissions with LULUCF	-8 165.33	-4 411.88	3 753.45	-45.97
	Total CO_2 Eq Emissions without LULUCF	12 055.61	11 961.00	-94.61	-0.78
1998	Total CO_2 Eq Emissions with LULUCF	-7 664.92	-3 425.21	4 239.71	-55.31
	Total CO_2 Eq Emissions without LULUCF	11 539.44	11 437.09	-102.35	-0.89
1999	Total CO_2 Eq Emissions with LULUCF	-8 608.59	-3 860.71	4 747.87	-55.15
	Total CO_2 Eq Emissions without LULUCF	10 739.32	10 635.69	-103.63	-0.96
2000	Total CO_2 Eq Emissions with LULUCF	-9 138.51	-4 096.81	5 041.70	-55.17
	Total CO_2 Eq Emissions without LULUCF	10 104.88	9 993.58	-111.30	-1.10
2001	Total CO_2 Eq Emissions with LULUCF	-8 131.98	-3 442.49	4 689.49	-57.67
	Total CO_2 Eq Emissions without LULUCF	10 735.03	10 625.78	-109.25	-1.02
2002	Total CO_2 Eq Emissions with LULUCF	-6 805.30	-1 059.62	5 745.68	-84.43
	Total CO_2 Eq Emissions without LULUCF	10 689.98	10 604.55	-85.42	-0.80
2003	Total CO_2 Eq Emissions with LULUCF	-7 185.47	-2 188.21	4 997.25	-69.55
	Total CO_2 Eq Emissions without LULUCF	10 925.67	10 856.07	-69.60	-0.64
2004	Total CO_2 Eq Emissions with LULUCF	-6 685.23	-2 137.16	4 548.07	-68.03
	Total CO_2 Eq Emissions without LULUCF	11 067.17	10 852.07	-215.10	-1.94
2005	Total CO_2 Eq Emissions with LULUCF	-6 835.09	-2 338.42	4 496.67	-65.79
	Total CO_2 Eq Emissions without LULUCF	11 157.16	11 056.34	-100.82	-0.90
2006	Total CO_2 Eq Emissions with LULUCF	-8 171.26	-3 701.14	4 470.12	-54.71
	Total CO_2 Eq Emissions without LULUCF	11 646.68	11 522.35	-124.33	-1.07
2007	Total CO_2 Eq Emissions with LULUCF	-6 456.70	-2 781.08	3 675.62	-56.93
	Total CO_2 Eq Emissions without LULUCF	12 139.19	11 978.93	-160.25	-1.32
2008	Total CO_2 Eq Emissions with LULUCF	-8 029.98	-4 832.29	3 197.69	-39.82
	Total CO_2 Eq Emissions without LULUCF	11 630.61	11 496.15	-134.47	-1.16
2009	Total CO_2 Eq Emissions with LULUCF	-8 924.04	-3 523.34	5 400.70	-60.52
	Total CO_2 Eq Emissions without LULUCF	10 940.78	10 849.53	-91.25	-0.83

		Previous submission	Latest submission	Difference	Difference
		CO_2 equivalent (Gg)			(%)
2010	Total CO_2 Eq Emissions with LULUCF	-4 313.72	857.49	5 171.21	-119.88
	Total CO_2 Eq Emissions without LULUCF	12 097.07	11 987.43	-109.64	-0.91
2011	Total CO_2 Eq Emissions with LULUCF	-5 633.92	-690.66	4 943.26	-87.74
	Total CO_2 Eq Emissions without LULUCF	11 545.28	11 139.89	-405.40	-3.51

The following recalculations by sectors was made:

Energy sector:

1) Updated data received by CSB (for example, wood consumption in 1.A.1.a sector).
2) Addition of data smaller than 1 kt for particular fuels (diesel oil, coal, LPG generally for years 2010-2011). Data were obtained from the Energy balance, available at CSB on-line database. Amounts less than 1 TJ were not shown in Energy balance, therefore could not be added to Energy emissions' database.
3) Input mistakes – due to input mistake in natural gas GCV in 2009 there can be seen slight changes in natural gas consumption and emissions as well. Also there are small input mistakes in wood consumption, coal and straws in particular years (1.A.4.a).
4) Changes in emission factors for charcoal (previously taken from IPCC 2006, however, an EF from IPCC 1996 is available for charcoal), biodiesel (instead of previously reported other liquid biofuels) and fuels consumed in Military sector (unclear references previously, IPCC 1996 in Submission 2014). Emissions for indirect GHG were recalculated for all time series because of new version of EMEP/EEA Guidebook.
5) Fuel split from other liquid fuels to waste oils, petroleum coke and other liquid fuels, which influenced all time series. Amounts for these fuels with an exception of petroleum coke were taken from Energy balance, available on CSB on-line database, and the consumption of petroleum coke was taken from Annual Questionnaire sent by CSB. It was decided to split these fuels because of availability of disaggregated data and to improve the transparency of the emissions report.
6) Change in methods – for 1.B.2.b Natural gas sector the amounts of natural gas leaked were obtained from the only natural gas distributing company, as well as recalculated CH_4, CO_2 and NMVOC emissions, based on methane content in gas and other physical parameters, in all time series.

Transport:

- Road transport (CRF A.3.b) - all emissions for year 2009-2011 have been recalculated. Recalculations have been done due to improvement of activity data. Improvements comprise more precise split of passenger cars, LDV and HDV by subgroups (depending on engine volume) and layers (EURO classes) and mileage. It is recalculated emissions of road transport for year 2009 and 2011. Recalculation affected direct and non direct emissions.

- Road transport (CRF A.3.b) - CO_2 emissions for 2011 have been recalculated. Recalculations have been done due to corrected fuel consumption data (year 2011) by CSB.

Industrial processes:

Within Industrial Processes sector in subsectors 2.A.5 and 2.A.6. the recalculations were made in all time series due to updated EF for CO and NMVOC taken from EMEP/EEA 2013.

In the sector 2 IIA.F.1.1 (Domestic refrigeration) recalculations were made according to the updated statistical data in number of households and number of inhabitants. This caused changes in emissions of HFC-134a in all time series of Domestic Refrigeration subcategory both in actual and potential emissions.

Solvent and other product use:

Recalculations have been carried out for period 1990-2012 under CRF 3.A, 3.B and 3.D.5 mainly due to the reason that the list of NMVOCs substance is supplemented, therefore recalculations are carried out for all time series. Also the time series consistency is performed using one method for all time series.
Recalculations under CRF 3.C for period 1990-2012 was perfomed due to the supplemented list of NACE codes, therefore recalculations are carried out for all time series. The second reason is that the time series consistency is performed using one method for all time series.

For period 1990-2012 recalculations have been carried out under CRF 3.D.1 mainly due to two reasons. The first one is that during QA/QC procedures mistakes in calculation of activity data were found and therefore recalculation was performed. The second reason is that the time series consistency is performed using one method for all time series.

Agriculture:

Recalculations of methane emissions from dairy cattle and non-dairy cattle for period 2000-2011 are done based on ERT recommendation (during in-country review 2013) about different approach to calculate number of days on pasture. This made an impact on GE values and consequently on VS values. Same minor recalculations are done according to correction of statistical data about livestock numbers. According to ERT recommendation also crop production statistics is reported under CRF 4F.

LULUCF:

Major changes were done in the LULUCF inventory part since previous submissions in 2013. The reason for recalculations were recommendations provided during the in-country review in September, 2013; implementation of recent research results, particularly in land use and land use change calculations in cropland and grassland; and implementation of results of the support mission organized by the Joint Research Centre in summer and autumn of 2013. A new spreadsheet based model for calculation of GHG emissions in LULUCF sector is elaborated and implemented in 2013 (the abbreviate of the model is EPIM from Latvian Emissions' projection and inventory model). The model is still in testing stage; therefore, minor changes are still possible. The model first was tested in elaboration of the Latvian national Forest management reference level (FMRL). Another innovation was separation of estimation of the land use and land use change calculations (another spreadsheet based model) to simplify calculations and follow-up of the both calculation models. Updated NFI data were used in land use and land use change calculations as well as in estimation of mortality and harvesting stock. More detailed description of recalculations will be provided in specified sections of NIR

General improvements

One of the most important improvements is harmonization of the country area data for the whole reporting period using the most recent value published by CSB – 6 457.30 kha instead of annual estimates by the State land service, which fluctuated from year to year causing deviations in the LULUCF inventory and inconsistencies in the NIR. Updated information about land use in Latvia is provided in Table 10.2.

The major improvement of the inventory were application of country specific BEFs, relative wood density and carbon content in biomass on the base of the study on evaluation of impact of different forest management measures on GHG emissions and CO_2 removals in commercial forests. In spite the absolute impact of the switching to the country specific coefficients was not statistically significant, we were able to report carbon stock changes using Tier 2 level methodology.

Table 10.2 Land use structure in Latvia

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Total country area, 1000 ha	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457	6457
Forest land, 1000 ha	3169	3175	3179	3186	3193	3200	3210	3220	3228	3239	3248	3260	3268	3277	3288	3300	3312	3324	3336	3349	3348	3347	3346
land remaining forest, 1000 ha	3163	3161	3158	3156	3153	3151	3150	3148	3147	3146	3145	3143	3141	3140	3138	3137	3135	3134	3132	3131	3130	3128	3127
land converted to forest > 20 years ago, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	14	21
land converted to forest, 1000 ha	5	14	21	30	39	49	60	72	81	93	103	117	127	138	150	163	177	190	204	219	214	205	198
Cropland, 1000 ha	1842	1837	1834	1829	1824	1818	1810	1803	1797	1789	1782	1773	1767	1759	1751	1742	1733	1724	1715	1705	1705	1705	1695
land remaining cropland, 1000 ha	1840	1833	1828	1821	1814	1806	1798	1790	1783	1775	1767	1757	1750	1742	1733	1723	1714	1704	1694	1683	1683	1683	1674
land converted to cropland > 20 years ago, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	6
land converted to cropland, 1000 ha	2	4	6	8	10	11	12	13	14	15	15	16	17	17	18	19	20	20	21	21	20	18	16
Grassland, 1000 ha	755	753	752	750	747	745	742	739	736	733	730	727	724	721	717	714	710	706	703	698	698	699	708
land remaining grassland, 1000 ha	755	746	740	731	721	711	700	688	679	667	657	643	633	623	610	597	584	570	556	541	541	541	541
land converted to grassland > 20 years ago, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	12
land converted to grassland, 1000 ha	0	7	12	19	26	34	42	50	57	66	73	83	91	98	108	117	127	136	147	157	157	150	155
Settlements, 1000 ha	239	239	240	241	241	242	242	243	243	244	244	245	246	247	248	249	249	250	251	252	253	254	255
settlements remaining settlements, 1000 ha	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
land converted to settlements > 20 years ago, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
land converted to settlements, 1000 ha	1	1	2	2	3	4	4	5	5	5	6	7	8	9	9	10	11	12	13	14	14	15	15
Wetland, 1000 ha	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448
land remaining wetland, 1000 ha	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448	448
land converted to wetland > 20 years ago, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
land converted to wetland, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other land, 1000 ha	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
land remaining other land, 1000 ha	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
land converted to other land > 20 years ago, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
land converted to other land, 1000 ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The net CO_2 removals in forest lands and, as a result, in the whole LULUCF sector considerably decreased after recalculation, because of updated information about carbon losses due to commercial felling and natural mortality in forests. The preliminary results of the NFI demonstrated that natural mortality between 2005 and 2012 (the first and a part of the second NFI cycle) in all forests was 7.6 mill. m^3 annually (by 59 % more than reported according to mortality factors utilized in forestry earlier), but wood losses due to commercial felling in the same period was 15.3 mill. m^3 annually (by 39 % more than statistics on commercial roundwood production). These values might be updated after completion of the second cycle of the NFI. In spite of difference in absolute values of harvesting stock, the area of final felling in official statistics and according to NFI do not differs significantly, which actually means that the reason for the difference is considerably higher growing stock in forest and not illegal logging. The additional extracted volume is generally low value biomass utilized in energy sector and not appearing in accounting of timber industry working with higher quality logs. The reason for higher natural mortality in forests is not fully evaluated; however, it can be caused by changes in age and species composition of forests since previous large scale research of forest inventory was done in Soviet period and even at the beginning of the 20th century, when growing stock in forest in Latvia was twice smaller than it is now and forest resources were considerably depleted selective felling approach and intensified utilization of forest resources during the both World wars.

It is assumed in the GHG accounting that the difference in natural mortality and harvesting stock can be linearly applied to the whole accounting period. The same mortality factors was used for the forest land, grassland and settlements, where carbon stock changes were accounted using updated information from the NFI.

Forest lands

Minor changes introduced in NO_x and CO calculations by application of the EPIM model in LULUCF sector and harmonization of the country area in the land use calculations. The result contains minor numeric changes due to different activity data.

Recalculation of the forest area and area of drained organic soils in forest is done due to harmonization of the country area data for the whole period. Only minor changes are implemented. The area of drained organic soils in forest is estimated on the base of updated NFI data.

Recalculation of gains and losses in living biomass is done due to implementation of EPIM model in LULUCF sector and application of updated activity data (forest area).

Recalculation of emissions from drained organic soils in forest lands remaining forest is done due to changes in activity data, no emissions' factors are changed.

Recalculation of carbon stock change in dead biomass is done due to implementation of EPIM model, updating of activity data and natural mortality factors since 1970. The study on evaluation of decomposition of below-ground biomass, harvesting residues and litter is in the implementation phase. Preliminary results shows that decomposition period of all types of biomass will be slightly or considerably (for pine) longer.

Area of drained mineral and organic soils is updated according to recalculations due to harmonization of the country area. No accounting methods are changed. Notation key is changed to NA to CH_4 emissions due to drainage of soil, because no Tier 1 methodology is provided in IPCC GPG LULUCF (2003) to calculate CH_4 emissions.

Major changes are done in activity data for controlled biomass burning. Amount of harvesting residues is recalculated according actual harvesting data.

Considerable improvements are done to calculate emissions due to wildfires in forest lands. Instead of using default factors of incinerated biomass (IPCC GPG LULUCF), sum of average growing stock and dead biomass in a particular year is used as input to estimate emissions due to wildfires. The accounting method is not changing.

In the land converted to forest category distribution of the forest stand types is recalculated according to updated information on afforested lands (stand types are determined for several NFI plots in afforested lands, having only remark on afforestation and dominant species in the previous NFI cycle).

Recalculation of changes of carbon stock in living biomass is done according to updated activity data applying the same wood density values and BEFs as in forest land remaining forest. Minor recalculation due to inconsistency between Kyoto protocol Article 3.3 and the Convention reporting. Different approach in reduction of afforested areas (moving areas of lands afforested 20 years ago to forest land remaining forest category) after completion of 20 years transition period is applied.

Major changes were applied to calculation of carbon stock changes in dead biomass considering 150 years transition period (2 average rotations) instead of 20 years to reach values of dead wood stock characteristic for historical forest lands. The mathematical estimation of the conversion period based on field measurement data is going to be elaborated; however, not completed yet.

Wildfires in lands converted to forest are marked as not occurring, because no evidences of forest fires are found in the NFI lots representing afforested areas as well as in the State forest service (SFS) data base. Notation keys of emissions due to wildfires in lands converted to forest are updated to NO according to updated activity data.

Cropland

Notation key is changed for NO_x, CO and NMVOC to NO because no biomass burning takes place in cropland.

Major changes in area of cropland are applied due to implementation of research data about distribution of extensively managed cropland sometimes wrongly reported as grassland by NFI teams, because the area is rarely cultivated, but still used for crop production. These areas includes cultivated grasslands (regenerated by ploughing every 5^{th} to 10^{th} year) and biological farms using longer rotation cycle. Area of organic soils in cropland is updated according to new data on croplands keeping the same share of organic soils in farmlands.

Emissions from organic soils are recalculated due to implementation of different emission's factor (according to expert recommendation the average value applied in Sweden – 3.74 tons C ha^{-1}) is used instead of default value (1 ton C ha^{-1}) and due to updated area of organic soils.

Minor changes are applied to forest area converted to cropland due to implementation of EPIM LULUCF sector. However, major changes are implemented in calculation of organic soils.

Major changes are applied in calculation of losses in living biomass due to conversion of forest land to cropland. Carbon losses are calculated using instant oxidation method according to average growing stock of living biomass in a transition year. Similarly, major changes are applied to calculate losses in dead biomass; they are now calculated using instant oxidation method according to average growing stock of dead biomass in a particular year and average stock of litter in the whole period.

Losses in mineral soil are accounted considering that carbon stock in mineral soils in converted lands will reach values characteristic for cropland within 20 years. Country specific input data are applied (124 tons C ha^{-1} at 0-30 cm depth in forest land on mineral soils; 88 tons ha^{-1} at 0-30 cm depth in cropland, respectively losses in soil carbon stock are equal to 36 tons ha^{-1}; 20 years transition period is considered). For conversion of forest land to settlements weighted (by area) carbon stock in forest soils is used (244 tons ha^{-1} at 0-30 cm depth) considering that all soil carbon will transform into emissions within 20 years. For organic forest soil converted to cropland the same emission's factor as in cropland remaining cropland (3.7 tons C ha^{-1}) is applied. The changes in activity data (area of organic soils) is also considered in recalculation.

Recalculation of N_2O emissions due to disturbances caused by conversion of forest land to cropland is done due to methodological changes in calculation of CO_2 emissions from soils and activity data – area of organic soils, as described earlier.

Grassland

Major changes in area of grassland are applied due to implementation of research data about distribution of extensively managed cropland sometimes wrongly reported as grassland as described earlier. Area of organic soils is updated according to new data on grassland keeping the same share of organic soils.

Calculation of carbon stock in grassland (areas covered with trees, but not complaining with thresholds of forest land definition) is implemented into the inventory after completion of the most of measurements in the 2nd cycle of the NFI, demonstrating that grasslands is net sink of CO_2 removals in living biomass. The removals are calculated according average increase of growing stock depending from age of woody vegetation for the period before 2006 (middle of the 1st NFI cycle), on the base of actual data for the period between 2006 and 2010 (comparing the 1st and the 2nd NFI cycle) and using extrapolation for 2011-2012. BEFs, wood density and carbon content values applied to the forest land is used for grassland too.

Losses of carbon in living biomass are calculated as mortality rate applying average mortality rate (share of increment) in forest land in a particular year. Losses in dead biomass are accounted as decomposition of dead wood applying 20 years transition period.

Major changes are applied to calculation of carbon stock change in soil due to updated activity data and emission factor. Average losses of carbon stock in grassland on organic soils applied in Sweden (1.6 tons C ha^{-1}) is used instead of default value (0.25 tons C ha^{-1} annually); respectively, CO_2 emissions from organic soil in grassland increased several times.

Limestone is not used in grassland, except cultivated grassland used for fodder production, which are now moved to cropland category; therefore, the notation key is changed to NO.

No biomass burned is reported under controlled burning because the emissions reported under controlled burning are now moved to wildfires category. No controlled burning of grassland takes place in Latvia, because it is illegal. Grassland fires are now reported under wildfires category, just like forest fires to harmonize GHG inventory. Biomass burned previously reported under controlled burning is moved to wildfires category. The mistake in representation of measurement units (previously tons instead of kg were entered) is corrected. Biomass burning in 1990-1992 is extrapolated from average values in 1993-1997.

Area of cropland converted to grassland is recalculated according to research data on distribution of extensively managed cropland, which was wrongly reported as conversion of cropland to grassland and backward. The recalculation considerably reduced previously overestimated conversion of cropland to grassland and backwards. The conversion of cropland to grassland and grassland to cropland is considered to be fully compensating each other, respectively only net changes are reported for calculation of GHG emissions and CO_2 removals.

Area of organic soil converted to grassland is recalculated according to changes in total converted area. Share of organic soils is not changed.

Net removals of carbon stock in mineral soils in cropland converted to grassland is calculated as difference of carbon stock in cropland and grassland, considering 20 years transition period. Country specific data are used for carbon stock in cropland and grassland. The net removals of CO_2 in mineral soils due to conversion of cropland to grassland is considered equal to 1.1 ton C ha^{-1}. The reduction of emissions due to conversion of organic soil in cropland to grassland is considered as difference of CO_2 emissions in cropland and grassland (2.1 ton C ha^{-1}), reduction of emissions of N_2O due to conversion of cropland to grassland is calculated as a proportion, considering reduction of CO_2 emissions from soil due to the conversion.

Wetlands

Area of wetlands is updated due to harmonization of the country area in the whole reporting period. Carbon losses in living biomass is not reported due to lack of accurate date of mortality in wetlands. Similarly, no gains in living biomass is not reported due to lack of accurate date of increment in wetlands. The figures are going to be updated in the NFI to report in further inventories.

No Tier 1 method is provided in IPCC GPG LULUCF to calculate CH_4 emissions; therefore, the notation key is changed to NO.

Settlements

Area of settlements is updated due to harmonization of the country area in the whole reporting period. Calculation of carbon stock in settlements (areas covered with trees, but not complaining with thresholds of forest land definition, like roadside buffer zones) is implemented into the inventory after completion of the most of measurements in the 2^{nd} cycle of the NFI, demonstrating that settlements is net sink of CO_2 removals in living biomass. The removals are calculated according average increase of growing stock depending from age of woody vegetation for the period before 2006 (middle of the 1^{st} NFI cycle), on the base of actual data for the period between 2006 and 2010 (comparing the 1^{st} and the 2^{nd} NFI cycle) and using extrapolation for 2011-2012. BEFs, wood density and carbon content values applied to forest land are used for settlements too.

Losses in living biomass is calculated as mortality rate applying average mortality rate (percentage of increment) in forest land in a particular year. Losses in dead biomass are accounted as decomposition of dead wood applying 20 years transition period.

Minor changes in area converted to settlement due to implementation of the EPIM model and harmonization of the country area in the whole reporting period.

Major changes are applied to calculation of GHG emissions due to conversion of forest land to settlements; losses in living biomass are calculated using instant oxidation method according to average growing stock of living biomass in forest land in a particular year. Losses in dead biomass are calculated using instant oxidation method according to average growing stock of dead biomass in a particular year and average stock of litter in forest land in the whole period.

Losses in soil are accounted considering that carbon stock in soil in upper 30 cm layer will be lost within 20 years. Country specific input data on average carbon stock in forest soil is considered. More detailed description was provided earlier in Cropland's section.

Other land

Area of other land is updated due to harmonization of the country area in the whole reporting period.

Other

Minor changes in accounting of harvested wood products (HWP) due to implementation of EPIM model in LULUCF sector.

Waste:

- Methane emissions from Domestic Waste water handling were recalculated for entire period due to change of methodology (IPCC default method was applied instead of „check method" used previously) and update of activity data (data on national population was updated).
- Methane emissions from domestic sludge were recalculated for period 2008 – 2011 due to update of activity data.
- Methane emisions from industrial waste water handling were recalculated for periods 1990 – 1996 and 2000 – 2011 due to update of MCF values.
- Nitrous oxide emissions were recalculated for entire due to changes of activity data (data on national population was updated).

Recalculations made for the 2014 inventory submission by CRF category and their implications to the emission level in 1990 and 2011 are shown in Table 10.3.

Table 10.3 Recalculations made for the 2014 inventory submission

CRF category		Recalculation	Reason for recalculation	Implication to the CRF category level		Implication to the total emission level without LULUCF %	
				1990	2011	1990	2011
1.	**Energy**			**-84.09**	**-335.78**	**-0.32**	**-3.01**
1.A.	Fuel Combustion Activities			31.17	-281.97	0.12	-2.53
1.A.1.	Energy Industries	1.A.1.a.	Activity data were updated by CSB for wood consumption. Energy consumption less than 1 kt was taken from Energy balance available on CSB on-line database. Slight changes in natural gas GCV that influenced the amounts of gas consumed. Landfill gas previously reported in 1.A.1.a was allocated to 1.A.4.a sector. Changed emission factor for biodiesel (previously reported as other liquid biofuels). Other liquid fuels were split into waste oils petroleum coke and other liquid fuels therefore the consumption changed divided by fuel types.	0.92	0.43		0.004
1.A.2.	Manufacturing Industries and Construction	1.A.2.a., 1.A.2.b., 1.A.2.c., 1.A.2.d., 1.A.2.e., 1.A.2.f.	Other liquid fuels were split into waste oils, petroleum coke and other liquid fuels, therefore changed their NCVs in the whole time series and CO_2 emission factor as well as CO_2 emissions. Natural gas - slight changes in NCV from 37.359 to 37.358 which slightly affected the consumption of gas used in all subsectors (1.A.1, 1.A.2, 1.A.4), CO_2 EF and CO_2 emissions. Fuel type "other liquid biofuels" was changed to "biodiesel" and CO_2 EF was changed to biodiesel's EF. Slight changes in 1.A.2.a-1.A.2.e sectors generally due to addition of Energy balance data (less than 1 kt) for several fuels, such as diesel oil and coal (mainly in 2010, 2011). Completely changed structure of 1.A.2.f sector after in country review with a suggestion from Energy expert to split 1.A.2.f sector into smaller subsectors in order to improve the reporting transparency. In 1.A.2.f sector activity data changes for LPG, coal, peat, diesel oil due to addition of Energy balance data. Corrections of activity data for industrial wastes, where information was precised by the company which consumes the specific fuel type.	18.79	-1.99	0.07	-0.02

CRF category		**Recalculation**	**Reason for recalculation**	**Implication to the CRF category level**		**Implication to the total emission level without LULUCF %**	
			Emissions from indirect gases were recalculated as well due to updates in guidebook (EMEP/EEA 2013). Consumed amounts of oil shale in 1990 were added. Emissions from indirect gases were recalculated as well due to updates in guidebook (EMEP/EEA 2013).				
1.A.3.	Transport	1.A.3.B	Fuel consumption has been changed by CSB; Annual mileage for passenger cars groups corrected.		-245.85		-2.21
1.A.4.	Other Sectors	1.A.4.a., 1.A.4.b, 1.A.4.c.	Other liquid fuels were split into waste oils and other liquid fuels, therefore changed their NCVs in the whole time series and CO_2 emission factor as well as CO_2 emissions. Natural gas - slight changes in NCV from 37,359 to 37,358 which slightly affected the consumption of gas used in all subsectors (1.A.1, 1.A.2, 1.A.4), CO_2 EF and CO_2 emissions. Input mistake in coal consumption (1.A.4.a; 2001), straw consumption and CO_2 emissions (1.A.4.a; 2006-2010), wood consumption (2008). Corrected activity data provided by CSB for coal (2011). Data from Energy balance (less than 1 kt) added for LPG, RFO (2010, 2011). The consumption of jet fuel was allocated from 1.A.5.b sector (1.A.4.c) for years 1995-2000. Charcoal - changed EF to IPCC 1996. Fuel type "other liquid biofuels" was changed to "biodiesel" and CO_2 EF was changed to biodiesel's EF. Changed EF for diesel used for fishing from stationary to mobile offroad (boats) after QA/QC procedures while comparing data for UNFCCC and CLRTAP submissions.	11.46	-35.31	0.04	-0.32
1.A.5.	Other	1.A.5.b	Emission factors changed to IPCC 1996, except CO_2 EF for diesel fuel. Precised activity data in cooperation with CSB. Consumption of jet fuel allocated to 1.A.4.c sector. Emissions from indirect gases were recalculated as well due to updates in guidebook (EMEP/EEA 2013).		0.74		0.01
1.B.	Fugitive Emissions from Fuels	1.B.2.a, 1.B.2.b.	NMVOC emissions from database „2-AIR” were revised and the inventory was updated; Data provided by natural gas company "Latvijas Gaze", using amounts of natural gas leaked and methane content in gas in particular year and physical parameters which allows to calculate CO_2 and NMVOC	-115.26	-53.81	-0.44	-0.48

CRF category		Recalculation	Reason for recalculation	Implication to the CRF category level		Implication to the total emission level without LULUCF %	
			content in natural gas.				
2.	**Industrial Processes**			**-1.46**	**-62.42**	**-0.01**	**-0.56**
2.A.	Mineral Products	2.A.5 Asphalt Roofing	Updated emission factor according to EMEP/EEA 2013.	-1.46	-62.42	-0.01	-0.56
3.	**Solvent and Other Product Use**	3.A.,3.B.,3.C., 3.D.1	Changes in calculation method, In time period of 1990-2004 for emissions calculation are used population data	**-7.79**	**4.13**	**-0.03**	**0.04**
4.	**Agriculture**			**1.26**	**0.59**	**0.005**	**0.01**
4.A	Enteric Fermentation	4.A	GE are recalculated for methane emissions calculation from dairy cattle for period 1990-2011 based on ERT recommendation about different approach to calculate number of days on pasture; Emissions are recalculated due to correction of statistical data of livestock population 1990-1999; Statistical data corection of livestock number.	0.69	-5.76	0.003	-0.05
4.B.	Manure Management	4.B.	Emissions are recalculated due to correction of statistical data of livestock population, Correction of transfered values.	0.08	-0.56	0.0003	-0.01
4.D.	Agricultural Soils	4.D.1.2., 4.D.2., 4.D.3.1., 4.D.3.2.	Correction of transfered value.	0.50	6.91	0.002	0.06
5.	**Land Use, Land-Use Change and Forestry (net)**			**2 439.37**	**5 348.66**		
5.A.	Forest Land	5.A.1 Forest Land remaining Forest Land \ Carbon stock	New GHG accounting model;	752.42	4367.27		

CRF category		**Recalculation**	**Reason for recalculation**	**Implication to the CRF category level**		**Implication to the total emission level without LULUCF %**	
		change	Country specific BEFs, carbon content in biomass, emissions from organic soils in cropland and grassland; Harmonization of country area; updated information about harvesting rate, mortality and stock of living biomass in forest; Updated forest area.				
5.B.	Cropland	5.B.1, 5.B.2.1	Emissions from organic soils are recalculated due to implementation of different emission's factor (the average value applied in Sweden - 3,74 tons C ha-1) is used instead of default value (1 ton C ha-1) and due to updated area of organic soils. Losses in mineral soil are accounted considering that carbon stock in mineral soils in converted lands will reach values characteristic for cropland within 20 years. Country specific input data are applied. Major changes, the same emission's factor as in cropland remaining cropland (3,7 tons C ha-1) us applied to converted lands. The changes in activity data (area of organic soils) is also considered in recalculation. Recalculation of N_2O emissions due to methodological changes in calculation of CO_2 emissions from soils and activity data - area of organic soils. Minor changes in calculation of N_2O emissions due to application of updated activity data - area of mineral soil.	1 252.65	1 055.88		
5.C.	Grassland	5.C.1	omplaining with thresholds of forest land definition) is implemented into the inventory after completion of the most of measurements in the 2nd cycle of the NFI, demonstrating that grasslands is net sink of CO2 removals in living biomass. The removals are calculated according average increase of growing stock depending from age of woody vegetation for the period before 2006 (middle of the 1st NFI cycle), on the base of actual data for the period between 2006 and 2010 (comparing the 1st and the 2nd NFI cycle) and using extrapolation for 2011-2012. BEFs and carbon content applied to forest land is used for grassland too.	167.18	-591.83		

CRF category		**Recalculation**	**Reason for recalculation**	**Implication to the CRF category level**		**Implication to the total emission level without LULUCF %**	
			Losses in living biomass is calculated as mortality rate applying average mortality rate in forest land in a particular year. Average losses of carbon stock in grassland on organic soils applied in Sweden (1,6 tons C ha-1) is applied instead of default value (0,25 tons C ha-1 annually).				
5.E.	Settlements	5.E.1, 5.E.2.1	Losses in living biomass is calculated as mortality rate applying average mortality rate in forest land in a particular year. Calculation of carbon stock in settlements (areas covered with trees, but not complaining with thresholds of forest land definition, like roadside buffer zones) is implemented into the inventory after completion of the most of measurements in the 2nd cycle of the NFI, demonstrating that settlements is net sink of CO_2 removals in living biomass. The removals are calculated according average increase of growing stock depending from age of woody vegetation for the period before 2006 (middle of the 1st NFI cycle), on the base of actual data for the period between 2006 and 2010 (comparing the 1st and the 2nd NFI cycle) and using extrapolation for 2011-2012. BEFs and carbon content applied to forest land is used for settlements too. Losses in dead biomass are accounted as decomposition of dead wood applying 20 years transition period. Major changes in 5.E.2.1.category. Losses in living biomass are calculated using instant oxidation method according to average growing stock of living biomass in forest land in a particular year. Major changes in 5.E.2.1 category. Losses in dead biomass are calculated using instant oxidation method according to average growing stock of dead biomass in a particular year and and average stock of litter in forest land in the whole period. Losses in soil are accounted considering that carbon stock in soil in upper 30 cm layer will be lost within 20 years. Country specific input data on average carbon stock in forest soil is considered.	31.07	-22.21		
5.G.	Other	5.G. Harwested wood	Now Tier 1 accounting method is provided in IPCC GPG LULUCF	236.05	539.54		

CRF category		Recalculation	Reason for recalculation	Implication to the CRF category level		Implication to the total emission level without LULUCF %	
		products	(2003).				
6.	**Waste**			**-7.45**	**-3.96**	**-0.03**	**-0.04**
6.A.	Solid Waste Disposal on Land	6.A.2.1.	CH_4 Recovery reestimated for unmanaged sites.		-1.44		-0.01
6.B.	Waste-water Handling	6.B.1., 6.B.2.1	Update of MCFs; Update of national population and share of population not connected to treatment; Update of national population.	-7.45	-2.51	-0.03	-0.02
	CO_2 Emissions from Biomass				**-58.93**		**-0.53**
2.F.	Consumption of Halocarbons and SF_6	2.F.1.	Updated statistical data (number of households and number of inhabitants) in all time series; Corrected input mistake .		-7.96		-0.07

10.1.2 KP-LULUCF inventory

Minor changes in estimation of afforested area are introduced by using of the EPIM model. The result might differ by number of decimal signs or minor numeric differences due to slight changes in activity data, because of harmonization of the country area in the whole inventory.

Gains and losses in living biomass are recalculated according to updated BEFs, biomass density and carbon concentration values. Major changes are applied to dead biomass, considering that carbon stock in litter and dead wood will reach values characteristic for forests within 150 years (2 rotations).

Carbon losses in organic soils are considered according to average carbon losses in forests on drained organic soils and updated activity data.

Minor changes in deforested area to harmonization of the country area and application of the EPIM model and harmonization of the country area data and application of new GHG accounting model affecting activity data.

Losses in dead biomass due to deforestation are calculated using instant oxidation method according to average growing stock of dead biomass in forest lands in a particular year. Losses in mineral soil are accounted considering that carbon stock in mineral soils in converted lands will reach values characteristic for cropland within 20 years and average carbon stock in forest soil considering complete loss of upper 30 cm layer carbon stock in lands converted to settlements. Country specific input data are applied in forest lands and cropland. More detailed description of the recalculations is provided in Cropland's and Settlements' sections.

Minor changes in calculation of GHG emissions due to application of liming materials in deforested areas due to harmonization of the country area, which lead to change of proportion of liming material applied to deforest areas.

Detailed description of recalculations in forest management category is provided in Forest land's section. Recalculation of area of managed forests and area of forests on organic soil is done due to implementation of the EPIM model and due to harmonization of the country area data for the whole period.

Losses in living biomass now includes natural mortality and updated figures on harvesting stock. Both, mortality and harvesting stock are updated according to results of the National forest inventory (NFI) second cycle. Linear increase of mortality and harvesting stock is applied to the whole period.

The species specific mortality factors are updated according to results of the second cycle of the NFI. Decomposition period is considered 20 years for above and below ground biomass.

The values of N_2O emissions from drained soils are slightly updated due to changes in activity data (area of drained mineral and organic soils) caused by harmonization of the country area.

Table 10.4 Changes in methodological descriptions

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methododological descriptions compared to the previous year NIR	**Please tick where this is also reflected in recalculations compared to the previous year CRF**	**If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc**
Total (Net Emissions)			
1. Energy			
A. Fuel Combustion (Sectoral Approach)			
1. Energy Industries	+	+	Changes in method after ERT suggestion that country-specific CO_2 EF is considered as Tier 2, not Tier 1 as stated in CRF and NIR previously. However, data and description of methodology have not changed, only the name of method.
2. Manufacturing Industries and Construction	+	+	Changes in method after ERT suggestion that country-specific CO_2 EF is considered as Tier 2, not Tier 1 as stated in CRF and NIR previously. However, data and description of methodology have not changed, only the name of method.
3. Transport	+		Country specific CO_2 EF has been used for emission calculation in railway from diesel oil. Referred to this Tier-2 method has been indicated.. It does not make impact to emission amount.
4. Other Sectors	+	+	Changes in method after ERT suggestion that country-specific CO_2 EF is considered as Tier 2, not Tier 1 as stated in CRF and NIR previously. However, data and description of methodology have not changed, only the name of method.
5. Other	+	+	Changes in method after ERT suggestion that country-specific CO_2 EF is considered as Tier 2, not Tier 1 as stated in CRF and NIR previously. However, data and description of methodology have not changed, only the name of method.
B. Fugitive Emissions from Fuels			
1. Solid Fuels			
2. Oil and Natural Gas	+	+	Activity data and emissions from leakages from natural gas were calclulated by the gas company for each subsector, therefore the method was changed into country specific. As emissions are obtained taking physical parameters of natural gas into account in particular years, as well as methane content in gas, the EF was changed to plant specific. Further information on methods used and emissions can be found on Chapter 3.3.2.
2. Industrial Processes			
A. Mineral Products	+	+	For years 1990-2011 all emisions has been recalculated in all time series due to updated emission factors for CO, NMVOC according to EMEP/EEA 2013 guidelines in sector 2.A.5 Asphalt Roofing and 2.A.6 Road paving with asphalt. Detailed description under NIR chapter 4.2.5.5 Source-specific recalculations
B. Chemical Industry			
C. Metal Production			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methododological descriptions compared to the previous year NIR	Please tick where this is also reflected in recalculations compared to the previous year CRF	If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc
D. Other Production			
E. Production of Halocarbons and SF_6			
F. Consumption of Halocarbons and SF6			
G. Other			
3. Solvent and Other Product Use	+	+	For years 1990-2012 all emissions have been recalculated due to improvement of activity data. As well as time series consistency is performed using one method for all time series.
4. Agriculture			
A. Enteric Fermentation		+	Recalculation due to changing days on pasture for cattle
B. Manure Management		+	Recalculation due to changing days on pasture for cattle
C. Rice Cultivation			
D. Agricultural Soils		+	Recalculation due to changing days on pasture for cattle
E. Prescribed Burning of Savannas			
F. Field Burning of Agricultural Residues			
G. Other			
5. Land Use, Land-Use Change and Forestry			
A. Forest Land	+	+	Implementation of Tier II methods in calculation of living biomass, minor changes in representation of the country area
B. Cropland	+	+	Major changes in calculation of emissions from organic soil
C. Grassland	+	+	Implementation of Tier II methods in calculation of living biomass, calculation of C changes due to conversion of cropland to grassland; major changes in calculation of emissions from organic soil
D. Wetlands	+	+	Minor changes in the country area representation
E. Settlements	+	+	Major changes in calculation of emissions due to deforestation
F. Other Land			
G. Other	+	+	Major changes in HWP, instant oxidation considered for harvesting stock extracted due to deforestation
6. Waste			
A. Solid Waste Disposal on Land		+	Change CH_4 recovery in year 2011.
B. Waste-water Handling	+	+	CH_4 from Domestic Waste Water Handling and Sludge, for entire period
C. Waste Incineration			
D. Other			
7. Other (as specified in Summary 1.A)			
Memo Items:			

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methodological descriptions compared to the previous year NIR	Please tick where this is also reflected in recalculations compared to the previous year CRF	If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc
International Bunkers			
Aviation			
Marine			
Multilateral Operations			
CO2 Emissions from Biomass			

NIR Chapter	DESCRIPTION		REFERENCE
	Please tick where the latest NIR includes major changes in descriptions compared to the previous year NIR		If ticked please provide some more detailed information for example reference to pages in the NIR
Chapter 1.2 Institutional arrangements			
Chapter 1.6 QA/QC plan			
Chapter 7 Land Use, Land-Use Change and Forestry	+	+	Major changes in the most of calculation modules due to switch to country specific methods (Tier 2) in biomass calculations, adaptation of new land use change calculation module and emission factors recommended during in country review and other experts.

10.2 IMPLICATION FOR EMISSION LEVELS

10.2.1 GHG inventory

See Section 10.1.

10.2.2 KP-LULUCF inventory

See Section 10.1.

10.3 IMPLICATIONS FOR EMISSION TRENDS, INCLUDING TIME SERIES CONSISTENCY

10.3.1 GHG inventory

See Section 10.1.

10.3.2 KP-LULUCF inventory

See Section 10.1.

10.4 RECALCULATIONS, INCLUDING IN RESPONSE TO THE REVIEW PROCESS, AND PLANNED IMPROVEMENTS TO THE INVENTORY

10.4.1 GHG inventory

The development of the GHG inventory aims to improve the calculation and reporting of the inventory. The improvement plan is discussed and approved by all experts and organizations involved in GHG inventory preparation process.

Many improvements of future GHG inventories are planned within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy ":

-) development of an integrated database for climate change and air quality data aggregation. The development of the database will result in enhanced data quality, workflow optimization and facilitation of report submissions;

-) preparation of research studies for GHG inventory improving (for example, Promoting sustainable land management through creation of a digital soil database; analyse bovine intestinal fermentation processes (methane release); evaluate agricultural fertilizer-related processes and activities; estimation of soil carbon stock in cropland and grassland);

-) ensuaring QA/QC evaluation for land use, land use change and forestry and industrial processes sectors;

-) conferences, training seminars and other experience-sharing events carried out to increase the capacity of Latvian inventory experts.

The Table 10.5 shows the sector specific improvements needs for the forthcoming inventories. More detailed information about planned improvements can be found under sectoral chapters.

Table 10.5 Sector specific improvements needs of Latvia`s national GHG inventory

CRF category	Planned improvement	Tentative time schedule	Progress
General	Improve QC/QA procedures to avoid inconsistencies. Engagement of third part experts.	2013-2014	Third part reviews was performed for Industrial processes, Solvent and Other Product use sectors and General chapter. All suggestions are implemented in the latest submission.
General	Improve uncertainty of the inventory implementing Tier 2 approach (Monte Carlo model)	2014-2015	Within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy ".
1.A.1. 1.A.2.	Implement the country specific emission factors obtained in research of CH_4 emissions from solid biomass combustion. Use of EU ETS data.	2014-2015	Will be implemented in 2015 Submission
1.A.3.	Based on the results of carried out study in year 2013 (prepared formats for activity data collection from national railway administration and calculation sheets for emission calculation) to implementation Tier 2 method for CH_4 and N_2O emission calculation in year 2015.	2015	Will be implemented in 2015 Submission
1.A.4.	It is planned to investigate amounts of fuel used for fishing (off-road purposes) with collaboration with CSB. More detailed activity data by technology types for Residential sector is planned to be obtained as Residential sector is a key source.	2014-2015	Planned to implement in next submissions

CRF category	Planned improvement	Tentative time schedule	Progress
1.B.2.A	Investigate the oil flow in the country.	From 2014	Planned to implement in next submissions
2.A.7.	According to in country review in September of 2013 the ERT recommends Latvia to report aggregated brick production emissions in one line in the CRF table to avoid misunderstanding as incomplete reporting for a single plant, and in the meanwhile include plant-specific estimates in the NIR for the sake of transparency.	2015	On submission 2015 there are planed to make some technical updates in CRF under sector 2.A.7 Other following to ERT recommendations.
2.C	It is planned to revise CO_2 emission estimations for 2.C sector (Metal production) as plant specific parameters and values are used in emission estimation. There were involved external auditor for QA/QC as this is a key source category.	From 2014	Planned to implement in next submissions
2.F	It is planned to ensure detailed quality control procedures for quality assurance of Industrial process sector. Also it is planned to reduce uncertainties.	2014-2015	Within the EEA Financial Mechanism 2009-2014 Programme "National Climate Policy " Will be implemented in 2015 Submission
3.A, 3.B, 3.D.5	It is planned to obtain much more activity data from „Chemical Register" to ensure completeness. To achieve results it is necessary to supplement the list of NMVOC substances.	2014-2015	Will be implemented in 2015 Submission
3.C	It is planned to obtain much more activity data from „Air-2" to ensure completeness. To achieve results it is necessary to supplement the list of NACE code and particular NMVOC emitted substances.	2014-2015	Will be implemented in 2015 Submission
4.A, 4.B	Elaboration of methodology to expand calculations on age subgroups of non-dairy livestock.	From 2014	Planned to implement in next submissions
4.D	In the future submissions it is planned to evaluate new methodology for assessing area of cultivated organic soils (Histosols) for nitrous oxide emission calculation.	From 2014	Planned to implement in next submissions.
5.A	The most important planned improvements: • estimation of decay period for dead wood (harvesting residues and below-ground biomass, planned to complete until report 1990-2013); • estimation of carbon stock changes in drained organic soils in forest lands (2014); • estimation of transition period for dead wood and litter carbon stock in afforested lands (2015); • development of production version of EPIM model, including instantaneous calculation of uncertainties, broader representation of land use change options and integration of Kyoto protocol and the convention reporting; • improvement and simplification of structure of land use change calculation model, including uncertainty estimates; • improved quality control of utilized data and calculations by broader use of cross-checks and indicative values represented in different databases (like dead wood stock or growing stock of living biomass.	From 2014	Will be implemented in 2015 Submission.
5.B	There are several major issues, which will be solved until the next inventory: • updated area of organic soil in cropland according to the NFI study started in	From 2014	Will be implemented in 2015 Submission.

CRF category	Planned improvement	Tentative time schedule	Progress
	2012; the same values of share of organic soil will be used for land converted to cropland. Logarithmic regression will be used in time series to reduce share of organic soil in cropland before 1990 (5.18 %) to the actual value; • updated carbon stock in cropland remaining cropland to estimate carbon losses in soil due to conversion of forest land to cropland as well as carbon stock changes in soil due to conversion to grassland and vice versa; • updated CO_2 emissions from organic soils considering area changes and recent findings in Nordic and Baltic countries, particularly, doctoral thesis by Jüri-Ott Salm "Emission of greenhouse gases CO_2, CH_4, and N_2O from Estonian transitional fens and ombrotrophic bogs: the impact of different land-use practice" • updated N_2O emissions due to disturbances using new data on carbon stock changes in soil; • carbon stock changes in living biomass and dead wood using updated conversion factors for density and carbon stock, as well as biomass expansion factors; • Tier 1 methodology to estimate carbon stock changes in cropland considering changes of cropping practices since 1970.		
5.C	The most of attention will be paid to improve knowledge about carbon stock change in grassland; particularly, in historical grasslands due to different management of grasslands as well as due to land use conversion from and to grassland. The most important improvements proposed for the future inventories are: • evaluation of carbon stock in historical grassland, cropland and forest land representing similar growth condition to estimate carbon stock changes in soil due to land use change; • recalculation of carbon stock changes in living and dead biomass and soil carbon pools due to land use changes; • recalculation of carbon stock changes in all carbon pools in grassland areas covered by woody vegetation.	From 2014	Planned to implement in next submissions.
5.D	develop method for estimation impact of ditches and other types of wetlands on N_2O and CH_4 emissions. Considering growth of peat extraction for energy purposes from abandoned peatlands and forests on wet organic soils, it is important to be able to calculate impact of drainage on non-CO_2 emissions as well as to be able to separate wetlands on organic soils (high N_2O emissions) and mineral soils (low N_2O emissions). Wetlands is one of the priorities in further development of GHG inventory in LULUCF sector in Latvia.	From 2014	Planned to implement in next submissions.
5.E	It is planned to use high resolution satellite images to evaluate dynamics of carbon stock in living biomass in certain pilot areas since 1990 and to extrapolate obtained results to all NFI plots to avoid potential overestimation of removals of CO_2 in living biomass.	From 2014	Planned to implement in next submissions.
5 (V)	A new methodology on estimation of incineration efficiency in forest fires is under development in the	From 2014	Planned to implement in next

CRF category	Planned improvement	Tentative time schedule	Progress
	LSFRI Silava. Information provided by the State forest service will be used for quality assurance. Harvesting residues burning will be evaluated by forest owners questionnaires.		submissions.
5 (I-III)	The research is started in 2011-2013 to evaluate carbon stock in grasslands to elaborate methodology for estimation of net emissions from conversion between forest lands and grasslands. Similar study is initiated in 2012 to estimate carbon stock in croplands. These data will be used to evaluate emissions of CO_2 and N_2O due to conversion of forest lands to cropland.	From 2014	Will be implemented in 2015 Submission
5.G	Major changes will we applied to activity data, when new IPCC methodology will be adopted and more detailed information on structure of the roundwood assortments will be available from industry. Impact factors of species composition on structure of assortments will be included into the calculations in the next inventory.	2014-2015	Will be implemented in 2015 Submission.
6.A	For waste polygons is planned to start calculate emissions with specific DOC values for each of them according to disposed waste content.	From 2014	Planned to implement in next submissions.
6.D	New waste recovery clasiffication in Latvia comes in force in 2013. Determination of composting will be more precise, because special R code will be used for composting.	From 2014	Will be implemented in 2015 Submission.

Response to the previous reviews (Table 10.6) was prepared mainly according to recommendations by ERT during Incountry review (ICR, September 2013) as well as according to recommendations by ERT during Centralized reviews in 2011 and 2012.

Table 10.6 Response to the review process

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
General	Provide more specific information in NIR on institutional structure, responsibilities and functions of institutions involved in its next annual submission; elaborate on the information on formal approval of annual submissions in its next annual submission.	FCCC/ARR/2013/LVA DRAFT, 11., 14. pts.	Implemented into the 2014 inventory, Chapter 1.2.
General	Ensure continuity of the functions of the national system despite this upcoming change and to thoroughly describe the upcoming changes in the next NIR.	FCCC/ARR/2013/LVA DRAFT 16. pt.	Implemented into the 2014 inventory, Chapter 1.2.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
General	Improve the use of notation keys filling the CRF tables. *Energy sector *Industrial processes *Agriculture *LULUCF	FCCC/ARR/2012/LVA 28.pt.	Implemented into the 2014 submission, CRF tabeles.
General	Include information on trends, background for recalculations, information on methods, EFs and other parameters to increase transparency of reporting.	FCCC/ARR/2013/LVA DRAFT, 4. pt.	Implemented into the 2014 inventory. New subchapters regarding explanations of emission trends by sector were established under Chapter 2.3.
General	Providing detailed information in the NIR on how the key category analysis are used to prioritize inventory improvements.	FCCC/ARR/2011/LVA 19.pt. FCCC/ARR/2012/LVA 16.pt	For the Latvian inventory, higher tiers are mostly used for calculating emissions from key categories as requested by the Good Practice Guidance (IPCC, 2000) and country specific emission factors are used as far as possible.
General	Uncertainty analysis with Tier 2.	FCCC/ARR/2011/LVA 20.pt. FCCC/ARR/2012/LVA 19.pt	It is planned to perform uncertainty analysis using Monte Carlo model within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy". The results will be implemented into the 2015 inventory.
General	Provide in the NIR of its next annual submission, information on how uses the uncertainty analysis in prioritizing future inventory improvements.	FCCC/ARR/2011/LVA 23.pt. FCCC/ARR/2012/LVA 22.pt.	The categories with the largest uncertainties were rewised and the uncertainty levels were reduced as far as possible (information provided under sectors with the most highest uncertainties – Energy (Chapter 3); LULUCF (Chapter7).
General	Improving the way in which the QC procedures are implemented in order to reduce the occurrence of errors and inconsistent reporting between the CRF tables and the NIR (important for all sectors) and reporting on any improvements made; Additional QC check process to check the tables generated by the CRF Reporter particulary for Energy, IP and LULUCF sectors.	FCCC/ARR/2011/LVA 26.pt. FCCC/ARR/2012/LVA 27., 54, 60, 66 and 69.pts. FCCC/ARR/2013/LVA DRAFT 46., 52., 68., 110. pt.	The third party experts were involved on purpose to carry out quality control procedures several times (Energy, Transport, Agriculture and Waste sectors).

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
General	Strengthen implementation of the QA/QC plan and include improvements applied to its QA/QC system in next annual submission.	FCCC/ARR/2012/LVA 26.,29.,30., 31., 32. pts.	Implemented into the 2014 inventory, Chapter 1.6.
General	Improvements in transparency on methods and AD: The methodology information for CH_4 emissions from the company operating natural gas supply system.	ICR, September 2013.	For the 2014 inventory the active data from gas company "Latvijas Gāze" is recieved. Methodological information will be implemented in the 2015 inventory.
Energy			
Energy in overview	Improve transparency (e.g. split between domestic and international aviation and navigation, and natural gas fugitive emissions) for sections that deal with methods, AD, EFs and assumptions. Provide references to the uncertainty figures where expert judgement is used. Organize and archive all recommendations made by previous review teams and make an assessment of the recommendations as part of the inventory planning process.	FCCC/ARR/2013/LVA DRAFT, 27., 28., pts.	Emission factors have been provided with references, as well as other assumptions have been explained, e.g. uncertainty assessment for activity data provided by CSB.
1.A	Improving of activity data received from CSB to include in the emission estimation data smaller than EUROSTAT Annual Questionnaire's thresholds of 1kt.	FCCC/ARR/2011/LVA 40.pt. FCCC/ARR/2012/LVA 43.pt.	Done for categories where AQ threshold was smaller than 1 kt, data from Energy Balance were added. For CRF 1.A.5.b activity data for all years were precised by CSB and amounts of fuel consumed less than 1 kt also are reported.
1.A	Revise the thresholds (10 per cent) used for the QC procedures in the energy sector, and make the thresholds specific to each category.	FCCC/ARR/2011/LVA 40.pt	Revised in 2014 Submission.
1.A	Country specific CO_2 emission factors for gasoline and diesel oil as well as country specific CH_4 EF will be determined for next inventories.	FCCC/ARR/2011/LVA 40.pt.	Country specific CO_2 emission factors for gasoline and diesel oil have been determined. However, more data for country specific CH_4 emission factor for biomass have to be obtained and additional research has to be done for the next inventories.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
1.A.1, 1.A.2, 1.A.4	The research on CH4 emissions from the solid biomass combustion.	FCCC/ARR/2011/LVA 37., 41.pt.	More data for country specific CH_4 emission factor for biomass have to be obtained and additional research has to be done.
1.AA.2	Update the characteristics of fuels, such as gasoline and coal, using more recent information and provide transparent information in the NIR on the underlying data and assumptions used Explanations of the emission trends should be included in the sectoral chapters of the NIR, especially the Iron and Steel, and Chemicals category.	FCCC/ARR/2011/LVA 49., 53. pt.	Explanations are provided in Submission 2014.
1AD	Feedstocks and non-energy use of fuels: The ERT encourages the Party to include data on all feedstocks in CRF table 1.A(d) and to report on the emissions when these occur.	FCCC/ARR/2011/LVA 47.pt	All emissions from all the feedstocks have been reported.
1AC	Reference/sectoral approach: The ERT recommends that Latvia discuss in the NIR of its next annual submission the reasons leading to the improvement of difference between the reference and sectoral approaches.	FCCC/ARR/2011/LVA 43.pt.	Differences have been explained in 2014 Submission in Chapter 3.2.1.1.
1AC	Reference/sectoral approach: ERT recommends that Latvia conduct an in-depth quantitative investigation to analyse the difference between approaches throughout the time series and reports correct values for entire time series.	FCCC/ARR/2011/LVA 31.pt.	Correct time series have been provided as well as data on interproduct transfer, distribution losses and statistical differences, and the largest differences have been explained.
1AC	Reference/sectoral approach: The ERT recommends that the Party improve its QA/QC plan to include a process to check the final output of the CRF tables, such as a third part expert review of the tables generated by the CRF Reporter, to ensure that the Party's estimates are accurately reflected in the CRF tables.	FCCC/ARR/2013/LVA DRAFT, 30.pt.	CRF data is compared with database (done by the expert) as well as the third part expert review is carried out for Energy sector. Results included under relevant subchapter.
1AC	Reference/sectoral approach: The ERT recommends that Latvia correct the oxidation value in the reference approach tables.	FCCC/ARR/2013/LVA DRAFT, 32.pt.	Corrected. (Chapter 3.2.4.)

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
1AC	Reference/sectoral approach: ERT recommends that Latvia use both the Eurostat data and the IEA data to conduct QC of the CRF tables to ensure consistency between datasets and provide a simple explanation of the differences in.	FCCC/ARR/2013/LVA DRAFT, 33.pt.	Correct time series have been provided as well as data on interproduct transfer, distribution losses and statistical differences, and the largest differences have been explained (Chapter 3.2.4.).
1AD	Report the appropriate fraction of carbon stored in lubricants in the CRF table and specify the amount of CO_2 emissions and allocated category name in the appropriate cells.	FCCC/ARR/2013/LVA DRAFT, 35.pt.	Latvia has reported the correct amounts of lubricants used in Submission 2014, taking amounts combusted in Transport sector into account.
1.AA.3	Assess the two studies used for assessment of emissions from gasoline to ensure that the methods of estimating the EFs are consistent.	FCCC/ARR/2013/LVA DRAFT, 35.pt.	Calculations of CO_2 emissions from gasoline in road transport with a new EF (71,18) for time series 1990 – 2008 and comparison with the submitted time series has been performed. Will be included in the 2015 submission.
1.AA3.C	Revision of activity data for railway to investigate a possibility for implementation of Tier 2 method in year 2012.	Research on "Necessary data for Tier 2 implementation for emission calculation in railway" has been carried out on 2013.	To implement Tier 2 method country specific EF for CO_2 emission calculation has been used.
1.AA3.C	Provide further explanations on the emission trend for navigation and the split between national and international navigation .	FCCC/ARR/2011/LVA 38., 46 pt. FCCC/ARR/2011/LVA 34.pt. FCCC/ARR/2013/LVA DRAFT, 38.pt.	Explanation of trends provided in the current submission (chapter 3.2.6.5.). More detailed information about fuel consumption split between domestic and international mode are provided (chapter 3.2.2).
1.B.2.a.	Double check the oil flow and report AD, and emissions, if existing. Improve desription of methods of the fugitives section. Investigate the oil consumption flow in the country to verify that there are no fugitive emissions in Latvia.	FCCC/ARR/2013/LVA DRAFT, 39.pt.	Will be improved in the 2015 submission.
1.B.2.b.	Correct notation neys and describe the methods and data.	FCCC/ARR/2013/LVA DRAFT, 40.pt.	The emissions have been recalculated and CO_2, CH_4 and NMVOC emissions ave been provided in Submission 2014.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
International bunkers	Describe in NIR the methodology used to split national and international (bunker) fuel consumption for navigation and aviation.	FCCC/ARR/2011/LVA 28.pt. FCCC/ARR/2012/LVA 46.pt. FCCC/ARR/2013/LVA DARFT, 34.pt.	More detailed information about fuel consumption split between domestic and international mode are provided (chapter 3.2.2).
Industrial Processes			
Industrial processes overview	ERT recommends that more priorities should be given to the two key categories with regard to further improvements and allocation of resources for the preparation of the GHG inventories; provide information in NIR	FCCC/ARR/2013/LVA DARFT, 42.pt.	In NIR submission 2014 there are updated information about used activity data of clinker production. Detailed clarification under section "4.2.2.2 Methodological issues".
Industrial processes overview	Improve time series consistency by undergoing capacity building projects so as to achieve better time series consistency in the emissions estimates for the next submission.	FCCC/ARR/2013/LVA DARFT, 43.pt.	It is planned to make these efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for next submission.
Industrial processes overview	Improve the consistency of the time series in the industrial processes sector where different methodologies or AD are used for different time periods	FCCC/ARR/2011/LVA 62, 66 and 69.pts	This issue is quite complex and it will take more research thereby it is planned to make these efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for next submission.
2.A, 2.C, 2.F	Verification for Industrial Processes sector and especially for the HFCs, SF6 estimations as well as for 2.A Mineral Products and 2.C Iron & Steel sectors.	Implementation of QC procedures in Latvian GHG inventory (for Industrial processes and Solvents and Other Product Use) – the report of third part expert Janis Rekis;	All recommendations and updated information indicated by independent reviewer are already implemented in submission 2014 under relevant subchapters.
2.A.1	Improve the accuracy of the emission estimates for cement production by moving to a Tier 2 method;	FCCC/ARR/2011/LVA 65.pt.	In NIR submission 2014 there are updated information about used methodology of clinker production as there are used plant specific activity data that are considered as Tier 2 method. Detailed clarification under section "4.2.2.2

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
			Methodological issues ".
2.A.1	Include detailed information on clinker production data from the cement plant	FCCC/ARR/2013/LVA DRAFT, 44., 45. pts.	In NIR submission 2014 there are updated information about used activity data of clinker production. Detailed clarification under section "4.2.2.2 Methodological issues"
2.A.7 Other	Improve transparency and report aggregated brick production emissions in one line.	FCCC/ARR/2013/LVA DARFT, 48.pt.	On submission 2015 there are planned to make some technical updates in CRF under sector 2.A.7 Other following to ERT recommendations.
2.F	Make further efforts towards a more complete reporting of potential emissions from consumption of halocarbons and SF_6 for the next submission.	FCCC/ARR/2013/LVA DARFT, 47.pt.	It is planned to make these efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for the next submission.
Solvent and Other Product Use			
Solvents overview	Ensure time series consistency using one method for all time series.	FCCC/ARR/2013/LVA DARFT, 43.pt.	For period 1990-2012 recalculations have been carried out under CRF 3. The time series consistency is performed using one method for all time series. See Section 5.2.2, 5.3.2 and 5.4.2
Solvents overview	To provide more clear information about emission factors in emission calculations file Solvent_Submission_2013.xls and 90-04_SEG_CALCULATION.xls (internal documentation).	Implementation of QC procedures in Latvian GHG inventory (for Industrial processes and Solvents and Other Product Use) – the report of third part expert Janis Rekis;	Information for emission factor is available in Section 5.2.2, 5.3.2 and 5.4.2 as well as in 2014_Solvent_calculation file_3.A, 3.B, 3.C, 3.D.5.xls
Solvents overview	Improve the list of substances to be included in the inventory on emissions.	ICR, September 2013	For period 1990-2012 the list of NMVOCs substances is supplemented, therefore recalculations are carried out under CRF 3.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
Solvents overview	To evaluate the possibility to extrapolate the activity data back to the year 1990.	ICR, September 2013	Extrapolation is done: for period 1990-2004 under CRF 3.A, 3.B and 3.D.5, see in Section 5.2.2; for period 1990-2003 under CRF 3.C, see in Section 5.3.2. for period 1990-1994 under CRF 3.D.1, see in Section 5.4.2
3.A, 3.B, 3.C, 3.D	Integrate both calculation files (emission calculations file Solvent_Submission_2013.xls and 90-04_SEG_CALCULATION.xls (internal documentation) in order whole time series is covered in one file.	Implementation of QC procedures in Latvian GHG inventory (for Industrial processes and Solvents and Other Product Use) – the report of third part expert Janis Rekis;	For period 1990-2012 emission calculation for CRF 3 is done in one calculation file (2014_Solvent_calculation file_3.A, 3.B, 3.C, 3.D.5.xls). All calculations are archived and available in FTP.
3.C	Provide missing information on 3.C	Implementation of QC procedures in Latvian GHG inventory (for Industrial processes and Solvents and Other Product Use) – the report of third part expert Janis Rekis;	All necessary information for CRF 3.C is available in Section 5.3.
Agriculture			
Agriculture overview	Ensure transparency of the inventory describing the collection of national statistics, including description of surveys, and censuses. Describing the decision processes and justification with regards to national circumstances emissions factors, especially for livestock when country specific factors are used and especially if lower than default values. Provide tables of more parameters such as birth weight (BW) used for tier 2 livestock energy equations, and MCF (methane conversion factors) used. In using the lower value of a range recommended for anaerobic digesters (MCF) by the 2000 IPCC GPG provide the justification. Research report is not required for MCF anaerobic digester values since the IPCC provides a range and value is from within range.	FCCC/ARR/2013/LVA DRAFT, 51., 52. pts.	Describing of the collection of national statistics: Chapter Sources of information and activity data, p.41 Providing of tables of more parameters: Table 10.7 Input data for gross energy intake calculation

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
Agriculture overview	Provide more explanation of trends, especially where there are large increasing or decreasing trends in a category, or something that may appear an outlier.	ICR, September 2013	Chapters *Sources of information and activity data* and *Overview of greenhouse gas emissions.*
Agriculture overview	The ERT recommends that Latvia provide further information in the NIR, and justifications for parameter choices. In the case of anaerobic digesters, the ERT recommends that Latvia ensure that the CH_4 recovered for energy use is reported in the energy sector.	FCCC/ARR/2013/LVA DRAFT 53.pt.	Information provided under Chapter 4.3.2.
4A,4B, 4D	1. Obtain more accurate information on: -) detailed split of activity data; 2.Calculate CH4 EF from manure management for other cattle according to tier 2; 3.Calculate CH4 EF for swine from enteric fermentation according to Tier 2.	FCCC/ARR/2011/LVA	This is planned for next submission
4.A	Disaggregate under subgroups of non-dairy cattle.	ICR, September 2013	This is planned for next submission.
4.B	Improve data on animal waste management systems to improve tier 2 calculations and time series consistency.	ICR, September 2013	Detailed AWMS for 1990-1999 are not available yet.
Land Use, Land Use Change and Forestry			
LULUCF overview	ERT recommends that the Party provide an explanation of the the trend of CH_4 emissions from forest land (76.53 per cent decrease relative to 2010, from 40.31 to 9.46 Gg CO2 eq).	FCCC/ARR/2013/LVA DRAFT, 64.pt.	The CH_4 emissions are accounted for the forest fires and incineration of biomass after commercial felling. The fluctuations in activity data are described in chapter 9.8 Biomass Burning (CRF 5

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
			(V)).
LULUCF overview	The ERT recommends that Latvia use consistent notation keys for all pools in these categories in the next submission. The ERT noted that Latvia report changes in carbon stocks in organic soils but uses NO when reporting the changes in carbon stock in mineral soils from grassland converted to forest land. Latvia clarified that the notation key NO was used to avoid overestimation of removals. The ERT considers that these changes occur and therefore the notation key used is not appropriate. The ERT recommends that Latvia improve accuracy of reporting by either providing an estimate or by reporting this estimate as NE.	FCCC/ARR/2013/LVA DRAFT, 65.pt.	The reason for use notation key "NO" is generally lack of statistically significant difference between carbon stock in grassland and forest land. More logical would be to use zero value characterizing situation, but it is not possible in the inventory.
LULUCF overview	The ERT recommends that Latvia provide an explanation for not considering land-use matrices for a longer period and the potential implications for the estimations for land converted to forest land.	FCCC/ARR/2013/LVA DRAFT, 67.pt.	The information on historical land use (since 1970) is not available to the NFI or GHG team and thus cannot be applied to the calculation. Possible ways and funding necessary to obtain these data are discussed in Ministry of Agriculture; however, no solution were found yet. This issue is forwarded to the inventory improvement plan.
LULUCF overview	The ERT has identified several inconsistencies between the areas presented in NIR table 7.4 and those in CRF tables 5.B (1,142.5 and 1,162.93 kha, respectively; 5.C (1,259.7 and 1,239.11 kha, respectively); and 5.E (254.1 and 254.65 kha, respectively) for 2011. In response to questions raised by the ERT during the review, Latvia explained that some mistakes were introduced into the CRF tables due to the transfer of areas from provisional (land converted to) to permanent (land remaining as) land-use categories, but that these inconsistencies had no effect on the net emission estimates. The	FCCC/ARR/2013/LVA DRAFT, 68.pt.	The inconsistencies are solved and the total country area is harmonized for the whole accounting period (6 457.30 kha).

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	ERT also noted several inconsistencies in the total territorial area reported by Latvia, from 64,559 km2 (page 26 of the NIR) to 64,569 km2 (footnote 89) to 64,562.4 km2 (KP-LULUCF table NIR–2). Inconsistencies were also identified in the previous review report and so the ERT reiterates the recommendation made in the previous review report that Latvia improve the consistency of reporting between the CRF tables and the NIR.		
LULUCF overview	The ERT recommends that the Party use language consistent with that in the IPCC good practice guidance for LULUCF (e.g. for the carbon pools and land-use categories) as well as provide separate information for lands remaining in the same land category, and lands converted to other land categories, to improve readability and enhance transparency.	FCCC/ARR/2013/LVA DRAFT, 69.pt.	Under the convention report deforestation and afforestation is replaced with land use conversion from and to forest land.
5.A.1.	. Previous review reports have recommended that the Party make efforts to generate country-specific data and higher-tier methods to be in alignment with good practice guidance for key categories. Latvia reported in the NIR and reaffirmed during the review that country-specific data will be applied in the next inventory submission, including growing stock, biomass expansion factors, root-to-shoot ratios, basic densities and mortality rate from the second round of measurements of the NFI, to be finalized in 2014. The ERT commends the Party for the efforts to produce national data and to report using higher-tier methods, and recommends that Latvia continue these efforts that will contribute to improving the accuracy of its future inventory.	FCCC/ARR/2013/LVA DRAFT, 70.pt.	Growing stock, biomass expansion factors, root-to-shoot ratios, basic densities, carbon stock in biomass and mortality rate country specific data are implemented in the GHG inventory for LULUCF sector, 9.2.4 Methodological issues and 9.2.7 Category-specific recalculations
5.A.1.	The ERT recommends that the Party evaluate the appropriateness of using the carbon stock change method after the second round of the NFI is completed and the forest properties are better known. The	FCCC/ARR/2013/LVA DRAFT, 71.pt.	The accounting using stock change method is added to the EPIM model used in GHG accounting in LULUCF sector since 2014. However, only 2 cycles of the NFI are

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	ERT also encourages the Party to apply both methods and assess whether there are significant differences in the estimates.		completed, characterizing situation in 2004-2013, and for the rest of period only logical control is possible due to lack of comparable data.
5.A.1.	The ERT noted that the default method applied by the Party as mentioned in paragraph 21 requires that losses of carbon stocks from living biomass be estimated for commercial fellings, fuelwood gathering and other losses, including those from disturbances. The ERT noted that Latvia provided estimates only for losses from commercial fellings, and strongly recommends that estimates for the other components be included and that the Party indicates in the NIR how these are considered. Additionally, the ERT recommends that Latvia provide information about the annual harvesting data and its relation to the annual volume increment of the forest total growing stock, and how salvage logged wood or wood affected by disturbances are treated and included in the inventory.	FCCC/ARR/2013/LVA DRAFT, 72.pt.	The fuelwood gathering is now included into commercial felling, just like extraction of damaged trees (sanitary felling) after storms and other extreme events. Extreme events are considered in mortality factors utilized in calculations, chapters 9.2.4 Methodological issues and 9.2.7 Category-specific recalculations. However, there might be overlapping of mortality and commercial felling, because it is common to extract dead trees after extreme events. This issue is not solved yet and there is no common vision, how much wood is accounted as emissions twice – as dead wood and as wood products.
5.A.1.	The ERT also noted that losses of biomass due to pest infestation (e.g. defoliation) need to be transparently reported and estimated in a way consistent with that used to estimate the biomass gains. For instance, the default biomass expansion factor used to expand the growing stock volume increment data to non-merchantable biomass components includes branches, foliage and non-commercial trees. Hence, losses of biomass from these components also need to be estimated. Finally, the ERT noted that carbon losses from decay due to natural mortality are included in the estimation of decreases in carbon stocks from annual commercial felling. The ERT considers that emissions from natural mortality should be included as part of the emissions from the dead wood pool and	FCCC/ARR/2013/LVA DRAFT, 73.pt.	The country specific biomass factors implemented in 2014 excludes foliage, therefore this issue is not valid any more. However, there is ongoing work to extrapolate results of the 1st level forest monitoring data on defoliation to include foliage into accounting of CO_2 removals in living biomass. The work is not finalized due to lack of funding and relatively small importance of this issue.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	recommends that the Party separate these emissions from the estimates of changes in carbon stocks in living biomass.		
5.A.1.	The ERT encourages the Party to assess these other sources of harvested timber and seek to understand the differences, if applicable. The ERT encourages the Party to report on any such QA efforts in its NIR.	FCCC/ARR/2013/LVA DRAFT, 74.pt.	The harvesting figures are changed from reporting of merchantable wood to losses in living biomass due to human activity on the base of comparison of the 1st and 2nd NFI cycle, which includes firewood, bark and undergrowth trees. The difference between the statistics on merchantable wood and NFI data for the period between 2006 and 2012 is expressed in percent and applied to the whole accounting period (since 1970). The figures on harvesting rate and calculation method is provided in chapters 9.2.1 Source category description and 9.2.4 Methodological issues.
5.A.1.	Regarding the annual increases in carbon stocks due to biomass growth, these have been estimated using country-specific growing stock increment data from the NFI (which have been adjusted to reflect changes since 2008). Both the annual growing stock increment per hectare as well as the total growing stock increment are presented for five-year periods, the period between [inventory][NFI] cycles. For the period 2004–2008, the NFI data were used. Prior to this period, the growing stock increments and total growing stock were estimated with these data using back-casting techniques. Post 2008 estimates are projected based on NFI data. The NIR does not provide transparent information on how these estimates are produced. The ERT recommends that Latvia provide a more detailed description in the NIR of the estimates for the annual growing stock increments.	FCCC/ARR/2013/LVA DRAFT, 75.pt.	More detailed description of coefficients used for calculation in forest land remaining forest land are provided in chapter 9.2.4 Methodological issues.

Sector/CRF category	**Finding**	**Reference to finding**	**Improvement made (Time schedule, NIR chapter)**
	As previously mentioned, default data for basic density, biomass expansion factor and root-toshoot ratio are used to provide the annual change in carbon stocks in living biomass. The ERT recommends that Latvia include in its annual submission the estimate of the average carbon stocks in living biomass in forest land remaining forest land, by type of forest and age, to increase the transparency of the reporting.		
5.A.1.	The ERT recommends that Latvia provide clear information regarding how the mortality rates have been estimated, and how the age, species and other parameters have been taken into account. It also recommends that the Party provide information regarding how the carbon stock lost from thinning is incorporated into the estimation of carbon stock changes in forest land.	FCCC/ARR/2013/LVA DRAFT, 76.pt.	Figures on mortality are provided in chapter 9.2.4 Methodological issues. The same biomass expansion factors are applied for living and dead biomass. Biomass extracted in thinning is evaluated just like any other type of felling. Biomass extracted in pre-commercial thinning (every tree being taller than 2 m during the 1st cycle of the NFI) is treated in the same way since 2014.
5.A.1.	The ERT recommends that the Party report the carbon stock estimated for each of the carbon pools in its NIR, indicating how these values were estimated in order to improve transparency, taking into consideration any deviations observed from the default values in the IPCC good practice guidance for LULUCF.	FCCC/ARR/2013/LVA DRAFT, 77.pt.	The information on carbon stock, particularly historical figures are going to be updated, the preliminary data were prepared after completion of the NIR and will be provided in further submissions.
5.A.1.	The ERT recommends that Latvia apply default values appropriate to the climate zone reported in the NIR.	FCCC/ARR/2013/LVA DRAFT, 78.pt	The default emission factors are changed to those recommended for temperate zone, borrowed from neighbouring countries or replaced by country specific values, chapters 9.2.4 Methodological issues, 9.3.4 Methodological issues, 9.4.3 Methodological data
5.A.2.	Latvia has not provided estimates of the areas converted to forest land for the years 2010 and 2011, except for estimate of the area for grassland converted to forest land. It did provide the methodological approach for the estimates for the period 1990–2008, which were	FCCC/ARR/2013/LVA DRAFT, 80.pt	Important part of the NFI is quality control and validation of field measurement data, which includes identification of outliers, resolution of problematic situations, improvement of methodologies to adopt to

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	already reported in previous inventory reports. Latvia informed the ERT that no area estimates were provided for the last two years to avoid overestimation of removals, since data from the NFI were not yet available. The ERT noted that, according to the IPCC good practice guidance for LULUCF (page 3.16), "even though national reporting of sources and sinks is required annually, it does not mean that national inventories have to be carried out annually for all pools, since data from national inventories done on 5 to 10 year cycles can be interpolated". The Party has indicated that information will be updated in 2014, when field measurements from at least 80 per cent of the permanent plots in the NFI will be available from the second round of measurements. The ERT recommends that Party to use all available data and information to provide estimates that are as accurate as possible.		unexpected situations (for instance, in 2012 and 2013 severe damages of young stands by ice took place in several regions and measurement as well as the calculation methodology had to be adopted to consider reduction of height of trees bended down by ice). The NFI database according to the program funding plan is updated at the end of the period therefore no calculations are possible before completion of the 5 years period. Starting from the 3rd cycle (in 2014) floating period will be introduced to deliver updated data every year.
5.B.1.	Latvia has reported only changes in carbon stocks in organic soils. Latvia has reported in the NIR that there is an increase in the growing stock volume of trees in cropland, but that the uncertainly is very high (60.0 per cent). Due to this high uncertainty, Latvia decided not to provide estimates for changes in carbon stocks for the living biomass pool. It noted in the NIR and reaffirmed during the review in response to questions raised by the ERT, that the data from the second cycle of the NFI will have considerably smaller uncertainty, thus producing more accurate estimates for changes in the living biomass pool. The ERT recognizes the conservative approach adopted by the Party, but emphasizes the need to explore the available data and information to provide estimates that are as accurate as possible for all carbon pools and recommends	FCCC/ARR/2013/LVA DRAFT, 81.pt	The notation key "NO" is used on the base of evaluation of statistical significance of difference, respectively, lack of difference between 2 periods. In this case "NO" is used to demonstrate "zero" changes. Additional motivation to avoid reporting of removals is lack of knowledge about historical increment figures, which could be negative in certain periods, when agricultural activity increased or farmers received subsidies for cleaning abandoned cropland. Accounting of current removals in living biomass in cropland would lead then to potential underestimation of emissions in the past.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	that estimates be provided, even if a tier 1 approach is used as an interim measure. The ERT also notes that the notation key used in CRF table 5.B for carbon stock change in living biomass should be "NE" instead of "NO" and recommends that the Party use the "NE" notation whenever an estimate is not provided.		
5.B.1.	Emissions from organic soils are reported following a tier 1 method with default EFs. The ERT noted that since this subcategory is a key category, higher tiers should be applied and it recommends that the Party implement higher-tier methods using country specific data.	FCCC/ARR/2013/LVA DRAFT, 82.pt	The project on evaluation of emissions from organic soils is started in 2014 and the results will be implemented in further submission. The project is based on evaluation of changes of surface level and soil characteristics in areas drained in 1960 and control areas.
5.C.1.	Aggregated CO_2 emissions from agricultural lime application are reported in CRF table 5(IV). The ERT noted that Latvia was not able to separate liming application for cropland from that for grassland and recommends that if no separate estimates can be provided, the emissions be reported under category 5.G, other (refer to footnote 4 in CRF table 5(IV)).	FCCC/ARR/2013/LVA DRAFT, 83.pt	Liming is not used in grasslands as it is not economically feasible and not supported by government. Reporting of liming under 5.G would lead to inconsistency with Kyoto protocol reporting, where, according to expert recommendations, we are reporting emissions due to liming in deforested lands.
5.B.2.	Latvia has applied the methodology based on annual rates of growth and loss to estimate changes in carbon stocks in cropland biomass. No biomass growth has been reported after the conversion, to avoid overestimation of removals. Losses are reported using data derived from the BioSoil Project for the dead organic matter pool (average carbon stock is assumed to be equal to 20.9 t C ha-1 for litter, equal to 6.0 t C ha-1 for dead wood, and equal to 124 t C ha-1for mineral and organic soils. The ERT noted that the average values reported for litter and deadwood are within the IPCC good practice guidance for LULUCF default values but recommends that the Party provide additional information about the methodology used to estimate	FCCC/ARR/2013/LVA DRAFT, 84.pt	The project on evaluation of organic carbon in cropland and grassland is completed to 40 %. Further work is planned in 2015, 2016 and 2017. The preliminary results are used in the NIR. Due to the fact that the study is not completed, the results are not published yet.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	these values, including for the soil organic carbon pool.		
5.B.2.	The ERT recommends that the Party update the organic soil area in its inventory submission.	FCCC/ARR/2013/LVA DRAFT, 85.pt	The project on evaluation of area of organic soil is completed to 40 %. Further work is planned in 2015, 2016 and 2017. The results demonstrates considerably smaller share of organic soils; however, the methodology to approve reduction of organic soils needs to be developed.
5.E.2.	Latvia has reported only forest land converted to settlements under this subcategory. However, it recognizes that other types of conversion may be possible, but indicated that there is no evidence in national statistics and thus it has reported all other conversions using the notation key "NO". Identification of other conversions is part of the improvements planned by the country. The ERT encourages the Party to improve its land-use change estimates to improve the accuracy of the reporting.	FCCC/ARR/2013/LVA DRAFT, 86.pt	The methodology proposed for improvement of the NFI considers extended options for calculations of land use changes using "floating" calculation period and 5 years period for all calculations. The land use change will be registered, if the conversion will be approved by 2 repeated measurements, respectively within 10 years to avoid registration of abundant amount of temporal changes like temporal roads in forests or grasslands or setting aside considerable areas of croplands in biological (extensive) farms using technologies from the middle ages.
5.E.2.	The ERT considered the response satisfactory, but notes that the report does not identify the areas of organic soils as large. The ERT recommends that Latvia include the description of the rational of the value for the carbon stock in the soil organic carbon in the next NIR.	FCCC/ARR/2013/LVA DRAFT, 87.pt	The distribution of organic soils in Latvia is provided in chapter 9.2.1 Source category description, Table Distribution of drained, naturally dry and wet mineral and organic soils in Latvia's forests. Total area of forests on organic soil in 2012 was 698.46 kha (22 % of the total forest area). The values of carbon stock in soil in different forest stand types were obtained from the forest soil monitoring project BioSoil.

Sector/CRF category	**Finding**	**Reference to finding**	**Improvement made (Time schedule, NIR chapter)**
5.E.2.	Latvia has provided estimates for all pools (living biomass, dead organic matter and soil organic carbon). For the changes in carbon stocks in living biomass, the Party uses the tier 1 method that assumes that all carbon in living biomass before the conversion is lost in the year of conversion and that carbon stocks following the conversion are zero. Latvia has provided estimates of changes in carbon stocks in the dead organic matter and soil organic carbon pools, although the methodological approach in the IPCC good practice guidance for LULUCF considers only living biomass. Latvia has also assumed that all carbon in lands converted to settlements is lost after the 20-year period from the original carbon under the original vegetation. The ERT notes that this can lead to an overestimation of emissions and encourages the Party to explore further whether the zero carbon stock is in fact an adequate assumption.	FCCC/ARR/2013/LVA DRAFT, 88.pt	The project on evaluation of decomposition period of dead biomass is started in 2012. Preliminary results will be available already in 2014 and verified results will be implemented into the NIR in 2015.
5.C.1.	The ERT recommends that instead of reporting "NO", Latvia provide estimates of changes in carbon stocks in mineral soils, even if a tier 1 approach is used.. Further, the ERT noted that grassland consists of areas with grasses and also with trees and recommends that Latvia stratify the grassland by different types in its submission, to improve the accuracy of the reporting.	FCCC/ARR/2013/LVA DRAFT, 89.pt	The information on removals of CO_2 in living biomass in grassland is updated, chapter 9.4.3 Methodological data. Latvia applied to the Joint research support for implementation of the Yasso model to forest lands with further extension of the calculation to farmlands; however, the application was rejected. The project on elaboration of Tier 1 method based on statistics on agriculture will be implemented in 2014 and implemented in the further submissions.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
5.F.	The ERT recommends that Latvia provide a much clearer explanation about the meaning of recultivated lands in the NIR, and use the data from the second NFI cycle to reallocate lands (e.g. grassland), as appropriate, even if considered insignificant.	FCCC/ARR/2013/LVA DRAFT, 90.pt	Moorlands are reported now under grassland category (chapter 9.7.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories), recultivated lands will be evaluated further to separate recultivated lands with and without soil layer. Areas with soil layer will be reported under grassland category.
KP-LULUCF			
KP-LULUCF	**105.** The ERT noted, however, that some supplementary information has not been adequately addressed or needed additional elaboration (e.g. subsection 11.3.1.3, "Information on whether or not indirect and natural GHG emissions and removals have been factored out", and sub-section 11.3.1.7, "The year of the onset of an activity, if after 2008"); for others, additional explanation needs to be provided (e.g. subsection 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"). The ERT strongly recommends that Latvia report this supplementary information.	FCCC/ARR/2013/LVA DRAFT, 105.pt	The specified chapters were updated during the support mission of the Joint research centre in 2013.
KP-LULUCF	The areas afforested and reforested in 2010 and 2011 were not identified or estimated due to lack of reliable data. Latvia expects to update the information on these lands in the next inventory submissions, when data from the NFI for the period 2009–2014 will be almost completed. The ERT strongly recommends that Latvia use these updated data to provide more reliable estimates of the areas converted to forest land in the period 2008–2010.	FCCC/ARR/2013/LVA DRAFT, 106.pt	The second cycle of the NFI was not completed and validated during elaboration of the NIR; therefore, information on afforestation was not changed to avoid overestimation of removals in living biomass, dead wood and litter

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
KP-LULUCF	Latvia continued to use default EFs and methodologies in the 2013 annual submission to estimate GHG emissions and removals for all KP-LULUCF activities, although there were some improvements in the data used. The ERT strongly reiterates the recommendation made in the previous review reports that Latvia move to higher-tier methods and apply country-specific data.	FCCC/ARR/2013/LVA DRAFT, 108.pt	The methodology for accounting living and dead biomass is improved and country specific BEFs are used, detailed description is provided in chapter 9.2.4 Methodological issues
KP-LULUCF	The NIR includes uncertainty estimates for the reported carbon pools, EFs and ADs, but the combined level of uncertainty continues not to be reported. No information has been provided on how the estimates are generated. Latvia did not implement the encouragement made in the previous review report to conduct a tier 2 uncertainty analysis. The ERT reiterates the encouragement and recommends that Latvia improve the transparency of its reporting on the uncertainty analysis.	FCCC/ARR/2013/LVA DRAFT, 109.pt	The Tier 2 uncertainty analysis is planned to be implemented within the scope of new project on improvement of the GHG inventory, which will be started in second half of 2014. The uncertainties are generally based of the NFI data, research results and expert judgment.
KP-LULUCF	The ERT noted some inconsistencies in the CRF KP-LULUCF tables; for example, in table NIR–1, Latvia reports "NO" for N2O emissions from disturbance associated with land-use conversion to cropland for deforestation. However, these emissions are reported in table 5(KP-II)3 with values inconsistent with those reported in CRF table 5(III) for emissions from forest land converted to cropland under the Convention; similarly, carbon emissions from lime application are reported as "NO" in table NIR–1 but aggregated CO2 emissions are reported in table 5(KP-II)4; and for the total area deforested, the values in table 11.2 (36.38 kilo hectares (kha)) are not consistent with those provided in CRF table NIR–2 (37.48 kha). In response to questions raised by the ERT during the review, Latvia explained that the CRF tables have been updated after consultation with external consultants. These inconsistencies	FCCC/ARR/2013/LVA DRAFT, 110.pt	The notation key was changed, difference is due to completion of 20 conversion period in lands converted to cropland, which is not applied to Kyoto protocol accounting.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	indicate that the QA/QC system in Latvia needs to be improved. The ERT reiterates the recommendation made in the previous review reports that Latvia improve the QA/QC procedures in order to enhance the consistency and transparency of its reporting.		
KP-LULUCF	Latvia has performed recalculations for the KP-LULUCF activities between the 2012 and 2013 submissions. The impact of the recalculation was an increase in CO2 removals of 98.94 per cent for afforestation/reforestation (from 506.22 to –1,007.09 Gg CO2 eq) and an increase in emissions of 5.93 per cent for deforestation (from 986.29 to 1,044.78 Gg CO2 eq). These values are estimated using the figures in the information table "Accounting for activities under Articles 3.3 and 3.4 of the Kyoto Protocol" provided in the NIR. The ERT noted, however, that the value for deforestation provided in this table for 2010 (1,044.78 Gg CO2) is not consistent with the sum of the estimates provided in KPLULCUF CRF tables in 2012 submission for 2010 for deforestation (table 5(KP-I)A2, equal to 597.40 Gg CO2 eq, and table 5(KP-II)4 for carbon emissions from lime application, equal to 0.01 Gg CO2 eq). If these KP-LULUCF CRF values are used to estimate the impact of recalculations on the 2010 estimates from deforestation, the result would lead to 57.18 per cent difference.	FCCC/ARR/2013/LVA DRAFT, 111.pt	The values are recalculated in the CRF. Considerable difference due afforestation is caused by calculation of carbon stock changes in dead wood and litter; however, these values are again recalculated considering temporarily 150 years conversion period instead of 20 years. As soon as more detailed information will be available about decomposition of dead wood and litter 150 years will be replaced by the average period of decomposition of dead wood and litter.
Afforestation and reforestation	Considering that under the Kyoto Protocol net emissions from all pools need to be accounted for unless the Party provides transparent and verifiable information that the pool is not a net source, the ERT strongly recommends that the Party provide information to support the indication that a pool is not a source in its next inventory submission if estimates are not generated.	FCCC/ARR/2013/LVA DRAFT, 114.pt	The BioSoil project results demonstrates no significant changes in litter and upper soil layer between 2006 and 2012 approving no statistically significant changes in both layers, however separate evaluation of the soil and litter layer is not possible due to different methodology, chapter 9.2.4 Methodological issues. New methodological solution for determination of

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
			litter layer is under preparation by the NFI team. The depth of litter will be evaluated in every plot during every visit. Changes in litter layer will we calculated on the base of difference between the layers.
Afforestation and reforestation	The ERT strongly recommends that the Party provide the appropriate documentation to demonstrate that the natural succession was the result of a direct human induced activity.	FCCC/ARR/2013/LVA DRAFT, 115.pt	Afforested/reforested areas are to be considered legally bound by national legislation. Usually these activities have resulted from a decision to change the land use by planting or seeding or managing of afforested lands. On the basis of the definitions provided in the Decision 19/CMP.136, afforestation and reforestation occurred on agricultural lands have to be included in the Article 3.3: a common forest management approach in Latvia is exploitation of natural re-growth by seeds of adjacent trees in forest regeneration and afforestation. In addition these transitions are essentially due to political decisions under the EEC Regulations 2080/92 and 1257/99 (art.10.1 and 31.1), chapter 13.4.1 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 .
Afforestation and reforestation	Latvia has reported changes in carbon stocks in mineral soils as "NO". The ERT notes that tier 1 calculations are very uncertain and that according to the IPCC good practice guidance for LULUCF (page 3.63) "countries for which land conversion to forests is a key category should report at tier 2 or 3." The ERT therefore recommends that the Party either provide estimates for this pool using a higher tier or demonstrate that the pool is not a source.	FCCC/ARR/2013/LVA DRAFT, 116.pt	Preliminary research data demonstrates no soil carbon stock changes due to afforestation; therefore, removals in this carbon pool are not accounted, chapter 9.2.4 Methodological issues.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
Deforestation	The ERT strongly recommends that Latvia use higher-tier methods and to be in alignment with good practice for key categories. The ERT noted that deforestation occurs only to convert the land to cropland and settlements. It recommends that the Party provide evidence that deforestation does not result from conversion to other land uses.	FCCC/ARR/2013/LVA DRAFT, 117.pt	Latvia developed country specific shoot to root ratios, wood density, carbon content and mortality factors for the most common tree species, which are implemented into the GHG inventory in 2014. The changes are described in chapters 9.2.4 Methodological issues and 9.2.7 Category-specific recalculations. The methodology applied and state statistics demonstrates that only land use changes to cropland and settlements takes place. Less evident land use changes, like conversion to wetlands (bogs) will be determined during 3rd NFI cycle.
Deforestation	Latvia explained in the NIR that some areas that meet the definition of forest continue to be reported as non-forested land (e.g. parks and yards, which are allocated under settlements; or areas that have the (biological) potential to reach the forest thresholds but will not, due to management decisions, which are normally reported as grassland). The ERT recommends that the Party provide additional information in the NIR justifying the reasons why these lands are not categorized as forests, to improve transparency of the reporting.	FCCC/ARR/2013/LVA DRAFT, 118.pt	The specified areas are not reported under forest management as they are not supposed to be or considered as managed forests, respectively, subjects of forest law. Due to this reason these areas are not reported as forests. The definition of forests is provided in chapter 13.1.1 Definition of forest and any other criteria.
Deforestation	The ERT recommends that the Party seek to provide specific harvesting losses for the areas deforested, which can be estimated as an average of the losses taking into account the location of the deforested lands to capture regional differences. The average losses from these can then be used as an estimate for the average harvesting losses.	FCCC/ARR/2013/LVA DRAFT, 120.pt	Losses in living biomass due to deforestation are calculated now according to IPCC GPG LULUCF 2013 as average growing stock in forest in a year of conversion; description is provided in chapter 9.2.4 Methodological issues
Forest management	The ERT reiterates recommendation of the previous review report and strongly recommends that the Party either estimate changes in carbon stocks for this pool applying a tier 2 or 3 method or demonstrate that this pool is not a source (e.g. by	FCCC/ARR/2013/LVA DRAFT, 121.pt	The assumption on no changes in litter carbon stock in forest lands in based on the 1st level forest monitoring data (repeated measurement of carbon stock in 95 plots in 2006 and 2012) demonstrating no statistically significant

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
	demonstrating that the country does not experience significant changes in forest types, disturbances or management regimes).		carbon stock changes in forest soils in litter layer and upper soil layer. The description is provided in chapter 13.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4. The methodology on field measurement of litter layer is elaborated by the National forest inventory team and will be implemented as soon as funding for this activity will be granted.
Forest management	Latvia has used a tier 1 methodology to estimate carbon stock changes in mineral soils, and therefore reports "NO" (no changes). The ERT recommends that the Party provide evidence that this pool is not a source (e.g. no changes such as intensification of forest management activities or changes in harvesting practices; or in frequency of disturbances such as pest and disease outbreaks, flooding and/or fires).	FCCC/ARR/2013/LVA DRAFT, 122.pt	The assumption on no changes in soil carbon stock in forest lands in based on the 1st level forest monitoring data (repeated measurement of carbon stock in 95 plots in 2006 and 2012) demonstrating no statistically significant carbon stock changes in forest soils. The description is provided in chapter 13.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4
Forest management	The ERT noted that the tier 1 methodology in the IPCC good practice guidance for LULUCF (equation 3.2.20) to estimate non-CO2 gases from biomass burning was not properly applied. The value in table 3.A.1.13 already tabulates the product of the biomass density on the land before combustion and the combustion efficiency, so no different values need to be provided for these variables. The ERT recommends that the Party correct this in its inventory submission, assuming that it applies the same methodology.	FCCC/ARR/2013/LVA DRAFT, 126.pt	The methodology is changed considering average carbon stock in living biomass, litter and dead wood and their characteristics as fuel for wildfires; the methodology is described in chapters 9.2.4 Methodological issues and 9.8.4 Methodological issues.
Waste			

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
Waste overview	The ERT recommends that Latvia report the tier 2 QC activities in the NIR.	FCCC/ARR/2013/LVA DRAFT, 93. pt.	Procedure of data collection are described in sector overview. Regional Environmental boards did data checking before approval. Only approved data are counted in summaries and used in calculations.
Waste overview	ERT recommends that Latvia include in its NIR updated information on different waste streams according to the type of waste treatment, data on imports and exports of waste, and information on the amount of waste reported under other sectors, such as the energy or the agriculture sector, if such allocations occurred.	FCCC/ARR/2013/LVA DRAFT94. pt.	Methane emissions are calculated only from disposed amounts. Waste treatment types in Latvia are mentioned in sector overview, mostly these are disposing and composting.
6.A	Estimate country specific degradable organic carbon (DOC) values depending on avalilable resources and timeframe.	FCCC/ARR/2013/LVA DRAFT 98. pt.	Carbon stock in different carbon pools is calculated for the whole reporting period to use with accounting of deforestation and to double check coefficients used in calculations (additional check by evaluation of impact on stocks and comparison of obtained data with other datasets), 2014
6.A	Estimate uncertainty for AD for MSW disposed in the period 1970-1995.	ICR, September 2013	For all activity data unceratinities are estimated as 20%. It is planned to make an efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy" to improve this section. Improvement will be undertaken for next submission.
6.A.1	Provide information in NIR on reference document used for estimation of waste density as well as more detailed information on waste recovery and recycling amounts and types in recent years (waste balance) and information on share of non-hazardous industrial waste (for example construction waste) in total solid waste.	FCCC/ARR/2013/LVA DRAFT 97. pt.	It is planned to make an efforts within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for next submission.

Sector/CRF category	Finding	Reference to finding	Improvement made (Time schedule, NIR chapter)
6.B.2	Increasing accuracy for activity data for CH_4 emission from domestic waste water handling sector. The ERT recommends that Latvia implement a Tier 2 method for this category.	FCCC/ARR/2013/LVA DRAFT 100. pt.	Done as much as was possible, also changed methodology due to recommendations of ERT during the In-country Review, however presented as "default method" in NIR (NIR chapters 8.3.2 and 8.3.4)
6.C	The ERT reiterates the recommendation made in the previous review report that Latvia report on emissions from waste incineration for the full time series, for time-series consistency, accuracy and completeness.	FCCC/ARR/2013/LVA DRAFT 102. pt.	Not done, because Latvia thinks that incineration without energy recovery did not occured in 1990 – 1998. There are no reasons to include these emmisions in submission.
6.D	The ERT reiterates the recommendation made in the previous review report that Latvia report on emissions from waste composting for the entire time series. For the time series reported, default EFs have been used from the 2006 IPCC Guidelines. The ERT also encourages Latvia to develop country-specific EFs for composting and to estimate amounts of composted waste in households, since composting is set as one of the prioritized areas in waste treatment in Latvia.	FCCC/ARR/2013/LVA DRAFT 103. pt.	Reaserch is needed. It is planned to evaluate EF and composted amounts in this year within the programme "European Economic Area Financial Mechanism 2009-2014 – "National Climate Policy". Improvement will be undertaken for next submission.

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11. KP-LULUCF

11.1 GENERAL INFORMATION

Under Article 3, paragraph 3, of the Kyoto Protocol (KP), Latvia reports emissions and removals from afforestation (A), reforestation (R) and deforestation (D), and under Article 3, paragraph 4 emissions and removals from forest management (FM). The estimates for emissions and removals under Articles 3.3 and 3.4 are consistent with the IPCC GPG LULUCF 2003 and Decisions 15/CMP.1 and 16/CMP.1 of the KP. The methodology for improved estimates of certain carbon pools (removals of CO_2 in dead wood, litter and soil) is continuously improving; therefore, future reporting will contain more up-to-date information.

11.1.1 Definition of forest and any other criteria

The National Forest Inventory (NFI) of Latvia is the main data provider for the GHG reporting in LULUCF sector and Kyoto protocol Article 3, paragraph 3 and Article 3, paragraph 4 activities. The applied forest definition for the reporting is harmonized the definition used within the NFI. The forest definition is the same as used in chapter 7.2.3. Land-use definitions and the classification systems used and their correspondence to the LULUCF categories. The selected parameters are presented in Table 11.1. Additional criteria defined by the Latvia's Forest law[187] is width of rows of trees of artificial or natural origin – they should be at least 20 m wide to be accounted as the forest. The whole country is considered as one sub-division in the reporting.

Table 11.1 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

Forest roads, cleared tracts, fire-breaks, seed orchards and other forest infrastructure are excluded from forest and are accounted under settlements; respectively, building of the forest infrastructure is accounted as deforestation.

11.1.2 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

For the commitment period 2008-2012 Latvia choose 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 did not elect Cropland management, Grazing land management and Revegetation. Following the Decision 8/CMP.2, the cap is equal to 6.23 Mt CO_2 for the whole commitment period.

[187] Latvijas Republikas Saeima, "Meža likums, 2000. (Forest law)", published in 24.02.2000.

Forest management areas are determined using spatial (statistical) approach within squares of 4 km grid according to the methodology of the NFI[188].

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 not equal to the area reported for Land use changes from and to forests in the UNFCCC greenhouse gas inventory, because lands afforested / deforested in 1990-1992 already completed 20 years transition period and under the UNFCCC greenhouse gas inventory they are accounted under land use categories retaining their land use status, respectively, lands afforested in 1990-1992 are reported in 2010-2012 under the forest land remaining forest land category. In the Kyoto protocol reporting transition period is not considered; therefore, deforested lands will be always deforested lands, even if they are covered by forests in future. The total area of forest lands, however, is the same in the both reports. All land use changes from and to forests takes place on managed lands and therefore are considered to be human induced. AR activities are reported together.

The information about ARD areas is based on results of the first and second cycle of the NFI and research results on deforestation obtained in 2010[189]. The first round of the NFI was carried out in 2004-2008 by the LSFRI Silava, therefore data on the land use changes are based on 5 years period. More detailed information on representation of the land use changes available in sections 7.6. Settlements (CRF 5.D), 7.3. Cropland (CRF 5.B) and 7.2. Forest Land (CRF 5.A). A second cycle of the NFI is started in 2009 and final results will be available for implementation into the GHG inventory in middle of 2014, therefore, the estimates on land use change during 2009-2012 will be updated according to actual information.

Since the beginning the NFI uses a permanently marked hidden grid system. For this reason ARD activities will be assessed at the same grid points and sample plots at each inventory period.

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 has elected only forest management under Article 3.4 activities; there is no need to build up a hierarchy between forest management and other Article 3.4 activities.

188 Zemkopības ministrija, 2004. Meža statistiskās inventarizācijas veikšanas un mežaudzes sekundāro parametru aprēķināšanas metodika, instrukcija Nr. 10 no 17.03.2004. (Instruction for implementation of National forest inventory and calculations of secondary forest taxation parameters).

189 Lazdiņš, "Harmonization of land use matrix in Latvia according to requirements of international greenhouse gas reporting system - extending outputs of National Forest inventory program"; Lazdiņš and Zariņš, "Elaboration and integration into National greenhouse gas inventory report matrices of land use changes of areas belonging to Kyoto protocol article 3.3 and 3.4 activities (Report on research work contracted by the Ministry of Environment of republic of Latvia)."

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

Latvia implements spatial approach (Reporting Method 1 of the IPCC GPG LULUCF) in reporting of lands subject to Article 3.3. and Article 3.4 activities. The approach is consistent with calculations of land use changes under the Convention reporting. The spatial assessment units for the submission of the Kyoto Protocol and Convention report cover the entire territory of Latvia. 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. Sample plots are split into up to 10 sectors if different land use categories or vegetation type in the same category are presented in a single plot. In total 23583 sectors in 16383 sample plots were used for calculations. Number of sectors may change from cycle to cycle, because of land use changes. Borders of sample plots are constant all the time. Each sector in average represents about 400 ha of the country area including internal water bodies. The uncertainty of representation of the country area is 0.3 % (19.4 kha). ARD activities are accounted as long as the forest definition is met (minimum assessment unit 0.1 ha), except AR in extensively managed grassland and cropland, if the trees do not reach at least 2 m height, because growth of trees in such areas usually don't mean afforestation, but delayed grass cutting. 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 polygon 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 polygon 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.

During the second NFI cycle the fact of afforestation and deforestation is fixed mathematically by accounting area of sectors, where land use category is changed from one type to another and multiplying by area (in ha) represented by 1 m^2 of sample plots. Uncertainty is determined as error of proportion. The method is not fully implemented and in many cases land use changes should be determined manually (when 2 or more sectors representing different land uses are merged into new sector). In future it is planned to use GIS tools to process land use information as well as information on destiny of every single tree – if it is cut due to deforestation or just moved to another land use category. So the calculation will be done in 2 levels – land use and destiny of trees. Dead wood will be treated in the same way as living trees.

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. Merging principles of the NFI land use categories into the LULUCF categories is shown in Table 11.2. Estimation of afforested and deforested area in 2009-2012 is based of extrapolation of the NFI data and the research results[190]. After completion of the second round of the NFI the land use change figures will be updated in the following years according to empiric data of land use changes.

Table 11.2 Land transition matrix – areas and changes in areas between the previous and the current inventory year (2008-2012, kilo ha)

2008		Article 3.3 activities		Article 3.4 activities				Other (5)	Total area at the beginning of the current inventory year
		Afforestation and Reforestation	Deforestation	Forest Management	Cropland Management	Grazing Land Management	Revegetation		
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	190,21	0,00						**190,21**
	Deforestation		32,35						**32,35**
Article 3.4 activities	Forest Management		1,58	3 131,99					**3 133,57**
	Cropland Management	NA	NA		NA	NA	NA		**0,00**
	Grazing Land Management	NA	NA		NA	NA	NA		**0,00**
	Revegetation	NA			NA	NA	NA		**0,00**
Other (5)		14,07	0,00	NA	NA	NA	NA	3 087,11	**3 101,18**
Total area at the end of the current inventory year		**204,28**	**33,93**	**3 131,99**	**0,00**	**0,00**	**0,00**	**3 087,11**	**6 457,30**
2009		Article 3.3 activities		Article 3.4 activities				Other (5)	Total area at the beginning of the current inventory year
		Afforestation and Reforestation	Deforestation	Forest Management	Cropland Management	Grazing Land Management	Revegetation		
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	204,28	0,00						**204,28**
	Deforestation		33,93						**33,93**
Article 3.4 activities	Forest Management		1,30	3 130,69					**3 131,99**
	Cropland Management	NA	NA		NA	NA	NA		**0,00**
	Grazing Land Management	NA	NA		NA	NA	NA		**0,00**
	Revegetation	NA			NA	NA	NA		**0,00**
Other (5)		14,44	0,00	NA	NA	NA	NA	3 072,67	**3 087,11**
Total area at the end of the current inventory year		**218,72**	**35,23**	**3 130,69**	**0,00**	**0,00**	**0,00**	**3 072,67**	**6 457,30**
2010		Article 3.3 activities		Article 3.4 activities				Other (5)	Total area at the beginning of the current inventory year
		Afforestation and Reforestation	Deforestation	Forest Management	Cropland Management	Grazing Land Management	Revegetation		
		(kha)							
Article 3.3 activities	Afforestation and Reforestation	218,72	0,00						**218,72**
	Deforestation		35,23						**35,23**
Article 3.4 activities	Forest Management		1,15	3 129,54					**3 130,69**
	Cropland Management	NA	NA		NA	NA	NA		**0,00**
	Grazing Land	NA	NA		NA	NA	NA		**0,00**

190 Lazdiņš, "Harmonization of land use matrix in Latvia according to requirements of international greenhouse gas reporting system - extending outputs of National Forest inventory program."

	Management								
	Revegetation	NA			NA	NA	NA		**0,00**
Other (5)		0,00	0,00	NA	NA	NA	NA	3 072,67	**3 072,67**
Total area at the end of the current inventory year		**218,72**	**36,38**	**3 129,54**	**0,00**	**0,00**	**0,00**	**3 072,67**	**6 457,30**
2011		**Article 3.3 activities**		**Article 3.4 activities**				**Other (5)**	**Total area at the beginning of the current inventory year**
		Afforestation and Reforestation	**Deforestation**	**Forest Management**	**Cropland Management**	**Grazing Land Management**	**Revegetation**		
		(kha)							
Article 3.3 activities	**Afforestation and Reforestation**	218,72	0,00						**218,72**
	Deforestation		36,38						**36,38**
Article 3.4 activities	**Forest Management**		1,09	3 128,45					**3 129,54**
	Cropland Management	NA	NA		NA	NA	NA		**0,00**
	Grazing Land Management	NA	NA		NA	NA	NA		**0,00**
	Revegetation	NA			NA	NA	NA		**0,00**
Other (5)		0,00	0,00	NA	NA	NA	NA	3 072,67	**3 072,67**
Total area at the end of the current inventory year		**218,72**	**37,47**	**3 128,45**	**0,00**	**0,00**	**0,00**	**3 072,67**	**6 457,30**
2012		**Article 3.3 activities**		**Article 3.4 activities**				**Other (5)**	**Total area at the beginning of the current inventory year**
		Afforestation and Reforestation	**Deforestation**	**Forest Management**	**Cropland Management**	**Grazing Land Management**	**Revegetation**		
		(kha)							
Article 3.3 activities	**Afforestation and Reforestation**	218,72	0,00						**218,72**
	Deforestation		37,47						**37,47**
Article 3.4 activities	**Forest Management**		0,99	3 127,46					**3 128,45**
	Cropland Management	NA	NA		NA	NA	NA		**0,00**
	Grazing Land Management	NA	NA		NA	NA	NA		**0,00**
	Revegetation	NA			NA	NA	NA		**0,00**
Other (5)		0,00	0,00	NA	NA	NA	NA	3 072,67	**3 072,67**
Total area at the end of the current inventory year		**218,72**	**38,46**	**3 127,46**	**0,00**	**0,00**	**0,00**	**3 072,67**	**6 457,30**

11.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

Latvia implements the Reporting Method 1 for lands subject to Article 3.3 and Article 3.4 activities. The area of Latvia is reported as a single region. The main data source for area estimates and tree biomass estimates was the National Forest Inventory (NFI) database (23583 sectors in 16383 sample plots were used for calculations, Figure 11.1). The sample design determines the theoretical location of sample plots and in the field sample plots were located by a GPS device and the actual location data were logged. LANDSAT images series from 1990, 1995 and 2000 were geographically referenced to fit to the actual location of sample plots before satellite image analysis. Since the geographical location of NFI sample plots were known, the results could be computed for geographically referenced areas. Geographical locations are identified by the coordinates of centres of the NFI sample plots.

Soil properties (carbon stock in litter and soil) in forest lands were determined in permanent 16 x 16 km grid of 95 sample plots (Figure 11.2). Results of comparison of carbon stock in soil at different depths including litter in mineral soils are shown in Figure 11.3. These results demonstrates, that mineral soils in forest lands are not source of emissions, but can be net sink. However, number of plots is insufficient to finalize conclusions about carbon stock change in forest lands. Latvia proposed willingness to participate in the project on implementation of Yasso model in forests organized by JRC and other European research institutions.

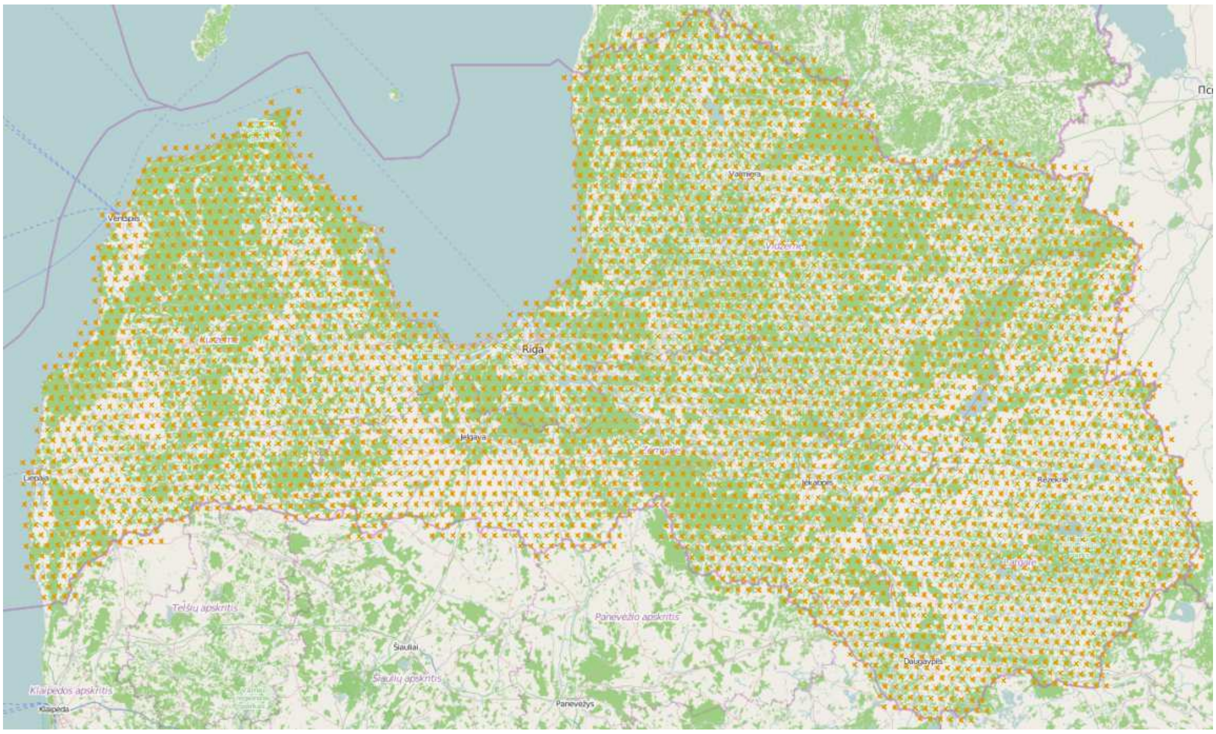

Figure 11.1 Permanent grid of the forest inventory plots

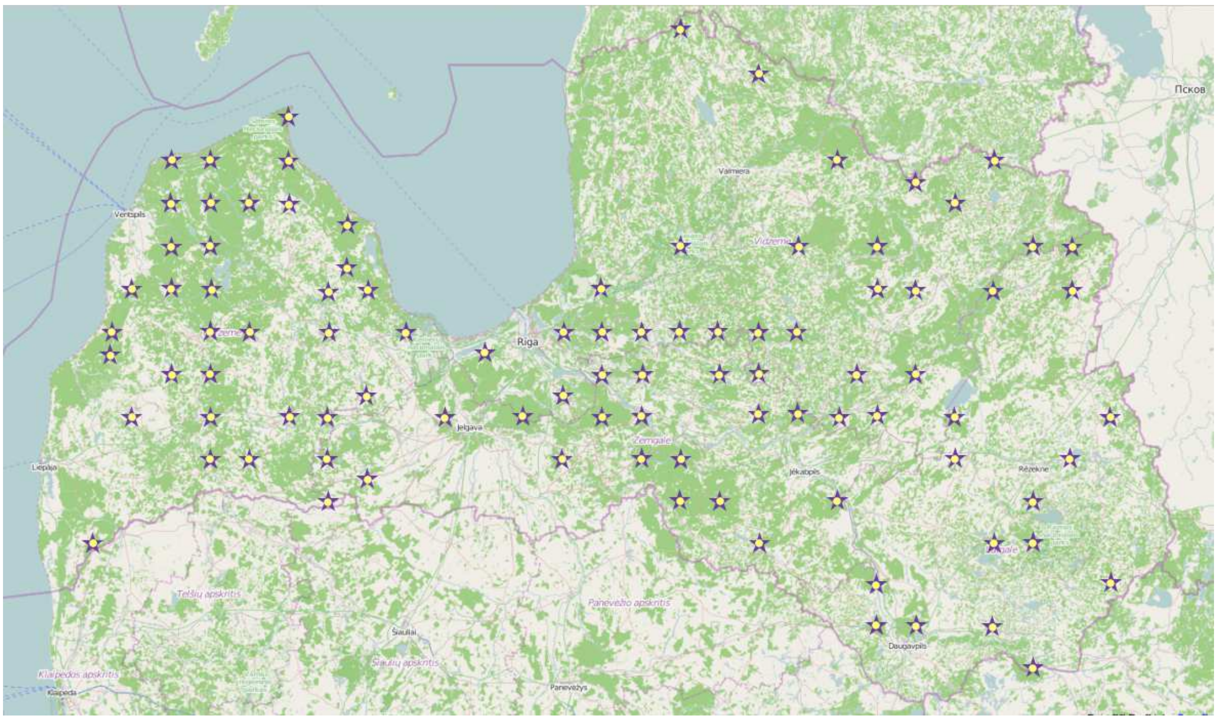

Figure 11.2 Permanent grid of the Level 1 forest monitoring plots

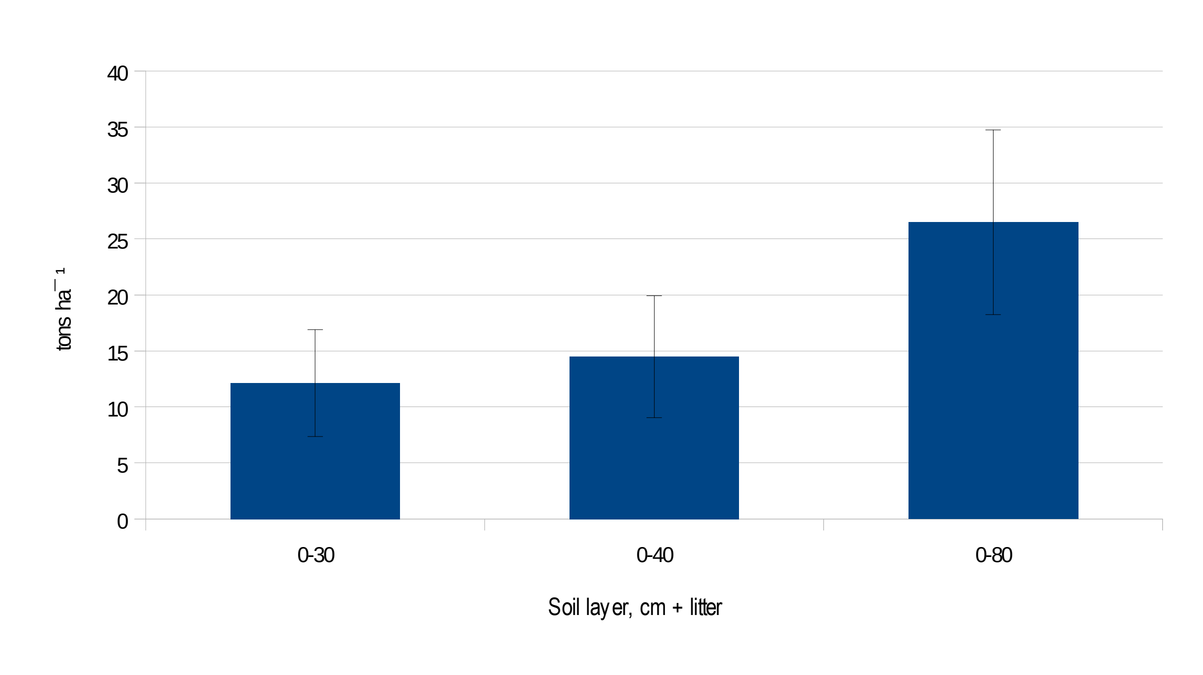

Figure 11.3 Carbon stock changes (between 2006 and 2012) in forest soils in Level I forest monitoring plots at different depths[191]

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

Methods for estimating carbon stock changes in forests (for Article 3.3 afforestation/reforestation and Article 3.4 forest management) are the same as those used for the UNFCCC greenhouse gas inventory (chapter 7.2.4. Methodological issues and 7.2.7. Category-specific recalculations). Estimations of carbon stock changes in living biomass on lands remaining forests is based on measurements of radial increment of growing trees and calculation of actual potential increment of timber volume of all living trees including mortality and commercial felling, respectively, if applied to the future projections, mortality should be excluded as losses in living biomass, but if calculated to previous period, mortality should be added to the calculation. Since research data are available, historical figures on mortality are recalculated and provided in the inventory considering 20 years decay period for dead biomass, respectively; calculations are done for the period 1970-2012. Removals of CO_2 in living biomass on afforested areas are calculated on the base of weighted average of timber stock changes in 1-25 years old forest stands on non-forest lands (Figure 11.4). Average standard error of mean of the estimation at different ages is 35 %.

[191] Lazdiņš, A., Liepiņš, K., Lazdiņa, D., Jansons, Ā., Bārdule, A., 2012. Mežsaimniecisko darbību ietekmes uz siltumnīcefekta gāzu emisijām un CO_2 piesaisti novērtējums (pārskats par 2012. gada darba uzdevumu izpildi) (No. 5.5-5.1/001Y/110/08/8). LVMI Silava & Meža nozares kompetences centrs, Salaspils.

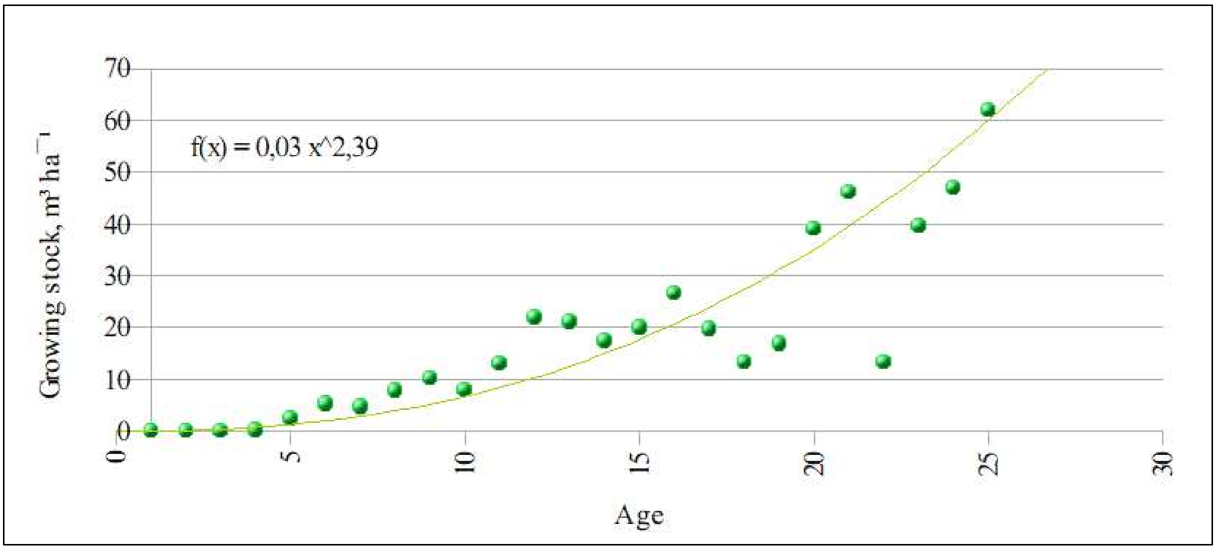

Figure 11.4 Average growing stock figures for afforested areas of different ages

Different approach was applied for the drain. The loss of tree biomass due to commercial harvesting was estimated according to the State Forest Service (summary of reports on harvesting permissions), but the second NFI cycle demonstrated that actual losses in living biomass are considerably larger. This is not due to illegal felling, because permissions for timber extraction is given for area and the area of final felling is the same in NFI and SFS reports, but due to considerably higher growing stock and, respectively, extracted volumes. The accounting methodology is not changed significantly in the SFS, therefore it is assumed that difference in felled volumes can be linearly applied to the whole period from 1970. Additional timber, which does not appear in statistics of production of sawn products, is generally used as firewood in households and other small scale applications. The findings of NFI on additional harvested volumes fully comply with energy sector statistics considered overestimated in utilization of solid biofuel. These results also explains, why in spite of theoretical shortage of firewood (according to timber extraction statistics), price of firewood as well as import is not increasing. The NFI estimations on harvesting stock will be updated after completion of the 2nd cycle.

No harvesting takes place in lands converted to forests; therefore no artificial emissions in living biomass are reported in this category. However if by some reasons (for instance, thinning) harvesting took place on afforested area it is also reported in national statistics and is included in Forest management related carbon stock changes. Therefore there is no risk of underestimation of emissions from living biomass.

Losses in living biomass due to deforestation initially were reported under forest management as instant oxidation of all harvested biomass, because it is not possible to separate historical figures of harvesting associated with forest management and deforestation in national statistics. Expert judgement was applied to separate emissions from living biomass due to commercial harvesting with following deforestation. Average growing stock figures were used to extrapolate average losses in living biomass due to deforestation. The method as well as the values used in calculations is explained in details in previous sections (chapter 7.2.4). Uncertainty level of the estimate according to the expert judgement is 90 %. All biomass, including stem, branches and below-ground biomass is considered instantly oxidized.

Carbon stock changes in dead wood, litter and soils are reported under deforestation assuming that average carbon stock on forest lands remaining forest in dead biomass pools is instantly oxidise during conversion, but carbon soil in mineral soils stabilizes in 20 years. For conversion to settlements is assumed that all carbon in 0-30 cm deep soil layer turns into emissions in 20 years. The methods are described previous sections under Croplands and Settlements categories. Removals in these pools due to afforestation and forest management are not accounted to avoid potential overestimations.

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

According to the National forest inventory afforestation take place only on grassland. The soil monitoring studies initiated in 2012 by the Joint stock company "Latvia state forests" and Ministry of Agriculture demonstrates that carbon stock in mineral soils in grassland and forest land in typical stands in afforested lands on mineral soils is nearly equal, i.e. no changes appears in SOM due to afforestation. The results are based on 95 plots in forest, 34 plots in afforested lands and 40 plots in grassland; for each plot 4 repetitions have been taken. The study is continuing to obtain more accurate information about SOM in cropland and grassland and will be published in 2014.

It is assumed in calculation of carbon stock changes in afforested lands, that dead wood and litter will reach values characteristic for the forest lands (average figures of the 1st cycle of the NFI and 2nd round of forest soil monitoring, representing the same time period) in 150 years, which is twice average rotation of the most common tree species in afforested lands (birch and spruce).

Data from the BioSoil net (95 plots) have been elaborated for the years 2006 and 2012 putting together the mineral soil and litter pools and then analysing the trend in changes of the total carbon stock and its significance. The result shows that there is no statistically significant difference in total carbon stock between 2006 and 2012.

The litter and soil pools have been analysed altogether since the separation of humic layers in the year 2006 and in the year 2012 has not been done following the same methodology, so that data on litter and data on soil cannot be compared among those 2 years.

However, to the accumulation of litter the increase of humic layers always associates, vice versa, a decrease, or a removal of litter causes a decrease of humic layers and therefore of soil carbon stocks in the soil carbon pool, as defined in the 2003 IPCC GPG for LULUCF. Consequently, whether the litter stock increases also the soil stock increases and vice versa, to a decrease in litter stock a decrease in soil stocks (humic layers) follows.

Therefore, the analysis conducted on the sum of both pools giving information on the total trends gives also the needed information on the trend of both pools i.e. whether the sum of litter and soil is not a source then both, the litter and the soil are not a source.

Emissions from biomass burning are estimated according to methodology described in section 7.8 Biomass Burning (CRF 5 (V)).

11.3.1.3 Information on whether or not indirect and natural GHG emissions and removals have been factored out

In general, it is recognized that: (i) for Article 3, paragraph 4 activities, the issue of "factoring out" was solved during negotiations with the cap for Forest Management and with the net-net accounting for the other Article 3, paragraph 4 activities; (ii) for Article 3, paragraph 3 activities, the dynamic effect of age is not relevant since all these activities have occurred after 1990; (iii) for the elevated CO_2 concentration and the indirect nitrogen deposition, there are no methodologies adopted by the UNFCCC.

N_2O emissions associated with conversion to croplands are reported using equations 3.3.13, 3.3.14 and 3.3.15 of the IPCC GPG LULUCF 2003. Carbon stock changes for calculation of the emission's factor taken from losses of soil organic carbon stock due to conversion for mineral soils and constant emissions factor (3.7 tons C ha^{-1}) for organic soils.

11.3.1.4 Changes in data and methods since the previous submission (recalculations)

Minor changes in estimation of afforested area are introduced by using of the EPIM model. The result might differ by number of decimal signs or minor numeric differences due to slight changes in activity data, because of harmonization of the country area in the whole inventory.

Gains and losses in living biomass are recalculated according to updated BEFs, biomass density and carbon concentration values. Major changes are applied to dead biomass, considering that carbon stock in litter and dead wood will reach values characteristic for forests within 150 years (2 rotations).

Carbon losses in organic soils are considered according to average carbon losses in forests on drained organic soils and updated activity data.

Minor changes in deforested area to harmonization of the country area and application of the EPIM model and harmonization of the country area data and application of new GHG accounting model affecting activity data.

Losses in dead biomass due to deforestation are calculated using instant oxidation method according to average growing stock of dead biomass in forest lands in a particular year. Losses in mineral soil are accounted considering that carbon stock in mineral soils in converted lands will reach values characteristic for cropland within 20 years and average carbon stock in forest soil considering complete loss of upper 30 cm layer carbon stock in lands converted to settlements. Country specific input data are applied in forest lands and cropland. More detailed description of the recalculations is provided in Cropland's and Settlements' sections.

Minor changes in calculation of GHG emissions due to application of liming materials in deforested areas due to harmonization of the country area, which lead to change of proportion of liming material applied to deforest areas.

Detailed description of recalculations in forest management category is provided in Forest land's section. Recalculation of area of managed forests and area of forests on organic soil is done due to implementation of the EPIM model and due to harmonization of the country area data for the whole period.

Losses in living biomass now include natural mortality and updated figures on harvesting stock. Both, mortality and harvesting stock are updated according to results of the National forest inventory (NFI) second cycle. Linear increase of mortality and harvesting stock is applied to the whole period.

The species specific mortality factors are updated according to results of the second cycle of the NFI. Decomposition period is considered 20 years for above and below ground biomass.

The values of N_2O emissions from drained soils are slightly updated due to changes in activity data (area of drained mineral and organic soils) caused by harmonization of the country area.

11.3.1.5 Uncertainty estimates

Uncertainties are estimated on the base of the NFI data, the default values provided by the IPCC GPG LULUCF 2003 and expert judgement, where other data are not available. 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 2003. Total level of uncertainty of emissions from soil is 90 %.

Uncertainty level of forest area is 0.3 %, uncertainty of afforested area is 1.7 %, and uncertainty of annual increment of forest lands is 0.9 %, uncertainty of increment on afforested lands 16 %. Uncertainty of deforested area is 36 %. Uncertainty of area of drained organic soils in forest lands remaining forests is 0.8 %, uncertainty of area of drained organic soils in afforested lands 3.4 %. Uncertainties calculated as standard error of mean. A standard error of mean of harvesting stock according to forest regulations is 10 %. BEFs utilized in calculations according to study results has uncertainty 0,8 %.

11.3.1.6 Information on other methodological issues

Latvia has decided to account for the emissions and removals under Article 3 paragraphs 3 and 4 in the end of the commitment period. Latvia is still developing methods for estimation of emissions and removals of greenhouse gases and their uncertainties. For that reason, the estimates presented in this submission for 2008-2012 might change for the final report of the commitment period.

The argument for applying NFI data is that it is the only continuous inventory and monitoring system in Latvia which covers all land uses and gives reliable estimates for land use and tree growth. It is also a system which can be used in combination with the Level I forest monitoring system to monitor carbon stock changes in soil, dead wood and litter.

11.3.1.7 The year of the onset of an activity, if after 2008

This information is implicitly achieved as the area estimates are provided in the NIR-2 CRF table of KP and discussed in the Ch. 11 text (Ch. 11.1.2 Areas and changes in areas between KP-LULUCF activities KP CRF NIR-2). Associated GHG emissions and removals have been reported in the back-ground tables of each activity since when the area has been reported in table NIR-2.

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

Changes in forest area were detected on the basis of the NFI data. The following afforestation/reforestation activities that occurred or could have occurred on or after 1990 are included in the reporting of these activities:

- planted or seeded grasslands;
- other management practices leading to afforestation of grasland, like stopping cultivation, ploughing or burning of vegetation.

In Latvia all land use categories (cropland, grassland, forest, settlements and partially wetlands) are considered managed; therefore any land use change occurs between managed lands and, consequently, is direct human-induced. The only exclusion are other lands with no considerable carbon stock, like sand dunes.

Afforested/reforested areas are to be considered legally bound by national legislation. Usually these activities have resulted from a decision to change the land use by planting or seeding or managing of afforested lands.

On the basis of the definitions provided in the Decision 19/CMP.136, afforestation and reforestation occurred on agricultural lands have to be included in the Article 3.3: a common forest management approach in Latvia is exploitation of natural re-growth by seeds of adjacent trees in forest regeneration and afforestation. In addition these transitions are essentially due to political decisions under the EEC Regulations 2080/92 and 1257/99 (art.10.1 and 31.1).

Concerning deforestation activities, as mentioned above, in Latvia land use changes from forest to other land use categories are allowed in very limited circumstances; however, due to large share of forest lands the most of economic activities associated with building of new infrastructure takes place on forest lands. The most common type of land use change in this reporting is construction of forest roads which is not considered as land use change according to national legislation but from the point of view of emissions it is land use change. Conversion to agriculture occurs to less extend and generally is associated with removal of woody vegetation from abandoned farmlands and it was more common in 90^{ths}.

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 if no other activities prohibiting forest regeneration are implemented. The NFI teams are trained to distinguish between forest management and land use changes. The legal requirements for the forest regeneration are to reach certain dimensions and density of trees within 5-10 years, depending from forest site type. Normally these requirements will not be reached only in case of flooding or human induced prohibiting of forest regeneration, like building of asphalted road. In such cases fact deforestation can be easily identified. In all other cases (mostly deforestation of afforested lands and management of short rotation woody crops) it is decided to use the same approach as for conversion from cropland to grassland and backward – if land use change is approved within 2 NFI cycles, the land use change is fixed. Identification of transition in such cases takes 10 years, which comply with the forest regeneration period for several stand types.

Afforested areas fulfil 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 (as described above within 2 NFI cycles), takes 10 years);
- 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, takes 5 years).

Deforestation includes artificial measures prohibiting regeneration of unstocked forest lands. In any natural conditions forests can regenerate, except, for instance, flooding or formation of dunes; therefore, the deforestation follows to temporary unstocking of forest lands which is accounted under forest management.

Deforestation and relevant land use changes (construction of forest roads) is regulated by national laws. In the National forest inventory new method to define actually deforested areas will be introduced since 3rd inventory period will be started in 2014. Similarly, like in case of conversion of grassland to cropland and vice versa, the temporarily unstocked area will be considered as deforested in will not fulfil criteria of forest lands during two NFI cycles. Respectively, identification of deforested areas will take 10years. However, in the most cases like road construction, the deforestation will be marked in the same NFI cycle, when the conversion takes place, as measure prohibiting forest regeneration. The new approach is important for land use conversion from forest land to grassland or cropland, where occasional ploughing or grass-cutting might increase considerably deforested and reforested areas, in spite no real land use changes takes place.

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

Restocking is assumed for forest areas that have lost forest cover through harvesting or forest disturbance, unless there is deforestation as described above. Information on the size and location of forest areas that have permanently lost forest cover (due to a tillage or construction) is collected on 5 years period basis by the NFI. These data can be validated by national statistics; however, no historical records since 1990 are available for statistics and only recent data can be used for the validation.

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

All territory of Latvia is considered managed and only land without relevant carbon stocks to be reported under other land, as well as natural bogs and inland water bodies are considered unmanaged and emissions from these areas are not reported.

Forests in 1 January 1990 were under forest management as subjects of Forest law, since Latvia considers all forest land managed and, therefore, all activities in forest land remaining forest – human-induced.

11.5.2 Information relating to Cropland Management, Grazing Land Management and Revegetation

Not applicable.

11.5.3 Information relating to Forest Management

According to the Forest law[192] forest management in Latvia is sustainable utilization and management of forests and forest 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 are considered as managed forests.

Forest management activity is practised on the forest area as defined above. The area of forest and the area under forest management (forest land remaining forest) in the end of 1989 larger in compare to 2011 because of deforestation.

The Forest law lays down provisions on management and utilisation of forest. Afforested lands are also considered as subjects of forest law apart from reason of afforestation. Therefore all afforested lands are also considered managed. The purpose of the Act is to promote economically, ecologically and socially sustainable, management and utilisation of the forests in such a way that forests provide a sustainable satisfactory yield while biological diversity is being maintained.

11.6 OTHER INFORMATION

11.6.1 Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Key category analysis for KP-LULUCF was performed according to section 5.4 of the IPCC GPG LULUCF 2003. Only total CO_2 emissions and removals from forest management (Art. 3.4) has been assessed as key category, in accordance with the IPCC good practice guidance for LULUCF section 5.4.4. The value has been compared with Table 1.6 Key categories for the latest reported year based on level of emissions (including LULUCF).

Article 3.3 Afforestation and reforestation (CO_2): The associated UNFCCC subcategory CO_2 emissions and removals from land converting to forest land have been identified as key category. Total CO_2 emissions and removals from afforestation and reforestation (Art. 3.3) are larger than the smallest UNFCCC key category. Therefore AR is stated to be a key category. CO_2 emissions from deforestation also are a key category.

Article 3.3 Deforestation (CO_2): The associated UNFCCC subcategory CO_2 emissions from deforestation have been identified as key category. Total CO_2 emissions and removals from deforestation (Art. 3.3) are larger than the smallest UNFCCC key category. Therefore D is stated to be a key category.

Article 3.3 Deforestation (N_2O): emissions from conversion of forest land to cropland are considerable source of N_2O emissions due to disturbances.

Article 3.4 Forest management (CO_2): The associated UNFCCC subcategory Forest land remaining Forest land is a key category in level and in trend assessment (Tier 1). The contribution of forest management is also greater than other UNFCCC key categories.

Article 3.4 Forest management (N_2O): emissions from drainage of mineral and organic soils are considerable source of N_2O emissions. The emissions are estimated Tier 1 method. Only N_2O (no CO_2) emissions are reported for mineral drained soils, because the soil monitoring data (comparison of carbon stock in soil in 2006 and 2012) do not shows any reduction of carbon stock in drained mineral soils.

[192] Latvijas Republikas Saeima, "Meža likums, 2000."

12. INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 BACKGROUND INFORMATION

The standard electronic format tables are included in the submission for the fifth time (see "SEF_LV_2014_1_10-19-46 13-1-2014.xls" attached to the submission). The SEF tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Latvia's registry on 31.12.2013 as well as information on transfers of the units in 2013 to and from other Parties of the Kyoto Protocol.

12.2 SUMMARY OF INFORMATION REPORTED IN THE SEF TABLES

At the beginning of the 2013 there were 85 886 119 AAUs in the Latvia's national holding account and 42907 ERUs, 264 246 CERs were held in entity holding accounts. At the beginning of 2013 10 499 146 EUAs and 848 191 CERs and 49 013 ERUs were stored in Retirement account.

At the end of 2013 66 330 176 AAUs, 418 607 ERUs, 322 904 CERs were left in National holding account and 16 107 CERs and 5 324 ERUs were held in the entity holding accounts.

10 499 146 EUAs_AAUs, 49 013 ERUs and 848 191 CERs were surrendered by Latvia's operators and retired to Latvia's national retirement account during compliance period at the beginning of 2013 and therefore these allowances are also stored in 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 78 489 468 Kyoto protocol units were stored in the ETR accounts at the end of 2013.

Latvia's assigned amount is 119 182 130 tonnes CO_2 eq.

12.3 DISCREPANCIES AND NOTIFICATIONS

12.3.1 List of discrepant transactions

No discrepant transactions rejected and / or terminated with the response codes that are considered to be a discrepancy for the purpose of the reporting occurred in 2013 in Latvia's ETR.

No transactions in Latvia's ETR were cancelled or terminated.

12.3.2 List of CDM notifications

CDM notifications – reversal of storage notifications, non-certification notifications were received in the reporting period 2013.

The report "R3: List of CDM notifications" is reported empty.

12.3.3 List of non-replacements

No non-replacement occurred during reporting period 2013.

It was considered not to report "R4: List of non-replacements" report as the non-replacement list is empty.

12.3.4 List of invalid units

There weren't any invalid units in Latvia's ETR in the reporting period from 1st January 2014 to 31st December 2013.

The report "R5: List of invalid units" is reported empty.

12.3.5 Actions and changes to address discrepancies

There weren't any discrepant transactions that were not terminated and / or cancelled in Latvia's ETR during reporting period 2013.

As cancelled and terminated transactions in 2013 were not considered discrepant according to DES no specific actions to correct any problems were necessary.

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 – http://www.meteo.lv/en/lapas/submission-under-un-framework-of-climate-change-convention-conference-?id=1476&nid=646 as well as in the webpage http://ec.europa.eu/environment/ets/account.do?languageCode=lv.

12.5 CALCULATION OF THE COMMITMENT PERIOD RESERVE (CPR)

Latvia's commitment period reserve for Latvia is estimated as 100 % the most recent inventory multiplied with 5 years:

$$CPR = 5 * 10978.4772519157\ CO_2\ eq. = 54892.3862595785\ Gg\ CO2\ eq.$$

$$or\ 54892386\ tonnes\ CO2\ eq.$$

Latvia's assigned amount is 119 182 130 tonnes of CO_2 eq. and the commitment period reserve calculated as 90% of the assigned amount amounts to 107263917 tonnes of CO_2 eq.

The figure of commitment period reserve as 100 % of the most recent inventory is smaller as commitment period reserve based on assigned amount.

12.6 KP-LULUCF ACCOUNTING

Latvia has chosen 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. Latvia's cap value is 6233.33 Gg CO_2 equivalents for the whole commitment period.

13. INFORMATION ON CHANGES IN NATIONAL SYSTEM

According to the Cabinet of Ministers Regulation No. 217 "Regulations regarding the National Inventory System of Greenhouse Gas Emission Units" Latvia University of Agriculture is responsible for GHG emissions from agriculture sector inventory at national level. To better organize this work, GHG Research Working Group is established in 2014 and approved with Latvia University of Agriculture Rector's order. Monthly group meetings take place at the university with representatives from the Ministry of Agriculture and the Ministry of Environmental Protection and Regional Development.

For submission 2014 quality manager from LEGMC Air and Climate division perform the overall QC/QA procedures for all sectors according to the QA/QC plan.

14. INFORMATION ON CHANGES IN NATIONAL REGISTRY

The following changes to the national registry of Latvia have therefore occurred in 2013.

Table 14.1 Functions of the national registry and its conformity with DES

15/CMP.1 annex II.E paragraph 32.(a)	Registry Administrators	1) Aiva Puļķe Secondary Latvian Emission Trading Registry administrator Latvian Environment, Geology and Meteorology Centre Address: Maskavas street 165, Riga, LV-1019 Tel.: +371 67032015 e-mail: Aiva.Pulke@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 3) EU-ETS Registry Service Desk Tel.:+3210487534 e-mail: ETS-ServiceDesk@iriscorporate.com
15/CMP.1 annex II.E paragraph 32.(b)	Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c)	Change to database structure or the capacity of national registry	An updated diagram of the database structure is attached as Annex A. Iteration 5 of the national registry released in January 2013 and Iteration 6 of the national registry released in June 2013 introduces changes in the structure of the database. Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. No change was required to the database and application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d)	Change regarding conformance to technical standards	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. However, each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production (see Annex B). Annex H testing was carried out in February 2014 and the successful test report has been attached. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e)	Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E	Change regarding security	No change of security measures occurred during the reporting period.

paragraph 32.(f)		
15/CMP.1 annex II.E paragraph 32.(g)	Change to list of publicly available information	http://www.meteo.lv/en/lapas/submission-under-un-framework-of-climate-change-convention-conference-?id=1476&nid=646
15/CMP.1 annex II.E paragraph 32.(h)	Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i)	Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(j)	Change regarding test results	Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission; the report is attached as Annex B. Annex H testing was carried out in February 2014 and the successful test report has been attached.

15. INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

Latvia is Annex 1 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 below.

In 2012 Latvia launched a comprehensive energy policy reform – elaborated project "Energy long-term strategy 2030 - competitive economy for community", approved amendments of laws and regulations, continuing market opening of electric energy and determining that November 1, 2012, regulated tariffs are applied only to households. As well as offered a vision for sustainable production of the electric energy from renewable energy sources (RES), for production of electric energy in the cogeneration and for field of biofuel further development. Within the framework of the reform, has been launched electric energy net settlement system in Latvia.

In 2012 Latvia implemented project "Support to the Moldova's North Regional Development Agency and Regional Development Council with the Updating of Regional Development Strategy". Within the framework of the project, updated Moldova's Northern Region Development Strategy 2010-2016; organized a five-day training four Moldova's Construction and Regional Development and the Ministry of Northern RAA employees; experts of Ministry of Environmental Protection and Regional Development (hereafter – MEPRD) provided methodological support for Moldova's northern region development program improvement, including energy efficiency, monitoring and business matters; cooperating with experts of MEPRD, including consulting with Latvia's region and local experience, learning from experts of MEPRD, employees of Moldova's North Regional Development Agency significantly increased their planning capacity. Total cost of the project was EUR 9960.

15.1 REFERENCES

- http://www.em.gov.lv/images/modules/items/EM%20PP%20par%202012_publicets.pdf.
- http://www.varam.gov.lv/lat/aktual/preses_relizes/?doc=16605.
- http://www.am.gov.lv/data/file/atbalsts_moldovas_ziemelu_regionalas_attistibas_agenturai.pdf.

ANNEXES TO THE NATIONAL INVENTORY REPORT

ANNEX 1: KEY CATEGORIES

A.1.1 Level assessment year 2012 without LULUCF

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment for 2012	% Cumulative Total of Level Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
5.A.1 Forest Land remaining Forest Land	CO_2	-22 314.62	-12 900.53	12 900.53	44.81%	44.81%	1.73%	20.00%	20.07%	195.89%	-286.61%	-203.28%	-0.57	-0.05	0.58
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.31	1 703.02	1 703.02	5.92%	50.72%	2.00%	5.00%	5.39%	-6.94%	35.37%	26.84%	0.02	0.01	0.02
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.14	1 662.41	1 662.41	5.77%	56.50%	2.00%	2.00%	2.83%	-3.56%	28.19%	26.20%	0.01	0.01	0.01
5.B.1 Cropland remaining Cropland	CO_2	1 311.57	1 198.11	1 198.11	4.16%	60.66%	0.78%	28.00%	28.01%	-25.38%	23.14%	18.88%	0.06	0.00	0.06
5.G Other	CO_2	36.96	-1 028.74	1 028.74	3.57%	64.23%	0.06%	30.00%	30.00%	23.34%	-16.09%	-16.21%	-0.05	0.00	0.05
5.E.2 Land converted to Settlements	CO_2	189.93	1 007.45	1 007.45	3.50%	67.73%	0.37%	32.00%	32.00%	-24.39%	16.49%	15.87%	0.05	0.00	0.05
4.D.1. Direct Soil Emissions	N_2O	1 618.70	1 011.18	1 011.18	3.51%	71.24%	40.00%	25.00%	47.17%	-36.08%	21.19%	15.93%	0.05	0.09	0.10
1.A.3.b Road Transportation - Gasoline	CO_2	1 689.33	690.23	690.23	2.40%	73.64%	2.00%	2.00%	2.83%	-1.48%	16.38%	10.88%	0.00	0.00	0.00
4.A. Enteric Fermentation	CH_4	2 148.74	687.58	687.58	2.39%	76.03%	2.00%	20.00%	20.10%	-10.45%	17.83%	10.83%	0.04	0.00	0.04
5.C.2 Land converted to Grassland	CO_2	-0.003	-662.927	662.927	2.303%	78.33%	50.00%	21.00%	54.23%	27.19%	-10.45%	-10.45%	-2.19%	-7.39%	7.71%
2.A.1 Cement Production	CO_2	366.12	576.63	576.63	2.00%	80.33%	10.00%	5.00%	11.18%	-4.88%	10.28%	9.09%	0.01	0.01	0.01
4.D.3.Indirect Emissions	N_2O	1 033.94	414.50	414.50	1.44%	81.77%	30.00%	40.00%	50.00%	-15.68%	9.91%	6.53%	0.04	0.03	0.05
5.A.2 Land converted to Forest Land	CO_2	-3.08	-353.77	353.77	1.23%	83.00%	3.40%	20.00%	20.29%	5.43%	-5.58%	-5.57%	-0.01	0.00	0.01
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	694.47	314.12	314.12	1.09%	84.09%	2.00%	10.00%	10.20%	-2.42%	7.22%	4.95%	0.01	0.00	0.01
6.A.2. Unmanaged Waste Disposal Sites	CH4	329.98	304.72	304.72	1.06%	85.15%	20.00%	52.00%	55.71%	-12.84%	5.88%	4.80%	0.03	0.01	0.03

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment for 2012	% Cumulative Total of Level Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	337.48	270.20	270.20	0.94%	86.09%	2.00%	5.00%	5.39%	-1.10%	5.36%	4.26%	0.00	0.00	0.00
1.A.3.c Railways - Liquid Fuels	CO_2	531.38	248.42	248.42	0.86%	86.95%	2.00%	5.00%	5.39%	-1.01%	5.65%	3.91%	0.00	0.00	0.00
1.A.4.b Residential - Gaseous Fuels	CO_2	219.61	246.99	246.99	0.86%	87.81%	50.00%	5.00%	50.25%	-9.39%	4.61%	3.89%	0.00	0.03	0.03
1.A.2.f Other - Gaseous Fuels	CO_2	835.24	221.74	221.74	0.77%	88.58%	2.00%	5.00%	5.39%	-0.90%	6.23%	3.49%	0.00	0.00	0.00
1.A.2.f Other - Solid Fuels	CO_2	38.69	180.47	180.47	0.63%	89.21%	2.00%	10.00%	10.20%	-1.39%	2.97%	2.84%	0.00	0.00	0.00
1.A.4.b Residential - Biomass	CH_4	126.06	175.17	175.17	0.61%	89.82%	50.00%	50.00%	70.71%	-9.37%	3.17%	2.76%	0.02	0.02	0.03
1.A.4.b Residential - Liquid Fuels	CO_2	329.91	154.25	154.25	0.54%	90.35%	50.00%	10.00%	50.99%	-5.95%	3.51%	2.43%	0.00	0.02	0.02

A.1.2 Level assessment year 2012 with LULUCF

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment for 2011	% Cumulative Total of Level Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
5.A.1 Forest Land remaining Forest Land	CO_2	-22 314.62	-12 900.53	12 900.53	44.71%	44.71%	10.08%	30.00%	31.65%	323.73%	-279.44%	-201.23%	-0.84	-0.29	0.89
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.31	1 703.02	1 703.02	5.90%	50.62%	2.00%	5.00%	5.39%	-7.27%	34.54%	26.57%	0.02	0.01	0.02
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.14	1 662.41	1 662.41	5.76%	56.38%	2.00%	2.00%	2.83%	-3.73%	27.80%	25.93%	0.01	0.01	0.01
5.B.1 Cropland remaining Cropland	CO_2	1 311.57	1 198.11	1 198.11	4.15%	60.53%	11.00%	90.00%	90.67%	-86.14%	22.67%	18.69%	0.20	0.03	0.21
5.G Other	CO_2	36.96	-1 028.74	1 028.74	3.57%	64.10%	10.00%	30.00%	31.62%	25.80%	-15.93%	-16.05%	-0.05	-0.02	0.05
5.E.2 Land converted to Settlements	CO_2	189.93	1 007.45	1 007.45	3.49%	67.59%	19.00%	14.60%	23.96%	-19.14%	16.29%	15.72%	0.02	0.04	0.05

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment for 2011	% Cumulative Total of Level Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
4.D.1. Direct Soil Emissions	N_2O	1 618.36	1 004.27	1 004.27	3.48%	71.07%	40.00%	25.00%	47.17%	-37.56%	20.58%	15.67%	0.05	0.09	0.10
1.A.3.b Road Transportation - Gasoline	CO_2	1 689.33	690.23	690.23	2.39%	73.46%	2.00%	2.00%	2.83%	-1.55%	15.91%	10.77%	0.00	0.00	0.00
4.A. Enteric Fermentation	CH_4	2 148.74	687.58	687.58	2.38%	75.84%	2.00%	20.00%	20.10%	-10.96%	17.26%	10.73%	0.03	0.00	0.03
5.C.2 Land converted to Grassland	CO_2	-0.003	-662.927	662.927	2.298%	78.14%					-10.34%	-10.34%			
2.A.1 Cement Production	CO_2	366.12	576.63	576.63	2.00%	80.14%	10.00%	5.00%	11.18%	-5.11%	10.11%	8.99%	0.01	0.01	0.01
4.D.3.Indirect Emissions	N_2O	1 033.94	414.50	414.50	1.44%	81.58%	30.00%	40.00%	50.00%	-16.43%	9.62%	6.47%	0.04	0.03	0.05
5.A.2 Land converted to Forest Land	CO_2	-3.08	-353.77	353.77	1.23%	82.80%	16.45%	30.00%	34.21%	9.60%	-5.53%	-5.52%	-0.02	-0.01	0.02
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	694.47	314.12	314.12	1.09%	83.89%	2.00%	10.00%	10.20%	-2.54%	7.02%	4.90%	0.01	0.00	0.01
6.A.2. Unmanaged Waste Disposal Sites	CH4	329.98	304.72	304.72	1.06%	84.95%	20.00%	52.00%	55.71%	-13.46%	5.76%	4.75%	0.03	0.01	0.03
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	337.48	270.20	270.20	0.94%	85.89%	2.00%	5.00%	5.39%	-1.15%	5.25%	4.21%	0.00	0.00	0.00
1.A.3.c Railways - Liquid Fuels	CO_2	531.38	248.42	248.42	0.86%	86.75%	2.00%	5.00%	5.39%	-1.06%	5.50%	3.88%	0.00	0.00	0.00
1.A.4.b Residential - Gaseous Fuels	CO_2	219.61	246.99	246.99	0.86%	87.60%	50.00%	5.00%	50.25%	-9.84%	4.53%	3.85%	0.00	0.03	0.03
1.A.2.f Other - Gaseous Fuels	CO_2	835.24	221.74	221.74	0.77%	88.37%	2.00%	5.00%	5.39%	-0.95%	6.01%	3.46%	0.00	0.00	0.00
1.A.2.f Other - Solid Fuels	CO_2	45.57	180.47	180.47	0.63%	89.00%	2.00%	15.00%	15.13%	-2.17%	2.95%	2.82%	0.00	0.00	0.00
1.A.4.b Residential - Biomass	CH_4	126.06	175.17	175.17	0.61%	89.60%	50.00%	50.00%	70.71%	-9.82%	3.12%	2.73%	0.02	0.02	0.02
1.A.4.b Residential - Liquid Fuels	CO_2	329.91	154.25	154.25	0.53%	90.14%	50.00%	10.00%	50.99%	-6.24%	3.42%	2.41%	0.00	0.02	0.02

A.1.3 Trend assessment year 2012 without LULUCF

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	1990, absolute values	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment	Trend Assessment	*Trend Assessmen with Uncertainty*	% Contribution to trend	% Cumulative Total of Trend Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	1990, absolute values	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment	Trend Assessment	*Trend Assessmen with Uncertainty*	% Contribution to trend	% Cumulative Total of Trend Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
4.D.1. Direct Soil Emissions	N_2O	1 618.700	1 618.700	1 011.179	1 011.179	9.211%	0.0725	*0.0342*	10.396%	10.3960%	40.00%	25.00%	47.17%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3 051.264	3 051.264	37.418	37.418	0.341%	0.2698	*0.0275*	8.367%	18.7629%	2.00%	10.00%	10.20%
1.A.4.b Residential - Solid Fuels	CO_2	585.452	585.452	53.182	53.182	0.484%	0.0418	*0.0213*	6.476%	25.2385%	50.00%	10.00%	50.99%
6.A.2 Unmanaged Waste Disposal on Land	CH_4	329.978	329.978	304.720	304.720	2.776%	0.0362	*0.0202*	6.136%	31.3743%	20.00%	52.00%	55.71%
1.A.4.b Residential - Biomass	CH_4	126.063	126.063	175.165	175.165	1.596%	0.0266	*0.0188*	5.723%	37.0970%	50.00%	50.00%	70.71%
2.F(a).1 Refrigeration and Air Conditioning Equipment	HFCs			76.159	76.159	0.694%	0.0166	*0.0176*	5.343%	42.4395%	75.00%	75.00%	106.07%
6.A.1 Managed Waste Disposal on Land	CH_4			143.747	143.747	1.309%	0.0313	*0.0174*	5.297%	47.7363%	20.00%	52.00%	55.71%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1 331.987	1 331.987	34.937	34.937	0.318%	0.1137	*0.0172*	5.234%	52.9699%	2.00%	15.00%	15.13%
1.A.4.b Residential - Gaseous Fuels	CO_2	219.607	219.607	246.988	246.988	2.250%	0.0337	*0.0169*	5.152%	58.1216%	50.00%	5.00%	50.25%
4.B.Manure Management	N_2O	569.751	569.751	122.826	122.826	1.119%	0.0252	*0.0126*	3.829%	61.9509%	40.00%	30.00%	50.00%
2.A.6 Road Paving with Asphalt	CO_2	0.001	0.001	0.067	0.067	0.001%	0.0000	*0.0000*	0.003%	61.9541%	20.00%	70.00%	72.80%
2.A.1 Cement Production	CO_2	366.123	366.123	576.633	576.633	5.252%	0.0921	*0.0103*	3.130%	65.0841%	10.00%	5.00%	11.18%
4.A. Enteric Fermentation	CH_4	2 148.743	2 148.743	687.580	687.580	6.263%	0.0462	*0.0093*	2.823%	67.9070%	2.00%	20.00%	20.10%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	616.136	1 662.410	1 662.410	15.142%	0.3054	*0.0086*	2.627%	70.5341%	2.00%	2.00%	2.83%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1 131.478	1 131.478	133.148	133.148	1.213%	0.0741	*0.0076*	2.298%	72.8323%	2.00%	10.00%	10.20%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.313	2 644.313	1 703.017	1 703.017	15.512%	0.1295	*0.0070*	2.121%	74.9533%	2.00%	5.00%	5.39%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	798.124	798.124	39.553	39.553	0.360%	0.0641	*0.0065*	1.988%	76.9411%	2.00%	10.00%	10.20%
4.D.2 Pasture, Range and Paddock Manure	N_2O	358.400	358.400	87.655	87.655	0.798%	0.0136	*0.0064*	1.948%	78.8893%	40.00%	25.00%	47.17%
1.A.2.f Other - Liquid Fuels	CO_2	944.946	944.946	151.655	151.655	1.381%	0.0531	*0.0054*	1.646%	80.5358%	2.00%	10.00%	10.20%
2.A.3 Limestone and Dolomite Use	CO_2	141.005	141.005	5.065	5.065	0.046%	0.0117	*0.0059*	1.787%	82.3226%	2.00%	50.00%	50.04%
1.A.2.f Other - Solid Fuels	CO_2	38.690	38.690	180.475	180.475	1.644%	0.0357	*0.0036*	1.108%	83.4306%	2.00%	10.00%	10.20%
3.D Other	CO_2	31.078	31.078	38.213	38.213	0.348%	0.0055	*0.0041*	1.250%	84.6809%	2.00%	75.00%	75.03%
1.A.4.b Residential - Biomass	N_2O	24.812	24.812	34.446	34.446	0.314%	0.0052	*0.0037*	1.125%	85.8058%	50.00%	50.00%	70.71%

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	1990, absolute values	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment	Trend Assessment	*Trend Assessmen with Uncertainty*	% Contribution to trend	% Cumulative Total of Trend Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	778.520	778.520	55.521	55.521	0.506%	0.0588	*0.0032*	0.964%	86.7694%	2.00%	5.00%	5.39%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	338.628	338.628	48.347	48.347	0.440%	0.0203	*0.0021*	0.630%	87.3998%	2.00%	10.00%	10.20%
1.A.2.c Chemicals - Liquid Fuels	CO_2	276.669	276.669	9.788	9.788	0.089%	0.0231	*0.0024*	0.716%	88.1154%	2.00%	10.00%	10.20%
1.A.4.a Commercial/Institutional - Biomass	CH_4	32.873	32.873	32.869	32.869	0.299%	0.0042	*0.0022*	0.680%	88.7957%	20.00%	50.00%	53.85%
1.A.4.b Residential - Solid Fuels	CH_4	43.019	43.019	3.634	3.634	0.033%	0.0031	*0.0022*	0.673%	89.4683%	50.00%	50.00%	70.71%
4.D.3.Indirect Emissions	N_2O	1 033.935	1 033.935	414.495	414.495	3.776%	0.0040	*0.0020*	0.613%	90.0813%	30.00%	40.00%	50.00%

A.1.4 Trend assessment 2012 with LULUCF

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	1990, absolute values	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment	Trend Assessment	*Trend Assessmen with Uncertainty*	% Contribution to trend	% Cumulative Total of Trend Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
5.A.1 Forest Land remaining Forest Land	CO_2	-22 314.616	22 314.616	-12 900.533	12 900.533	44.808%	-63.7189	*-12.7914*	40.407%	40.406574%	1.73%	20.00%	20.07%
5.B.1 Cropland remaining Cropland	CO_2	1 311.566	1 311.566	1 198.109	1 198.109	4.161%	-5.3423	*-1.4964*	4.727%	45.133574%	0.78%	28.00%	28.01%
4.D.1. Direct Soil Emissions	N_2O	1 618.700	1 618.700	1 011.179	1 011.179	3.512%	-4.8958	*-2.3094*	7.295%	52.428613%	40.00%	25.00%	47.17%
5.C.2 Land converted to Grassland	CO_2	-0.003	0.003	-662.927	662.927	2.303%	-2.4070	*-1.3053*	4.123%	*56.552063%*	50.00%	21.00%	54.23%
5.G Other	CO_2	36.959	36.959	-1 028.736	1 028.736	3.573%	-3.7073	*-1.1122*	3.513%	60.065323%	0.06%	30.00%	30.00%
4.D.3.Indirect Emissions	N_2O	1 033.935	1 033.935	414.495	414.495	1.440%	-2.2870	*-1.1435*	3.612%	63.677588%	30.00%	40.00%	50.00%
5.E.2 Land converted to Settlements	CO_2	189.932	189.932	1 007.446	1 007.446	3.499%	-3.8016	*-1.4148*	4.469%	68.146728%	19.00%	32.00%	37.22%
4.A. Enteric Fermentation	CH_4	2 148.743	2 148.743	687.580	687.580	2.388%	-4.1218	*-0.8285*	2.617%	70.763792%	2.00%	20.00%	20.10%
6.A.2 Unmanaged Waste Disposal	CH4	329.978	329.978	304.720	304.720	1.058%	-1.3560	*-0.7555*	2.386%	73.150250%	20.00%	52.00%	55.71%

IPCC GHG Source and Sink Categories	**Gas**	**1990 Estimate, Gg CO_2-eq**	**1990, absolute values**	**2012 Estimate, Gg CO_2-eq**	**2012 absolute values**	**% Level Assessment**	**Trend Assessment**	***Trend Assessmen with Uncertainty***	**% Contribution to trend**	**% Cumulative Total of Trend Assessment**	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
on Land													
5.C.1 Grassland remaining Grassland	CO_2	207.286	207.286	125.037	125.037	0.434%	-0.6108	*-0.1284*	0.406%	73.555813%	0.92%	21.00%	21.02%
1.A.4.b Residential - Gaseous Fuels	CO_2	219.607	219.607	246.988	246.988	0.858%	-1.0629	*-0.5341*	1.687%	75.242966%	50.00%	5.00%	50.25%
1.A.4.b Residential - Biomass	CH_4	126.063	126.063	175.165	175.165	0.608%	-0.7314	*-0.5171*	1.634%	76.876580%	50.00%	50.00%	70.71%
5.A.1 Forest Land remaining Forest Land	N_2O	146.638	146.638	144.192	144.192	0.501%	-0.6345	*-0.3174*	1.003%	77.879273%	1.73%	50.00%	50.03%
5.A.2 Land converted to Forest Land	CO_2	-3.081	3.081	-353.766	353.766	1.229%	-1.2868	*-0.2611*	0.825%	78.703917%	3.40%	20.00%	20.29%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.313	2 644.313	1 703.017	1 703.017	5.915%	-8.1836	*-0.4407*	1.392%	80.096041%	2.00%	5.00%	5.39%
4.B.Manure Management	N_2O	569.751	569.751	122.826	122.826	0.427%	-0.8769	*-0.4385*	1.385%	81.481092%	40.00%	30.00%	50.00%
1.A.4.b Residential - Liquid Fuels	CO_2	329.914	329.914	154.254	154.254	0.536%	-0.8096	*-0.4128*	1.304%	82.785169%	50.00%	10.00%	50.99%
5.B.2 Land converted to Cropland	CO_2	541.994	541.994	147.340	147.340	0.512%	-0.9449	*-0.4235*	1.338%	84.123077%	35.00%	28.00%	44.82%
1.A.4.b Residential - Solid Fuels	CO_2	585.452	585.452	53.182	53.182	0.185%	-0.6359	*-0.3243*	1.024%	85.147384%	50.00%	10.00%	50.99%
2.F(a).1 Refrigeration and Air Conditioning Equipment	HFCs			76.159	76.159	0.265%	-0.2765	*-0.2933*	0.926%	86.073881%	75.00%	75.00%	106.07%
6.A.1 Managed Waste Disposal on Land	CH_4			143.747	143.747	0.499%	-0.5219	*-0.2908*	0.919%	86.992442%	20.00%	52.00%	55.71%
4.D.2 Pasture,	N_2O	358.400	358.400	87.655	87.655	0.304%	-0.5894	*-0.2780*	0.878%	87.870612%	40.00%	25.00%	47.17%

IPCC GHG Source and Sink Categories	Gas	1990 Estimate, Gg CO_2-eq	1990, absolute values	2012 Estimate, Gg CO_2-eq	2012 absolute values	% Level Assessment	Trend Assessment	*Trend Assessmen with Uncertainty*	% Contribution to trend	% Cumulative Total of Trend Assessment	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
Range and Paddock Manure													
2.A.1 Cement Production	CO_2	366.123	366.123	576.633	576.633	2.003%	-2.3706	*-0.2650*	0.837%	88.707855%	10.00%	5.00%	11.18%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3 051.264	3 051.264	37.418	37.418	0.130%	-2.4438	*-0.2492*	0.787%	89.495119%	2.00%	10.00%	10.20%
5.E.1 Settlements remaining Settlements	CO2	-54.268	54.268	-110.368	110.368	0.383%	-0.4418	-0.1414	0.447%	89.941721%	0.37%	32.00%	32.00%

A.1.5 Level assessment year 1990 without LULUCF

IPCC GHG Source and Sink Categories (LUCF not included)		1990 Estimate, Gg CO_2-eq	1990 Absolute values	% Level Assessment	% Cumulative Total of Level Assessment
5.A.1 Forest Land remaining Forest Land	CO_2	-22 314.616	22 314.616	45.040%	45.040%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3 051.264	3 051.264	6.159%	51.199%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.313	2 644.313	5.337%	56.536%
4.A. Enteric Fermentation	CH_4	2 148.743	2 148.743	4.337%	60.873%
1.A.3.b Road Transportation - Gasoline	CO_2	1 689.330	1 689.330	3.410%	64.283%
4.D.1. Direct Soil Emissions	N_2O	1 618.700	1 618.700	3.267%	67.550%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1 331.987	1 331.987	2.688%	70.238%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1 131.478	1 131.478	2.284%	72.522%
4.D.3.Indirect Emissions	N_2O	1 033.935	1 033.935	2.087%	74.609%
1.A.2.f Other - Liquid Fuels	CO_2	198.545	198.545	0.401%	75.010%
1.A.2.f Other - Gaseous Fuels	CO_2	79.076	79.076	0.160%	75.170%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	798.124	798.124	1.611%	76.780%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	778.520	778.520	1.571%	78.352%

1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	694.469	694.469	1.402%	79.754%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	616.136	1.244%	80.997%
1.A.4.b Residential - Solid Fuels	CO_2	585.452	585.452	1.182%	82.179%
4.B.Manure Management	N_2O	569.751	569.751	1.150%	83.329%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	531.380	1.073%	84.401%
2.A.1 Cement Production	CO_2	366.123	366.123	0.739%	85.140%
4.D.2 Pasture, Range and Paddock Manure	N_2O	358.400	358.400	0.723%	85.864%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	338.628	338.628	0.683%	86.547%
5.B.1 Cropland remaining Cropland	CO_2	1 311.566	1 311.566	2.647%	89.195%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	337.481	337.481	0.681%	89.876%
6.A.2. Unmanaged Waste Disposal Sites	CH_4	329.978	329.978	0.666%	90.542%
1.A.4.b Residential - Liquid Fuels	CO_2	329.914	329.914	0.666%	91.208%
1.B.2.b Natural Gas	CH_4	193.495	193.495	0.391%	91.598%
1.A.2.c Chemicals - Liquid Fuels	CO_2	276.669	276.669	0.558%	92.157%
4.B.Manure Management	CH_4	203.009	203.009	0.410%	92.566%
5.B.2 Land converted to Cropland	CO_2	541.994	541.994	1.094%	93.660%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	234.464	234.464	0.473%	94.134%
1.A.4.b Residential - Gaseous Fuels	CO_2	219.607	219.607	0.443%	94.577%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	174.195	174.195	0.352%	94.928%
5.G Other	CO_2	36.959	36.959	0.075%	95.003%

A.1.6 Level assessment year 1990 with LULUCF

IPCC GHG Source and Sink Categories (LULUCF not included)		1990 Estimate, Gg CO_2-eq	1990, absolute values	% Level Assessment	% Cumulative Total of Level Assessment
5.A.1 Forest Land remaining Forest Land	CO_2	-22 314.616	22 314.616	45.040%	45.040%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3 051.264	3 051.264	6.159%	51.199%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.313	2 644.313	5.337%	56.536%
4.A. Enteric Fermentation	CH_4	2 148.743	2 148.743	4.337%	60.873%
1.A.3.b Road Transportation - Gasoline	CO_2	1 689.330	1 689.330	3.410%	64.283%

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5.G Other	CO_2	36.959	36.959	0.075%	95.003%

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)

V.Bergmanis

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:

combusted type of fuel and physical qualities of it;

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:

boiler units – generation of electricity and heat for public utilities;

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 are 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 CO_2 emission determination it is assumed that all carbon stored in fuel transforms into CO_2 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 CO_2 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	106,07	0,98**	**103,95**
Residual fuel oil	85,72	40,60	77,43	0,99	**76,65**
Diesel oil, liquid oven fuel	86,68	42,49	74,81	0,99	**74,06**
Motor gasoline (for off-roads****)	83,13	43,97	69,33	0,99	**68,64**
Natural gas	51,54	33,66***	55,54	0,995	**55,26**
LPG	77,99	45,54	62,80	0,995	**62,49**
Shale oil	82,82	39,35	76,19	0,99	**75,43**
Coke	63,87	26,79	88,43	0,98	**85,68**
Lubricants	83,77	41,86	73,33	0,99	**72,60**
Other kerosene	85,17	43,20	72,30	0,99	**71,58**
Jet fuel	85,18	43,21	72,29	0,99	**71,57**

* 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) CO_2 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:

capacity **N**;

installed capacity **N_{nom}**;

with fuel input installed capacity **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.

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.

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:

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

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 CO_2 (% 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.3.3 INDUSTRIAL PROCESSES SECTOR

A.3.1 Energy (excluding Transport sector)

Fuel type	Sulphur content																	
	90-95	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**
Diesel	0.3	0.3	0.26	0.33	0.23	0.3	0.28	0.33	0.21	0.19	0.14	0.12	0.18	0.1	0.14	0.21	0.1907	0.1
RFO	2	2	2.12	2.1	2	2.08	1.98	1.92	1.97	1.45	1.29	1.03	1.18	0.89	0.61	1.42	1.0857	1.1
Gasoline	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	0.02	0.02	0.015	0.02
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	0.05	0.05	0.05	0.05
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	0.05	0.05	0.05	0.05
Other liquids	0.55	0.55	0.55	0.56	0.52	0.43	0.42	0.3	0.25	0.21	0.21	0.23	0.27	0.18	0.15	0.15	0.1455	0.15
LPG	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0	0	0.0047	0
Shale oil	1	1	1	1	0.8	0.74	0.83	0.54	0.62	0.65	0.63	0.8	0.82	0.84	0.85	0.8	0.8	0.8
Coal	1.8	1.8	1.47	1.37	1.06	0.9	0.87	0.83	0.67	0.67	0.73	0.64	0.44	0.41	0.34	0.33	0.3741	0.32
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	0.4	0.4	0.4	0.4
Oil shale	1																	
Peat	0.3	0.3	0.28	0.22	0.21	0.24	0.22	0.27	0.27	0.25	0.27	0.24	0.22	0.12	0.21	0.17	0.17	0.17

Fuel type	EF (Gg/PJ)																	
	90-95	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**
Diesel	0.14	0.14	0.12	0.16	0.11	0.14	0.13	0.16	0.1	0.09	0.06	0.06	0.09	0.05	0.07	0.1	0.0898	0.05
RFO	0.97	0.97	1.02	1.01	0.97	1	0.96	0.93	0.95	0.7	0.62	0.5	0.57	0.43	0.3	0.68	0.5241	0.53
Gasoline	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0068	0.01
Jet fuel	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	0.02	0.02	0.0231	0.02
Jet fuel	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	0.02	0.02	0.0231	0.02
Other liquids	0.26	0.26	0.26	0.27	0.25	0.2	0.2	0.14	0.12	0.1	0.1	0.11	0.13	0.09	0.07	0.07	0.0695	0.07
LPG	0.09	0.09	0.09	0.09	0.07	0.07	0.07	0.01	0.01	0.01	0.01	0	0.01	0.01	0	0	0.0021	0
Shale oil	0.51	0.51	0.51	0.51	0.41	0.37	0.42	0.28	0.31	0.33	0.32	0.41	0.42	0.43	0.43	0.41	0.4066	0.41
Coal	1.14	1.14	0.93	0.87	0.67	0.57	0.55	0.53	0.46	0.46	0.5	0.44	0.3	0.28	0.23	0.23	0.2568	0.22
Coke	1.23	0.82	0.41	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.2688	0.27
Oil shale	1.96																	
Peat	0.51	0.51	0.47	0.37	0.35	0.4	0.36	0.46	0.45	0.43	0.46	0.41	0.37	0.2	0.35	0.29	0.2876	0.29

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

Fuel consumption in Energy sector (stationary combustion), PJ

1.A.1 Energy Industries

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1.A.1. Energy Industries																							
Liquid Fuels	*40.479*	*33.253*	*28.440*	*27.170*	*30.860*	*20.519*	*27.334*	*17.438*	*20.662*	*17.491*	*7.901*	*5.277*	*5.076*	*3.606*	*3.144*	*2.395*	*1.512*	*1.389*	*0.905*	*1.230*	*0.947*	*0.869*	*0.663*
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*	*0.482*	*0.430*	*0.430*	*0.524*
Gaseous Fuels	*48.609*	*49.859*	*39.792*	*24.255*	*16.779*	*24.117*	*18.828*	*28.442*	*27.088*	*25.720*	*28.868*	*33.579*	*32.544*	*34.078*	*32.415*	*33.355*	*35.235*	*32.668*	*32.698*	*31.304*	*38.662*	*35.583*	*31.876*
Biomass	*0.436*	*0.590*	*0.673*	*0.865*	*1.300*	*1.065*	*1.637*	*3.413*	*4.112*	*3.700*	*3.235*	*4.152*	*4.667*	*5.558*	*5.530*	*4.732*	*5.323*	*5.297*	*5.179*	*5.274*	*5.841*	*5.918*	*8.228*
1.A.1.a. Public Electricity and Heat Production																							
Liquid Fuels	*40.140*	*33.002*	*28.189*	*26.919*	*30.426*	*20.266*	*26.110*	*17.107*	*18.115*	*14.485*	*6.350*	*5.108*	*4.864*	*3.437*	*2.932*	*2.183*	*1.300*	*1.219*	*0.692*	*1.060*	*0.734*	*0.614*	*0.493*
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	0.016	0.015	0.042	0.127
RFO	32.561	26.146	23.183	24.563	30.044	20.016	25.984	16.768	17.905	14.007	5.278	4.425	4.425	3.207	2.801	2.111	1.218	1.137	0.650	1.015	0.690	0.568	0.365
LPG	0.046	0.046	0.046	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid	1.967	1.583	1.137	1.421	NO	0.126	0.084	0.042	0.126	NO	NO	0.126	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Waste oils	0.042	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	0.042	0.029	0.088	0.029	NO	NO	NO	0.029	0.029	0.003	NO
Shale oil	NO	NO	NO	NO	NO	0.039	NO	NO	NO	0.394	0.944	0.472	0.354	0.157	NO	NO	0.039	0.039	NO	NO	NO	NO	NO
Solid Fuels	*3.683*	*3.440*	*3.880*	*4.544*	*3.613*	*4.085*	*3.144*	*3.141*	*2.191*	*1.415*	*2.340*	*1.524*	*1.280*	*0.863*	*0.270*	*0.224*	*0.125*	*0.361*	*0.466*	*0.482*	*0.430*	*0.430*	*0.524*
Coal	2.305	1.736	1.935	2.106	1.366	1.395	0.740	0.541	0.427	0.370	0.370	0.398	0.285	0.210	0.210	0.184	0.105	0.341	0.446	0.472	0.420	0.420	0.524
Peat briquettes	0.031	0.015	0.015	0.015	0.015	0.077	0.062	0.077	0.015	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	0.010	0.010	0.010	NO
Natural gas	*47.802*	*49.234*	*39.162*	*23.631*	*16.143*	*23.172*	*17.785*	*27.871*	*26.347*	*25.080*	*28.059*	*32.700*	*31.737*	*33.203*	*31.542*	*32.481*	*34.295*	*32.098*	*31.892*	*30.806*	*37.787*	*34.641*	*30.899*
Biomass	*0.436*	*0.590*	*0.673*	*0.865*	*1.300*	*1.065*	*1.637*	*3.387*	*4.078*	*3.599*	*3.235*	*3.670*	*4.185*	*4.700*	*4.672*	*4.250*	*4.841*	*4.754*	*4.636*	*4.517*	*5.338*	*5.288*	*7.672*
Wood	0.436	0.590	0.673	0.831	1.300	1.045	1.595	3.363	4.060	3.558	3.191	3.617	4.097	4.644	4.570	4.132	4.741	4.675	4.556	4.390	5.121	4.635	5.793
Sludge Gas	NO	NO	NO	0.034	0.000	0.020	0.042	0.024	0.018	0.041	0.044	0.053	0.088	0.056	0.102	0.118	0.100	0.079	0.080	0.120	0.119	0.104	0.109
Other Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.007	0.091	0.497	1.731
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.008	0.052	0.039
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*	*1.224*	*0.330*	*2.547*	*3.005*	*1.551*	*0.170*	*0.212*	*0.170*	*0.212*	*0.212*	*0.212*	*0.170*	*0.212*	*0.170*	*0.212*	*0.255*	*0.170*
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	0.170	0.212	0.255	0.170

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
RFO	0.081	0.081	0.081	0.081	0.081	0.041	1.096	0.203	0.487	0.731	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	0.046	NO	NO	NO	0.182	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Jet fuel	NO	NO	NO	NO	NO	NO	NO	NO	0.216	0.346	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	NO	NO	NO	NO	NO	NO	NO	NO	1.716	1.716	1.423	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fuels	*1.578*	*1.307*	*1.628*	*1.035*	*0.905*	*1.126*	*1.005*	*0.824*	*0.591*	*0.350*	*0.412*	*0.121*	*0.010*	*0.010*	*0.010*	*0.020*	*0.010*	*0.010*	*NO*	*NO*	*NO*	*NO*	*NO*
Coal	NO	NO	NO	NO	NO	NO	NO	NO	0.028	0.028	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NO	NO	NO	NO	NO
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*	*0.498*	*0.875*	*0.942*	*0.978*
Wood	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.026*	*0.034*	*0.101*	*NO*	*0.482*	*0.482*	*0.858*	*0.858*	*0.482*	*0.482*	*0.543*	*0.543*	*0.757*	*0.503*	*0.630*	*0.556*

1.A.2 Manufacturing Industries and Construction

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1.A.2 Manufacturing Industries and Construction																							
Liquid Fuels	*28.963*	*18.770*	*16.010*	*16.557*	*16.022*	*16.300*	*15.981*	*15.687*	*12.669*	*11.157*	*7.334*	*4.892*	*4.612*	*4.741*	*4.530*	*3.654*	*4.280*	*4.050*	*3.309*	*3.034*	*3.616*	*2.389*	*2.752*
Solid Fuels	*1.599*	*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*	*2.074*	*2.130*	*1.497*	*1.956*	*2.324*	*2.332*
Gaseous Fuels	*25.610*	*23.489*	*19.006*	*12.431*	*9.761*	*9.990*	*9.885*	*9.548*	*9.791*	*9.144*	*9.858*	*11.600*	*12.848*	*12.726*	*13.093*	*13.550*	*13.263*	*12.884*	*11.607*	*9.281*	*10.495*	*7.543*	*7.887*
Biomass	*0.617*	*0.603*	*0.616*	*1.779*	*2.101*	*2.414*	*2.664*	*2.740*	*3.188*	*3.176*	*2.696*	*3.856*	*3.393*	*3.309*	*4.706*	*5.535*	*6.429*	*5.388*	*5.798*	*8.641*	*9.810*	*11.188*	*12.921*
Other Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.037*	*0.131*	*0.245*	*0.332*	*0.290*	*0.313*	*0.174*	*0.119*	*0.090*	*0.236*	*0.078*	*0.945*	*1.857*	*2.069*
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*	*0.793*	*1.006*	*NO*	*NO*
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.079	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	0.042	0.042	0.042	NO	0.042	NO	NO	NO	NO	NO	0.042	NO	NO	NO	NO	0.042	NO	NO	NO	NO	0.001	NO	NO
RFO	1.177	0.974	0.690	0.284	0.284	0.203	0.325	0.325	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.122	0.081	NO	NO	NO
Other Liquid Fuels	NO	NO	NO	0.447	0.586	0.502	0.460	0.837	1.088	1.130	1.130	0.963	0.963	0.963	0.963	0.084	0.963	0.963	0.795	0.712	1.005	NO	NO
Waste oils	0.837	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	NO	NO	NO	0.526	NO	NO	NO	NO	NO	NO	NO
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*	*0.134*	*0.107*	*0.107*	*0.348*
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.082
Coal	NO	NO	NO	0.028	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.026	0.026	0.105

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	0.134	0.080	0.080	0.161
Natural gas	*4.238*	*3.602*	*3.426*	*2.893*	*3.109*	*2.361*	*2.521*	*3.955*	*4.038*	*3.900*	*3.913*	*4.066*	*3.904*	*3.970*	*4.031*	*4.131*	*4.098*	*4.125*	*3.827*	*3.403*	*3.835*	*1.178*	*1.448*
1.A.2.b Non-Ferrous Metals																							
Diesel oil	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.042*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.002*	*0.003*
Coal	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.002*	*0.001*
Natural gas	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.054*	*0.101*	*0.169*	*0.190*	*0.269*	*0.302*	*0.269*	*0.203*	*0.204*	*0.201*	*0.134*	*0.101*	*0.134*	*0.168*	*0.169*
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*	*NO*	*NO*	*NO*	*NO*	*0.153*	*0.126*	*0.097*	*0.131*	*0.154*
Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	NO	NO
Other Kerosene	0.389	0.389	0.259	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	0.127	0.127	0.085	NO	0.042	NO	NO	NO	NO	0.042	NO	NO	NO	NO	NO	NO	NO	NO	0.042	0.085	0.085	0.085	0.017
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	NO	NO	NO	NO	0.081	0.041	0.009	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.046	0.137
Other Liquid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.029	NO	NO	NO	NO
Coal	*NO*	*NO*	*NO*	*0.028*	*0.028*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.001*	*NO*
Natural gas	*0.423*	*0.578*	*0.414*	*0.643*	*0.693*	*1.091*	*0.703*	*0.304*	*0.302*	*0.365*	*0.318*	*0.270*	*0.279*	*0.309*	*0.406*	*0.443*	*0.480*	*0.381*	*0.514*	*0.519*	*0.603*	*0.404*	*0.371*
Biomass	*NO*	*NO*	*NO*	*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*	*0.059*	*0.073*	*0.188*	*0.130*	*0.188*	*0.170*	*0.210*
Wood	NO	NO	NO	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	0.127	0.187	0.169	0.210
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.001	0.001	0.003	0.001	0.001	NO
1.A.2.d Pulp, Paper and Print																							
Liquid Fuels	0.203	0.162	0.122	0.122	0.041	0.081	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.014	0.006
RFO	0.203	0.162	0.122	0.122	0.041	0.081	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.014	0.006
Coal	0.028	0.028	0.028	0.114	0.057	0.057	0.057	0.057	0.028	0.028	NO	0.028	0.028	0.026	0.026	0.026	0.026	NO	NO	NO	NO	NO	NO
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	0.101	0.101	0.101	0.068
Wood	NO	NO	NO	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	0.163	0.156	0.107	0.102
1.A.2.e Food Processing, Beverages and Tobacco																							
Liquid Fuels	*10.547*	*7.700*	*7.045*	*6.807*	*4.419*	*4.653*	*5.429*	*5.205*	*5.239*	*4.133*	*2.809*	*1.650*	*1.483*	*1.122*	*0.960*	*0.999*	*1.003*	*0.788*	*0.507*	*0.616*	*0.614*	*0.435*	*0.536*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jet Kerosene	NO	NO	NO	NO	NO	NO	0.043	0.086	0.043	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Kerosene	NO	NO	NO	NO	NO	NO	0.043	0.043	0.043	0.043	0.043	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale Oil	NO	NO	NO	NO	NO	0.039	NO	NO	NO	NO	0.630	0.079	0.079	0.039	0.039	0.079	0.039	0.039	0.039	0.039	0.039	0.079	0.039
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	0.212	0.170	0.085	0.127
RFO	7.105	4.425	3.898	3.532	3.654	4.019	4.791	4.222	4.385	3.492	1.583	0.974	0.893	0.609	0.406	0.406	0.447	0.329	0.122	0.244	0.284	0.122	0.203
LPG	0.046	0.046	0.046	0.046	NO	NO	NO	0.046	0.046	0.046	NO	0.046	0.046	0.046	0.046	0.046	0.091	0.091	0.046	0.091	0.091	0.091	0.137
Other Liquid Fuels	0.167	NO	NO	NO	NO	0.042	0.042	NO	NO	NO	NO	0.084	0.084	NO	0.042	0.084	0.084	NO	NO	NO	NO	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	0.088	0.088	0.088	0.088	0.117	0.088	0.029	0.029	0.058	0.029
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*	*0.052*	*0.055*	*0.026*	*0.026*
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	0.052	0.052	0.026	0.026
Coke	0.158	NO	NO	0.053	0.053	0.053	0.053	0.053	0.026	0.053	0.026	0.026	0.027	0.027	NO	0.027	0.027	NO	NO	NO	NO	NO	NO
Peat Briquettes	NO	NO	NO	NO	0.015	NO	NO	0.015	0.015	0.015	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	NO	NO
Natural gas	*3.149*	*2.698*	*2.511*	*3.500*	*2.831*	*3.066*	*3.282*	*3.042*	*2.723*	*2.604*	*2.613*	*2.781*	*2.989*	*2.765*	*3.242*	*3.154*	*3.254*	*2.688*	*2.142*	*1.935*	*1.904*	*1.871*	*1.809*
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	0.488	0.339	0.361	0.535
Wood	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	0.483	0.333	0.361	0.535
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.005	0.006	0.000	NO
1.A.2.f Other																							
Construction																							
Liquid Fuels	*2.735*	*1.905*	*0.970*	*0.675*	*0.543*	*0.456*	*0.463*	*0.633*	*0.589*	*0.462*	*0.462*	*0.380*	*0.510*	*0.423*	*0.636*	*0.636*	*0.722*	*1.274*	*0.766*	*0.796*	*0.617*	*1.052*	*1.140*
Gasoline	0.836	0.176	0.176	0.176	0.044	NO	0.088	0.044	0.044	NO	NO	NO	0.044	NO	0.044	0.044	0.044	0.044	0.044	0.044	0.018	0.044	0.044
Diesel Oil	1.615	1.445	0.510	0.255	0.255	0.212	0.212	0.467	0.382	0.340	0.340	0.297	0.425	0.382	0.510	0.510	0.637	1.190	0.722	0.722	0.510	0.892	1.020
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.019	0.046	0.047
Other Liquid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	0.042	NO	NO	NO	NO	NO	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	NO	NO	NO	NO	NO	NO	NO	0.029	0.029	0.029	0.029
RFO	0.284	0.284	0.284	0.244	0.244	0.244	0.162	0.122	0.162	0.122	0.122	0.041	0.041	0.041	0.041	0.041	0.041	0.041	NO	NO	0.041	0.041	NO
Solid Fuels	*NO*	*NO*	*NO*	*0.142*	*0.114*	*0.057*	*0.028*	*0.028*	*0.028*	*0.028*	*0.028*	*0.028*	*0.028*	*0.026*	*0.026*	*0.026*	*0.026*	*NO*	*NO*	*NO*	*0.027*	*0.026*	*0.026*
Coal	NO	NO	NO	0.142	0.114	0.057	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.026	0.026	0.026	0.026	NO	NO	NO	0.026	0.026	0.026
Peat Briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.001	NO	NO
Natural gas	*1.429*	*1.851*	*0.315*	*0.288*	*0.070*	*0.131*	*0.127*	*0.101*	*0.144*	*0.186*	*0.192*	*0.274*	*0.554*	*0.768*	*0.634*	*0.699*	*0.906*	*0.948*	*0.972*	*0.622*	*0.653*	*0.657*	*0.859*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Biomass	*0.127*	*0.121*	*0.126*	*0.264*	*0.303*	*0.267*	*0.261*	*0.283*	*0.288*	*0.279*	*0.278*	*0.266*	*0.264*	*0.273*	*0.424*	*0.370*	*0.408*	*0.294*	*0.269*	*0.239*	*0.192*	*0.168*	*0.192*
Wood	0.127	0.121	0.126	0.264	0.303	0.267	0.261	0.283	0.288	0.279	0.278	0.266	0.264	0.273	0.424	0.370	0.408	0.294	0.269	0.239	0.191	0.168	0.192
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.001	NO	NO
Machinery																							
Liquid Fuels	*0.982*	*0.576*	*0.448*	*0.367*	*0.369*	*0.338*	*0.244*	*0.286*	*0.284*	*0.164*	*0.081*	*0.081*	*0.041*	*NO*	*0.042*	*0.046*	*0.088*	*0.088*	*0.088*	*0.042*	*0.042*	*0.088*	*0.014*
Diesel oil	0.170	0.170	0.042	0.042	0.085	0.297	NO	0.042	NO	0.042	NO	NO	NO	NO	0.042	NO	0.042	0.042	0.042	0.042	0.042	0.042	0.014
RFO	0.812	0.406	0.406	0.325	0.284	0.041	0.244	0.244	0.284	0.122	0.081	0.081	0.041	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.046	0.046	0.046	0.046	NO	NO	0.046	NO
Solid Fuels	*0.079*	*NO*	*NO*	*0.083*	*0.112*	*NO*	*NO*	*NO*	*0.028*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.010*	*0.026*	*0.026*	*0.026*	*0.004*	*NO*	*NO*	*0.001*	*0.002*
Coal	NO	NO	NO	0.057	0.085	NO	NO	NO	0.028	NO	NO	NO	NO	NO	NO	0.026	0.026	0.026	0.004	NO	NO	0.001	0.002
Coke	0.079	NO	NO	0.026	0.026	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.010	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	*3.337*	*3.334*	*2.804*	*0.641*	*0.270*	*0.068*	*0.081*	*0.077*	*0.110*	*0.156*	*0.129*	*0.203*	*0.212*	*0.311*	*0.278*	*0.276*	*0.339*	*0.306*	*0.272*	*0.205*	*0.269*	*0.202*	*0.266*
Wood	*0.008*	*0.007*	*0.007*	*0.046*	*0.128*	*0.152*	*0.166*	*0.199*	*0.192*	*0.196*	*0.130*	*0.138*	*0.151*	*0.136*	*0.103*	*0.158*	*0.163*	*0.170*	*0.177*	*0.121*	*0.110*	*0.115*	*0.127*
Other non-specified																							
Liquid Fuels	*1.268*	*0.899*	*0.771*	*0.289*	*0.291*	*0.465*	*0.427*	*0.218*	*0.083*	*0.046*	*0.046*	*NO*	*NO*	*NO*	*0.046*	*0.042*	*0.042*	*0.042*	*0.042*	*NO*	*0.010*	*0.010*	*0.042*
LPG	NO	NO	NO	NO	NO	0.091	0.137	0.091	NO	0.046	0.046	NO	NO	NO	0.046	NO	NO	NO	NO	NO	NO	NO	NO
RFO	1.056	0.771	0.771	0.203	0.162	0.203	0.162	0.041	0.041	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	0.212	0.127	NO	NO	0.085	0.085	0.085	NO	0.042	NO	NO	NO	NO	NO	NO	0.042	0.042	0.042	0.042	NO	0.010	0.010	0.042
Other Kerosene	NO	NO	NO	0.086	0.043	0.086	0.043	0.086	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fuels	*NO*	*0.020*	*0.010*	*0.085*	*0.028*	*0.044*	*0.028*	*NO*	*NO*	*NO*	*0.028*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.026*	*0.026*	*NO*	*NO*	*NO*	*0.003*
Peat Briquettes	NO	NO	NO	NO	NO	0.015	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	NO	NO	NO	0.085	0.028	0.028	0.028	NO	NO	NO	0.028	NO	NO	NO	NO	NO	NO	0.026	0.026	NO	NO	NO	0.003
Peat	NO	0.020	0.010	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	*0.417*	*0.291*	*0.296*	*0.172*	*0.149*	*0.101*	*0.073*	*0.065*	*0.076*	*0.034*	*0.033*	*0.068*	*0.068*	*0.101*	*0.101*	*0.136*	*0.142*	*0.165*	*0.099*	*0.033*	*0.068*	*0.068*	*0.068*
Wood	*0.074*	*0.074*	*0.074*	*0.317*	*0.275*	*0.391*	*0.391*	*0.428*	*0.302*	*0.255*	*0.144*	*0.155*	*0.165*	*0.285*	*0.412*	*0.479*	*0.492*	*0.451*	*0.323*	*0.157*	*0.115*	*0.158*	*0.186*
Non-metallic minerals																							
Liquid Fuels	*3.585*	*1.307*	*1.301*	*1.260*	*3.058*	*2.563*	*2.519*	*2.397*	*1.912*	*2.274*	*1.521*	*0.692*	*0.944*	*1.602*	*1.414*	*0.939*	*1.037*	*0.468*	*0.324*	*0.322*	*0.882*	*0.297*	*0.297*
Diesel oil	0.127	0.127	0.042	0.042	0.170	0.085	0.042	0.042	0.085	0.085	0.042	0.042	0.042	0.042	0.042	0.255	0.212	0.127	0.127	0.127	0.255	0.297	0.297

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
RFO	3.289	1.137	1.259	1.218	2.842	2.436	2.477	2.355	1.827	2.071	0.731	0.162	NO	NO	NO	0.041	NO	0.081	0.041	NO	NO	NO	NO
LPG	NO	NO	NO	NO	0.046	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Kerosene	0.043	0.043	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Liquid Fuels	0.126	NO	NO	NO	NO	0.042	NO	NO	NO	NO	NO	0.042	NO	0.251	NO	NO	0.042	NO	NO	NO	NO	NO	NO
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.198	0.956	1.088	0.429	0.627	0.132	NO	0.165	0.627	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.209	0.586	0.234	0.205	0.175	0.117	0.088	0.117	0.029	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.118	0.748	0.236	0.118	0.118	0.079	0.039	0.039	0.039	0.039	NO	NO	NO	NO
Solid Fuels	*0.170*	*0.085*	*0.114*	*0.199*	*0.171*	*0.114*	*0.057*	*0.095*	*0.039*	*0.028*	*0.028*	*0.028*	*0.028*	*0.026*	*0.026*	*0.682*	*1.127*	*1.809*	*1.888*	*1.285*	*1.757*	*2.124*	*1.914*
Coal	0.142	0.085	0.114	0.199	0.171	0.114	0.057	0.085	0.028	0.028	0.028	0.028	0.028	0.026	0.026	0.682	1.127	1.809	1.888	1.285	1.757	2.124	1.914
Oil Shale	0.028	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	0.010	0.010	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	*5.685*	*4.474*	*4.163*	*1.477*	*0.750*	*1.282*	*1.358*	*0.640*	*1.077*	*0.705*	*0.810*	*1.824*	*2.355*	*1.884*	*1.847*	*2.385*	*1.881*	*1.982*	*1.785*	*0.944*	*1.009*	*0.977*	*1.281*
Wood	*0.007*	*0.006*	*0.006*	*0.027*	*0.020*	*0.094*	*0.020*	*0.020*	*0.029*	*0.034*	*0.024*	*0.012*	*0.017*	*0.102*	*0.050*	*0.095*	*0.135*	*0.139*	*0.077*	*0.067*	*0.010*	*0.003*	*0.023*
Other Fuels	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.037*	*0.131*	*0.245*	*0.332*	*0.290*	*0.313*	*0.174*	*0.119*	*0.090*	*0.236*	*0.078*	*0.945*	*1.857*	*2.069*
Industrial Wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.037	0.131	0.245	0.332	0.290	0.313	0.174	0.119	0.090	0.081	0.021	0.107	0.424	0.313
Municipal Wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.155	0.057	0.838	1.433	1.756
Transport equipment																							
Liquid Fuels	*0.609*	*0.284*	*0.367*	*0.367*	*0.245*	*0.162*	*0.460*	*0.288*	*0.245*	*0.164*	*0.083*	*0.083*	*0.042*	*0.083*	*0.042*	*0.083*	*0.083*	*0.042*	*0.042*	*0.042*	*0.042*	*0.009*	*0.042*
Diesel Oil	NO	NO	0.042	0.042	0.042	NO	0.297	0.085	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.009	0.042
RFO	0.609	0.284	0.325	0.325	0.203	0.162	0.162	0.203	0.203	0.122	0.041	0.041	NO	0.041	NO	0.041	0.041	NO	NO	NO	NO	NO	NO
Solid Fuels	*0.028*	*0.028*	*0.028*	*0.083*	*NO*	*0.028*	*0.028*	*NO*	*NO*	*0.028*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*0.002*	*NO*
Coal	0.028	0.028	0.028	0.057	NO	0.028	0.028	NO	NO	0.028	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.002	NO
Coke	NO	NO	NO	0.026	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	1.318	1.356	0.425	0.335	0.188	0.270	0.346	0.112	0.084	0.067	0.101	0.101	0.169	0.168	0.168	0.168	0.235	0.235	0.134	0.101	0.101	0.101	0.101
Wood	*NO*	*NO*	*NO*	*NO*	*NO*	*0.007*	*0.006*	*0.003*	*0.003*	*0.003*	*0.003*	*0.003*	*0.003*	*0.003*	*0.003*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Mining and Quarrying																							
Liquid Fuels	*0.081*	*0.166*	*0.166*	*0.166*	*0.124*	*0.166*	*NO*	*NO*	*0.042*	*0.042*	*0.042*	*0.042*	*0.042*	*0.042*	*0.042*	*0.042*	*0.085*	*0.127*	*0.170*	*0.085*	*0.085*	*0.127*	*0.127*
Diesel oil	NO	0.085	0.085	0.085	0.042	0.085	NO	NO	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.085	0.127	0.170	0.085	0.085	0.127	0.127
RFO	0.081	0.081	0.081	0.081	0.081	0.081	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Solid Fuels	NO	NO	NO	NO	NO	NO	0.015	NO	0.085	0.057	0.028	0.028	0.028	0.026	0.026	0.026	0.026	0.026	NO	NO	NO	0.006	NO
Coal	NO	NO	NO	NO	NO	NO	NO	NO	0.085	0.057	0.028	0.028	0.028	0.026	0.026	0.026	0.026	0.026	NO	NO	NO	0.006	NO
Peat Briquettes	NO	NO	NO	NO	NO	NO	0.015	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	0.145	0.180	0.182	0.203	0.084	NO	0.004	0.004	0.006	NO	NO	0.033	0.033	0.033	0.033	0.033	0.068	0.067	0.067	0.068	0.068	0.068	0.068
Wood	NO	NO	NO	0.003	0.006	0.006	0.006	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	NO	NO	0.001
Wood and wood products																							
Liquid Fuels	1.343	0.906	0.736	1.264	1.145	1.063	1.065	1.024	1.188	0.983	0.499	0.379	0.255	0.256	0.256	0.214	0.256	0.256	0.299	0.212	0.214	0.212	0.385
Gasoline	0.044	0.044	0.044	0.044	0.088	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	NO	0.044	NO	NO
Diesel Oil	NO	0.212	0.042	0.042	0.042	0.085	0.127	0.127	0.170	0.127	0.212	0.170	0.170	0.212	0.212	0.170	0.212	0.212	0.255	0.212	0.170	0.212	0.340
RFO	1.299	0.650	0.650	1.177	1.015	0.934	0.893	0.853	0.974	0.812	0.203	0.081	0.041	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.046
Other Liquid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.084	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale Oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.039	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fuels	NO	NO	NO	0.028	0.028	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.010	0.003	0.003
Coal	NO	NO	NO	0.028	0.028	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.001	0.001
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.010	0.002	0.002
Natural gas	0.273	0.269	0.347	0.349	0.412	0.438	0.553	0.513	0.520	0.505	0.506	0.507	0.606	0.673	0.671	0.806	0.806	1.006	1.108	1.011	1.447	1.480	0.943
Wood	0.150	0.142	0.151	0.768	0.807	1.039	1.395	1.402	1.972	1.946	1.577	2.396	1.882	1.718	2.697	3.290	4.336	3.521	4.343	7.249	8.686	10.081	11.540
Textiles and Leather																							
Liquid Fuels	1.910	1.788	1.666	1.545	1.626	1.100	1.139	1.266	1.672	1.595	0.497	0.296	0.170	0.127	0.127	NO	NO	NO	NO	NO	0.004	0.011	0.004
RFO	1.868	1.746	1.624	1.502	1.583	1.015	1.096	1.096	1.502	1.340	0.284	0.041	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel Oil	0.042	0.042	0.042	0.042	0.042	0.085	0.042	0.170	0.170	0.255	0.212	0.255	0.170	0.127	0.127	NO	NO	NO	NO	NO	0.004	0.011	0.004
Coal	0.171	0.142	0.142	0.256	0.342	0.057	0.085	0.028	0.028	0.028	NO	NO	NO	NO	NO	0.026	0.026	NO	NO	0.026	NO	0.026	0.009
Natural gas	2.494	2.242	1.711	1.276	1.161	1.080	0.719	0.631	0.563	0.419	0.973	1.146	1.276	1.274	1.244	0.917	0.616	0.578	0.353	0.238	0.303	0.269	0.438
Wood	0.023	0.022	0.022	0.047	0.051	0.037	0.056	0.033	0.027	0.013	0.013	0.020	0.013	0.027	0.027	0.046	0.037	0.016	0.013	0.020	0.013	0.025	0.005

1.A.4 Other Sectors

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Liquid Fuels	29.452	34.043	25.645	21.848	14.536	9.226	9.125	8.174	7.191	7.682	6.968	7.496	7.041	7.945	8.093	7.837	8.514	7.918	7.144	7.786	8.261	8.307	8.309

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Solid Fuels	*23.526*	*20.774*	*16.882*	*13.965*	*9.879*	*5.57*	*6.028*	*4.997*	*3.596*	*2.884*	*2.204*	*3.004*	*2.391*	*2.213*	*2.15*	*2.065*	*2.007*	*2.002*	*1.814*	*1.589*	*2.12*	*1.895*	*1.004*
Gaseous Fuels	*24.144*	*24.475*	*11.806*	*9.396*	*7.032*	*7.18*	*6.825*	*5.513*	*5.755*	*5.951*	*6.269*	*7.08*	*8.118*	*8.803*	*9.748*	*9.795*	*10.15*	*11.064*	*10.989*	*10.264*	*11.701*	*10.239*	*10.391*
Biomass	*26.448*	*31.06*	*30.873*	*33.21*	*33.737*	*38.643*	*39.743*	*37.983*	*36.257*	*35.902*	*33.809*	*36.562*	*36.295*	*38.321*	*39.574*	*39.523*	*38.38*	*38.388*	*35.501*	*39.238*	*36.414*	*30.922*	*33.728*
1.A.4.a Commercial/Institutional																							
Liquid Fuels	*15.077*	*18.184*	*13.331*	*11.085*	*5.835*	*3.296*	*3.123*	*2.784*	*2.261*	*2.590*	*1.795*	*2.062*	*1.941*	*2.266*	*2.324*	*1.889*	*2.347*	*1.932*	*1.626*	*1.595*	*1.546*	*1.345*	*1.816*
Motor Gasoline	0.044	0.044	0.044	0.044	0.22	NO	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	0.044	0.044	0.088	0.044
Jet Kerosene	NO	NO	NO	NO	NO	0.086	0.043	0.173	0.043	0.13	NO	NO	NO	NO	0.043	NO	0.043	0.024	0.021	0.017	0.017	0.002	0.004
Other Kerosene	0.043	0.13	0.086	0.173	0.173	0.346	0.043	0.043	0.043	0.086	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale Oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.079	NO	NO	NO	NO	0.039	NO	NO	NO	NO	NO	NO	NO
Diesel oil	8.116	11.515	7.436	7.478	1.53	1.19	1.147	0.552	0.34	0.935	1.02	1.19	1.317	1.53	1.657	1.275	1.7	1.657	1.36	1.402	1.333	1.202	1.671
RFO	6.577	6.496	5.765	3.207	3.776	1.583	1.665	1.746	1.38	1.218	0.609	0.609	0.325	0.284	0.284	0.365	0.365	0.041	0.081	0.041	0.045	NO	NO
LPG	0.046	NO	NO	0.182	0.137	0.091	0.137	0.182	0.41	0.091	NO	0.091	0.046	0.182	0.137	0.137	0.137	0.137	0.091	0.091	0.099	0.053	0.098
Other Liquid Fuels	0.251	NO	NO	NO	NO	NO	NO	NO	NO	0.042	NO	0.042	0.084	0.167	0.042	NO	NO	NO	NO	NO	NO	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.042	0.126	0.058	0.117	0.029	0.058	0.029	0.029	NO	0.008	NO	NO
Solid Fuels	*15.585*	*11.93*	*11.492*	*8.143*	*4.623*	*3.015*	*3.523*	*2.895*	*2.49*	*2.065*	*1.596*	*1.552*	*1.423*	*1.347*	*1.285*	*1.069*	*1.141*	*1.136*	*0.949*	*0.75*	*1.025*	*0.894*	*0.375*
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	1.075	0.918	0.734	1.023	0.891	0.341
Peat	0.161	0.161	0.171	0.04	0.171	0.05	0.111	0.07	0.04	NO	NO	NO	NO	0.01	NO	0.02	0.04	0.06	0.03	0.01	NO	NO	0.03
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	NO	NO	NO	NO	NO	0.001	0.001	0.006	0.002	0.003	0.004
Natural Gas	*6.101*	*6.411*	*5.521*	*3.635*	*1.932*	*2.356*	*2.319*	*1.849*	*2.222*	*2.589*	*3.098*	*3.359*	*4.117*	*4.286*	*4.768*	*4.754*	*5.01*	*5.704*	*5.701*	*5.428*	*5.542*	*4.983*	*4.902*
Biomass	*5.218*	*5.162*	*5.282*	*5.508*	*5.63*	*8.282*	*8.029*	*7.636*	*5.615*	*6.179*	*4.991*	*5.497*	*5.709*	*5.965*	*6.894*	*6.737*	*6.651*	*7.242*	*5.009*	*4.849*	*5.102*	*4.417*	*5.591*
Wood	5.218	5.162	5.282	5.508	5.63	8.282	8.029	7.636	5.615	6.179	4.991	5.497	5.663	5.803	6.652	6.485	6.381	6.966	4.705	4.482	4.679	3.997	5.187
Landfill Gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.046	0.162	0.242	0.251	0.259	0.271	0.29	0.323	0.331	0.349	0.347
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.011	0.005	0.014	0.029	0.058	0.043	0.029
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.014	0.034	0.029	0.029
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*	*1.44*	*1.44*	*1.398*	*1.443*	*1.577*	*1.621*	*1.439*	*1.393*	*2.024*	*2.237*	*2.237*	*2.237*
Motor Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.132	0.132	0.132	0.132	0.132	0.22	0.264	0.264	0.264	0.264	0.264	0.264	0.264
Other Kerosene	0.086	0.086	0.043	0.043	0.043	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	1.912	2.762	2.592	1.827	0.892	0.127	0.042	0.042	0.042	0.085	0.127	0.17	0.17	0.127	0.127	0.127	0.127	0.127	0.127	0.85	1.062	1.062	1.062

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
RFO	0.041	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	2.869	2.823	2.368	2.14	1.913	1.275	1.23	1.321	1.412	1.321	1.184	1.139	1.139	1.139	1.184	1.23	1.23	1.047	1.002	0.911	0.911	0.911	0.911
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	0.813	1.069	0.974	0.577
Coal	6.404	7.542	4.44	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	0.813	1.049	0.944	0.577
Peat	0.131	0.131	0.131	0.01	0.02	0.02	0.04	0.04	0.04	0.02	0.01	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	0.03	NO
Peat Briquettes	0.294	0.201	0.248	0.248	0.124	0.232	0.201	0.139	0.155	0.031	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	3.97	4.238	4.905	5.09	4.361	4.182	3.799	3.093	2.927	2.857	2.665	3.007	3.298	3.667	3.964	4.199	4.333	4.595	4.7	4.313	5.216	4.478	4.481
Biomass	20.01	24.669	24.32	26.396	26.8	30.003	31.349	29.73	29.994	29.058	28.228	30.519	30.078	31.85	32.073	32.234	31.195	30.433	30.168	33.667	30.744	26.144	27.824
Wood	20.01	24.669	24.32	26.396	26.8	30.003	31.349	29.73	29.994	29.058	28.228	30.519	30.078	31.85	32.043	32.174	31.165	30.388	30.108	33.607	30.682	26.084	27.764
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.03	0.06	0.03	0.045	0.06	0.06	0.06	0.06	0.06
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.002	NO	NO
1.A.4.c Agriculture/Forestry/Fisheries																							
Liquid Fuels	9.468	10.187	7.311	6.753	5.853	4.527	4.73	4.026	3.476	3.687	3.729	3.994	3.66	4.282	4.326	4.37	4.546	4.548	4.125	4.167	4.477	4.725	4.255
Motor Gasoline	1.628	0.132	0.132	0.132	0.132	0.088	0.088	0.088	0.044	0.044	0.044	0.011	0.017	0.044	0.044	0.044	0.044	0.044	NO	NO	NO	0.088	0.088
Other Kerosene	0.086	0.086	0.043	0.043	0.043	NO	0.043	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	4.122	4.461	4.589	4.122
RFO	1.421	1.34	0.974	1.218	1.259	0.487	0.69	0.284	0.203	0.244	0.244	0.244	0.244	0.244	0.203	0.162	0.041	NO	NO	NO	0.003	0.003	NO
LPG	0.046	0.046	NO	0.091	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.046	0.046	0.013	0.046	0.046
Other Liquid Fuels	0.126	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fuels	1.112	0.97	0.572	0.527	0.7	0.481	0.3	0.215	0.114	0.085	0.085	0.114	0.114	0.079	0.079	0.052	0.052	0.052	0.052	0.026	0.026	0.026	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	0.026	0.026	0.026	0.052
Peat	NO	NO	NO	0.04	0.03	0.01	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat Briquettes	0.031	0.031	0.031	0.031	0.015	0.015	0.015	0.015	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural Gas	14.073	13.825	1.38	0.671	0.739	0.641	0.706	0.572	0.606	0.505	0.506	0.713	0.703	0.85	1.016	0.842	0.807	0.765	0.588	0.522	0.943	0.778	1.007
Biomass	1.22	1.229	1.271	1.306	1.307	0.358	0.365	0.617	0.648	0.665	0.59	0.546	0.508	0.506	0.607	0.552	0.534	0.713	0.324	0.722	0.569	0.361	0.313
Wood	1.22	1.229	1.271	1.306	1.307	0.358	0.365	0.617	0.648	0.665	0.59	0.546	0.508	0.506	0.607	0.552	0.534	0.713	0.324	0.722	0.568	0.361	0.313
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.001	NO	NO

1.A.5 Other

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Aviation Gasoline	NO	NO	NO	NO	NO	NO	0.00273	0.00136	0.00273	0.00215	0.00193	0.00237	0.00154	0.00215	0.00286	0.00237	0.00572	0.00097	0.00541	0.00112	0.00022	NO	NO
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	17.50	17.15	16.94	24.33	23.72	24.00	20.96	22.73	19.98	17.79	20.97
Diesel Oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	74.57	64.54	110.94	77.12	73.13	14.28	20.65	49.03	86.68	80.26	78.66

A.3.2 Transport

Distribution of road transport fleet by subsectors and layers, year 2012

Subsector	**Technology**	**Population**	**Mileage**
Passenger Cars			
Gasoline <1,4 l	ECE 15/00-01	616	1800
Gasoline <1,4 l	ECE 15/02	792	2200
Gasoline <1,4 l	ECE 15/03	1320	3000
Gasoline <1,4 l	ECE 15/04	6071	4000
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	7192	6111
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	6122	11330
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	7329	14175
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	9556	16133
Gasoline <1,4 l	PC Euro 5 - EC 715/2007	1955	21200
Gasoline 1,4 - 2,0 l	ECE 15/00-01	3400	1300
Gasoline 1,4 - 2,0 l	ECE 15/02	4080	1660
Gasoline 1,4 - 2,0 l	ECE 15/03	4760	2700
Gasoline 1,4 - 2,0 l	ECE 15/04	33094	4000
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	44814	8000
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	45451	12300
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	23782	18000
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	24552	20000
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	3340	24614
Gasoline >2,0 l	ECE 15/00-01	724	1800
Gasoline >2,0 l	ECE 15/02	758	2500
Gasoline >2,0 l	ECE 15/03	1034	3000
Gasoline >2,0 l	ECE 15/04	4378	4698
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	7524	11000
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	12417	16000
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	9199	19725
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	7991	23065
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	693	24416
Diesel <2,0 l	Conventional	15994	10005
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	26697	11141
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	29958	13780
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	30625	15012
Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	21666	20914
Diesel <2,0 l	PC Euro 5 - EC 715/2007	4149	24052

Subsector	**Technology**	**Population**	**Mileage**
Diesel >2,0 l	Conventional	6237	12000
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	14592	14200
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	24254	18039
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	25394	19860
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	16656	20475
Diesel >2,0 l	PC Euro 5 - EC 715/2007	1906	25814
LPG	Conventional	9103	15000
LPG	PC Euro 1 - 91/441/EEC	8159	19000
LPG	PC Euro 2 - 94/12/EEC	9075	19830
LPG	PC Euro 3 - 98/69/EC Stage2000	3875	20885
LPG	PC Euro 4 - 98/69/EC Stage2005	2889	22930
LPG	PC Euro 5 - EC 715/2007	262	24614
Light Duty Vehicles			
LPG	Conventional	175	30369
LPG	LD Euro 1 - 93/59/EEC	139	30369
LPG	LD Euro 2 - 96/69/EEC	195	30369
LPG	LD Euro 3 - 98/69/EC Stage2000	53	33727
LPG	LD Euro 4 - 98/69/EC Stage2005	135	43374
LPG	LD Euro 5 - 2008 Standards	69	47984
Gasoline <3,5t	Conventional	281	17183
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	304	19182
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	535	19183
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	288	21896
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	721	28541
Gasoline <3,5t	LD Euro 5 - 2008 Standards	171	31115
Diesel <3,5 t	Conventional	2766	25414
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	5719	25414
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	8454	26514
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	8097	28224
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	5571	36297
Diesel <3,5 t	LD Euro 5 - 2008 Standards	2476	40155
Heavy Duty Trucks			
LPG	Conventional	457	24400
LPG	HD Euro I - 91/542/EEC Stage I	9	24400
LPG	HD Euro II - 91/542/EEC Stage II	65	26000
Gasoline >3,5 t	Conventional	1184	18644
Gasoline >3,5 t	HD Euro I - 91/542/EEC Stage I	70	18644
Gasoline >3,5 t	HD Euro II - 91/542/EEC Stage II	97	18644

Subsector	Technology	Population	Mileage
Gasoline >3,5 t	HD Euro III - 2000 Standards	13	25057
Rigid <=7,5 t	Conventional	1163	20411
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	731	20411
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	683	20411
Rigid <=7,5 t	HD Euro III - 2000 Standards	495	27431
Rigid <=7,5 t	HD Euro IV - 2005 Standards	286	40171
Rigid <=7,5 t	HD Euro V - 2008 Standards	121	42379
Rigid 7,5 - 12 t	Conventional	604	20603
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	343	20603
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	343	20603
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	240	28929
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	123	38991
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	49	36565
Rigid 12 - 14 t	Conventional	182	20702
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	105	20702
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	57	20702
Rigid 12 - 14 t	HD Euro III - 2000 Standards	18	23111
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	26	29129
Rigid 12 - 14 t	HD Euro V - 2008 Standards	9	31534
Rigid 14 - 20 t	Conventional	1102	29551
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	1161	29551
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	1983	29551
Rigid 14 - 20 t	HD Euro III - 2000 Standards	1664	38380
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	2385	54733
Rigid 14 - 20 t	HD Euro V - 2008 Standards	959	57842
Rigid 20 - 26 t	Conventional	244	38401
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	141	38401
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	389	38401
Rigid 20 - 26 t	HD Euro III - 2000 Standards	548	53649
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	666	75000
Rigid 20 - 26 t	HD Euro V - 2008 Standards	307	80000
Rigid 26 - 28 t	Conventional	36	38401
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	24	38401
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	55	38401
Rigid 26 - 28 t	HD Euro III - 2000 Standards	82	53649
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	35	75000
Rigid 26 - 28 t	HD Euro V - 2008 Standards	9	80000
Rigid 28 - 32 t	Conventional	18	38401

Subsector	**Technology**	**Population**	**Mileage**
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	32	38401
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	77	38401
Rigid 28 - 32 t	HD Euro III - 2000 Standards	89	53649
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	39	75000
Rigid 28 - 32 t	HD Euro V - 2008 Standards	28	80000
Rigid >32 t	Conventional	15	38401
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	18	38401
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	45	38401
Rigid >32 t	HD Euro III - 2000 Standards	74	53649
Rigid >32 t	HD Euro IV - 2005 Standards	61	75000
Rigid >32 t	HD Euro V - 2008 Standards	21	80000
Articulated 14 - 20 t	Conventional	480	29551
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	507	29551
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	866	29551
Articulated 14 - 20 t	HD Euro III - 2000 Standards	727	38380
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	1040	54733
Articulated 14 - 20 t	HD Euro V - 2008 Standards	418	57842
Articulated 20 - 28 t	Conventional	432	38401
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	286	38401
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	658	38401
Articulated 20 - 28 t	HD Euro III - 2000 Standards	998	53649
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	425	75000
Articulated 20 - 28 t	HD Euro V - 2008 Standards	117	80000
Articulated 28 - 34 t	Conventional	40	38401
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	43	38401
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	115	38401
Articulated 28 - 34 t	HD Euro III - 2000 Standards	189	53649
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	154	75000
Articulated 28 - 34 t	HD Euro V - 2008 Standards	52	80000
Buses			
Urban Buses	Conventional	10	29840
Urban Buses	HD Euro I - 91/542/EEC Stage I	2	29840
Urban Buses	HD Euro II - 91/542/EEC Stage II	16	29840
Urban Buses Midi <=15 t	Conventional	329	32667
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	126	32667
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	262	32667
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	430	43991
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	551	56798

Subsector	**Technology**	**Population**	**Mileage**
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	213	52620
Coaches Standard <=18 t	Conventional	304	47805
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	159	47805
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	231	47805
Coaches Standard <=18 t	HD Euro III - 2000 Standards	203	59227
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	140	62820
Coaches Standard <=18 t	HD Euro V - 2008 Standards	53	69280
Coaches Articulated >18 t	Conventional	44	47805
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	87	47805
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	218	47805
Coaches Articulated >18 t	HD Euro III - 2000 Standards	253	59227
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	64	62820
Coaches Articulated >18 t	HD Euro V - 2008 Standards	7	69280
Mopeds			
<50 cm^3	Conventional	182	1097
<50 cm^3	Mop - Euro I	1414	1175
<50 cm^3	Mop - Euro II	9946	1175
Motorcycles			
2-stroke >50 cm^3	Conventional	1080	1140
2-stroke >50 cm^3	Mot - Euro I	1169	1628
2-stroke >50 cm^3	Mot - Euro II	439	1628
2-stroke >50 cm^3	Mot - Euro III	823	1628
4-stroke <250 cm^3	Mot - Euro III	366	408
4-stroke 250 - 750 cm^3	Conventional	880	1465
4-stroke 250 - 750 cm^3	Mot - Euro I	1354	2036
4-stroke 250 - 750 cm^3	Mot - Euro II	553	2036
4-stroke 250 - 750 cm^3	Mot - Euro III	1078	2443
4-stroke >750 cm^3	Conventional	543	1873
4-stroke >750 cm^3	Mot - Euro I	777	2036
4-stroke >750 cm^3	Mot - Euro II	307	2036
4-stroke >750 cm^3	Mot - Euro III	760	2443

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	2009	2010	2011	2012
Amount of inhabitants	2500580	2469531	2444912	2420789	2399248	2377383	2353384	2320956	2299390	2276520	2249724	2227874	2208840	2191810	2162834	2120504	2070371	2044813
Amount of households (units)	976500	967600	958700	948600	943300	928600	925000	917400	915400	910500	905600	904600	899400	899200	898600	888600	888400	817000
Amount of households (%)	39.05%	39.18%	39.21%	39.19%	39.32%	39.06%	39.31%	39.53%	39.81%	40.00%	40.25%	40.60%	40.72%	41.03%	41.55%	41.91%	42.91%	39.95%
Amount of refrigerators in households (units)	845649	837942	834644	830215	829915	821254	822325	829330	841253	850407	859414	872034	867921	868627	868946	860165	860860	792490
Amount of refrigerators in households (%)	86.60%	86.60%	87.06%	87.52%	87.98%	88.44%	88.90%	90.40%	91.90%	93.40%	94.90%	96.40%	96.50%	96.60%	96.70%	96.80%	96.90%	97.00%
Amount of freezers in households (units)	21483	21287	23201	25043	26978	28601	30525	41100	51812	62278	115373	83223	78698	74634	70540	65756	61744	53105
Amount of freezers in households (%)	2.20%	2.20%	2.42%	2.64%	2.86%	3.08%	3.30%	4.48%	5.66%	6.84%	12.74%	9.20%	8.75%	8.30%	7.85%	7.40%	6.95%	6.50%
Refrigerators and freezers containing HFC-134a (%)	5.0%	7.0%	8.0%	9.0%	11.0%	13.0%	15.0%	18.0%	22.0%	26.0%	30.0%	34.0%	38.0%	42.0%	45.0%	48.0%	51.0%	54.0%
Amount of refrigerators containing HFC-134a (units)	42282	58656	66772	74719	91291	106763	123349	149279	185076	221106	257824	296492	329810	364823	391026	412879	439038	427945
Amount of freezers containing HFC-134a (units)	1074	1490	1856	2254	2968	3718	4579	7398	11399	16192	34612	28296	29905	31346	31743	31563	31489	28677
HFC-134a in refrigerators (140 g) (kg)	5919.54	8211.83	9348.02	10460.71	12780.70	14946.82	17268.83	20899.11	25910.58	30954.81	36095.40	41508.84	46173.40	51075.28	54743.61	57803.07	61465.38	59912.24
HFC-134a in freezers (140 g) (kg)	5919.54	8211.83	9348.02	10460.71	12780.70	14946.82	17268.83	20899.11	25910.58	30954.81	36095.40	41508.84	46173.40	51075.28	54743.61	57803.07	61465.38	59912.24
HFC-134a in stocks (t)	6.069	8.420	9.608	10.776	13.196	15.467	17.910	21.935	27.506	33.222	40.941	45.470	50.360	55.464	59.188	62.222	65.874	63.927
HFC-134a charging one in a lifetime for refrigerators – (176.25 g) (kg)	3.599	4.992	5.683	6.359	7.769	9.086	6.999	8.470	10.501	12.545	14.628	16.822	18.713	20.699	22.186	23.426	24.910	24.281
HFC-134a charging one in a lifetime for freezers – (176.25 g) (kg)	0.091	0.127	0.158	0.192	0.253	0.316	0.390	0.630	0.970	1.378	2.946	2.408	2.545	2.668	2.702	2.686	2.680	2.441
HFC-134a charged	0.004	0.005	0.006	0.007	0.008	0.009	0.007	0.009	0.011	0.014	0.018	0.019	0.021	0.023	0.025	0.026	0.028	0.027
HFC-134a leakage during charging of refrigerators (2%) (kg)	0.0720	0.0998	0.1137	0.1272	0.1554	0.1817	0.1400	0.1694	0.2100	0.2509	0.2926	0.3364	0.3743	0.4140	0.4437	0.4685	0.4982	0.4856
HFC-134a leakage during charging of freezers (2%) (kg)	0.002	0.003	0.003	0.004	0.005	0.006	0.008	0.013	0.019	0.028	0.059	0.048	0.051	0.053	0.054	0.054	0.054	0.049

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
HFC-134a from charging (t)	0.00007	0.00010	0.00012	0.00013	0.00016	0.00019	0.00015	0.00018	0.00023	0.00028	0.00035	0.00038	0.00043	0.00047	0.00050	0.00052	0.00055	0.00053
HFC-134a leakage from stocks in refrigerators containing HFC-134a (1%) (kg)	59.195	82.118	93.480	104.607	127.807	149.468	172.688	208.991	259.106	309.548	360.954	415.088	461.734	510.753	547.436	578.031	614.654	599.122
HFC-134a leakage from stocks in freezers containing HFC-134a (1%) (kg)	1.504	2.086	2.598	3.155	4.155	5.205	6.410	10.357	15.958	22.669	48.457	39.614	41.867	43.885	44.440	44.188	44.085	40.147
HFC-134a from stock (t)	0.0607	0.0842	0.0961	0.1078	0.1320	0.1547	0.1791	0.2193	0.2751	0.3322	0.4094	0.4547	0.5036	0.5546	0.5919	0.6222	0.6587	0.6393
HFC-134a leakage after disposal (80%60%) (kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFC-134a leakage after disposal (80%60%) (kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 2 HFC–134a emission estimation from commercial and industrial refrigeration

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	6.8653	4.8303	6.6466	7.0848	8.7729	3.8173	3.3482
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	IE	IE	IE	IE
Amount of gas is manufactured equipment (t)	-	0.03	-	-	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	6.8653	4.8303	6.6466	7.0848	8.7729	3.8173	8.3482
Leakage from charging (%)	15%	15%	15%	15%	15%	15%	15%	15%	8%	8%	8%	8%	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	30.7908	25.9109	43.0996	61.6263	46.6234	17.0610	48.4359
Leakage from stocks (%)	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
HFC-134a emissions from charging (t)	0.0032	0.0068	0.0102	0.0160	0.0336	0.0454	0.0363	0.0389	0.1030	0.0725	0.0997	0.1063	0.1316	0.0573	0.1252
HFC-134a emissions from stocks (t)	0.0136	0.0335	0.0469	0.1162	0.1553	0.2107	0.3170	0.3704	2.4633	2.0729	3.4480	4.9301	3.7299	1.3649	3.8749
HFC-134a from disposal	-	-	-	-	-	-	-	NO	NO	NO	NO	NO	NO	NO	NO

Table 3 HFC–32 emission estimation from commercial and industrial refrigeration

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Amount of HFC-32 used in installation of new equipment (t)	-	-	0.4846	1.5818	1.3011	1.6591	2.0065	2.7336	3.1901
Amount of HFC-32 used for charging (t)	0.046	-	IE	IE	IE	IE	IE	IE	IE
Total amount of HFC-32 charged (t)	0.0460	-	0.4846	1.5818	1.3011	1.6591	2.0065	2.7336	3.1901
Leakage from charging (%)	15%	15%	8%	8%	8%	8%	8%	8%	8%
HFC-32 held in stocks (t)	0.4837	0.0184	1.1819	2.9121	5.5460	11.6342	6.7596	4.9438	3.5141
Leakage from stocks (%)	3.50%	3.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
HFC-32 emissions from charging (t)	0.0016	-	0.0073	0.0237	0.0195	0.0249	0.0301	0.0410	0.0479
HFC-32 emissions from stocks (t)	0.0726	0.0028	0.0945	0.2330	0.4437	0.9307	0.5408	0.3955	0.2811
HFC-32 from disposal	-	NO	NO	NO	NO	NO	NO	NO	NO

Table 4 HFC–125 emission estimation from commercial and industrial refrigeration

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Amount of HFC-125 used in installation of new equipment (t)	-	0.0660	8.2509	6.4119	12.1509	14.7358	19.1665	22.5163	21.0095
Amount of HFC-125 used for charging (t)	0.0931	-	IE	IE	IE	-	-	-	-
Total amount of HFC-125 charged (t)	0.0931	0.0660	8.2509	6.4119	12.1509	14.7358	19.1665	22.5163	21.0095
Leakage from charging (%)	15%	15%	8%	8%	8%	8%	8%	8%	8%
HFC-125 held in stocks (t)	0.6247	0.0861	7.2225	21.5748	33.4125	44.3485	35.2342	39.4360	32.3344
Leakage from stocks (%)	3.50%	3.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
HFC-125 emissions from charging (t)	0.0033	0.0023	0.1238	0.0962	0.1823	0.2210	0.2875	0.3377	0.3151
HFC-125 emissions from stocks (t)	0.0937	0.0129	0.5778	1.7260	2.6730	3.5479	2.8187	3.1549	2.5868
HFC-125 from disposal	-	NO	NO	NO	NO	NO	NO	NO	NO

Table 5 HFC–143 emission estimation from commercial and industrial refrigeration

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Amount of HFC-143 used in installation of new equipment (t)	-	0.0780	9.0183	5.6805	12.5648	13.5303	18.9081	23.1855	19.5919
Amount of HFC-143 used for charging (t)	0.0510	-	IE	-	IE	IE	IE	IE	IE
Total amount of HFC-143 charged (t)	0.0510	0.0780	9.0183	5.6805	12.5648	13.5303	18.9081	23.1855	19.5919
Leakage from charging (%)	15%	15%	8%	8%	8%	8%	8%	8%	8%
HFC-143 held in stocks (t)	0.0874	0.0780	6.8324	23.4256	32.0315	24.2838	32.3061	38.4572	49.2494
Leakage from stocks (%)	3.50%	3.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
HFC-143 emissions from charging (t)	0.0018	0.0027	0.1353	0.0852	0.1885	0.2030	0.2836	0.3478	0.2939
HFC-143 emissions from stocks (t)	0.0131	0.0117	0.5466	1.8740	2.5625	1.9427	2.5845	3.0766	3.9399
HFC-143 from disposal	-	NO	NO	NO	NO	NO	NO	NO	NO

Table 6 HFC–152 emission estimation from commercial and industrial refrigeration

	2006	2007	2008	2009	2010	2011	2012
Amount of HFC-152 used in installation of new equipment (t)	0.012267	-	-	-	-	-	2.976
Amount of HFC-152 used for charging (t)	IE	-	-	-	-	-	IE
Leakage from charging (%)	8%	8%	8%	8%	8%	8%	8%
HFC-152 held in stocks (t)	0.1110061	0.0744925	0.0379789	0.0024739	0.000546	0.0017979	1.1536601

Leakage from stocks (%)	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
HFC-152 emissions from charging (t)	0.0002	-	-	-	-	-	-
HFC-152 emissions from stocks (t)	0.0089	0.0060	0.0030	0.0002	0.00004	0.00014	0.09231

Table 7 HFC– 23 emission estimation from commercial and industrial refrigeration

	2008	2009	2010	2011	2012
Amount of HFC-23 used in installation of new equipment (t)	0.0012	-	-	-	0.57209
Leakage from charging (%)	8%	8%	8%	8%	8%
HFC-23 held in stocks (t)	0.011	0.02336	0.05732	0.0442	0.05056
Leakage from stocks (%)	1.50%	1.50%	1.50%	1.50%	1.50%
HFC-23 emissions from charging (t)	0.0000	-	-	-	0.0007
HFC-23 emissions from stocks (t)	0.0009	0.0019	0.0046	0.0036	0.0047
HFC-23 from disposal	NO	NO	NO	NO	NO

Table 8 HFC–134a emission estimation from transport refrigeration

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Amount of HFC-134a held in stocks (t)	0.0308	0.0913	0.2898	0.2598	0.3093	0.4580	0.5622	0.5440	IE	IE
Leakage from stocks (%)	15%	15%	15%	15%	15%	15%	15%	8%	8%	8%
Emissions from stocks (t)	0.0046	0.0137	0.0435	0.0390	0.0464	0.0687	0.0843	0.0435	IE	IE

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)	0.1000	0.0240	0.0500	0.1800	0.0900	0.0100	0.0100	0.0200	0.1200
Leakage from stocks (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%
Emissions from stocks (t)	0.0150	0.0036	0.0075	0.0270	0.0135	0.0015	0.0015	0.0030	0.0180

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 (%)	15%	15%	8%
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	2009	2010	2011	2012
Passenger cars with manufacturing year >1995	384	5137	9512	16061	23091	30730	41049	55166	73510	103917	151705	230926	324774	371591	376123	392265	403791	435907
Trucks with manufacturing year >1995	35	716	6655	8154	8220	12724	15164	17714	20875	25955	36693	46068	57906	63271	60437	33835	41263	48445
Passenger cars equipped with MACs (%)	20%	20%	20%	20%	20%	20%	23%	26%	29%	31%	33%	35%	36%	38%	39%	41%	42%	43%
Trucks equipped with MACs (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	53.3%	56.2%	58.7%	60.9%	62.9%	64.7%	66.4%	67.9%	69.4%	70.7%	71.9%	73.1%
Passenger cars equipped with MACs (pieces)	77	1027	1902	3212	4618	6146	9578	14448	21090	32124	49930	80203	118210	140967	148059	159644	169382	187982
Trucks equipped with MACs (pieces)	18	358	3327	4077	4110	6362	8087	9954	12252	15810	23084	29820	38448	42984	41922	23921	29688	35425
Amount of HFC-134a in passenger cars (kg)	61	822	1522	2570	3695	4917	7662	11559	16872	25699	39944	64162	94568	112773	118447	127715	135506	150386
Amount of HFC-134a in trucks (kg)	21	430	3993	4892	4932	7634	9705	11944	14702	18972	27701	35784	46137	51581	50306	28705	35625	42510
Total amount of HFC-134a in cars (t)	0.082	1.252	5.515	7.462	8.627	12.551	17.367	23.503	31.575	44.671	67.646	99.947	140.705	164.354	168.753	156.420	171.131	192.896
Leakage from stocks (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
HFC-134a emission from stocks (t)	0.012	0.188	0.827	1.119	1.294	1.883	2.605	3.525	4.736	6.701	10.147	14.992	21.106	24.653	25.313	23.463	25.670	28.934
Disposed MACs from passenger cars in year (piece)	6	82	152	257	369	492	766	1156	1687	2570	3994	6416	9457	11277	11845	12771	13551	15039
Disposed MACs from trucks in year (piece)	1	29	266	326	329	509	647	796	980	1265	1847	2386	3076	3439	3354	1914	2375	2834
F-gases remained in one MAC (%)	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Remained f-gases in annually disposed MACs (kg)	2.638	40.049	176.471	238.783	276.050	401.638	555.758	752.097	1010.385	1429.463	2164.658	3198.289	4502.569	5259.338	5400.103	5005.430	5476.191	6172.669
Leakage from disposal (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HFC-134a disposal emissions (t)	0.003	0.040	0.176	0.239	0.276	0.402	0.556	0.752	1.010	1.429	2.165	3.198	4.503	5.259	5.400	5.005	5.476	6.173

Table 12 Potential f-gases emissions estimation from Refrigerating and Air Conditioning Equipment

Chemicals / GWP	2004	2005	2006	2007	2008	2009	2010	2011	2012
HFC-32 (kg)	2.153	1.357	3.095	6.221	5.375	3.621	3.414	3.764	4.387
(Gg CO_2 eqv.) GWP 650	1.39945	0.88205	2.01175	4.04388	3.49375	2.35365	2.21910	2.44660	2.85175
HFC-125 (kg)	11.737	11.461	18.364	16.757	22.695	24.192	37.553	25.298	22.844
(Gg CO_2 eqv.) GWP 2800	32.8636	32.0908	51.41982	46.92015	63.546	67.73620	105.14728	70.83356	63.96376
HFC-134a (kg)	3.964	3.944	6.837	7.774	8.824	6.949	9.885	6.706	7.041
(Gg CO_2 eqv.) GWP 1300	5.1532	5.1272	8.88849	10.10619	11.4712	9.0331	12.8505	8.7172	9.1529
HFC-143a (kg)	11.046	11.738	17.576	11.64	20.14	22.88	33.12	22.19	20.28
(Gg CO_2 eqv.) GWP 3800	41.9748	44.6044	66.7888	44.2301	76.5320	86.944	125.837	84.322	77.064
HFC-152 (kg)	0.065	0.221	0.035	0.2055	0.3675	-	-	-	-
(Gg CO_2 eqv.) GWP 140	0.0091	0.03094	0.004914	0.02877	0.05145	-	-	-	-
TOTAL (Gg CO_2 eqv.)	81.40015	82.73539	129.11377	105.32908	155.0944	166.06690	246.05388	166.31931	153.03242

Table 13 Potential f-gases emissions estimation from Foam Blowing

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
HFC-134a (t)	24.88	3.9	37.28	178.7	318.5	12.56	0.07	6.469	4.912	4.428
HFC-134a (Gg CO_2 eq)	32.35	5.07	48.47	232.3	414.1	16.33	0.091	8.41	6.386	5.756
actual emissions during use (t)	2.488	0.39	3.728	17.87	31.85	1.256	0.007	0.647	0.491	0.442
HFC-134a	-	-	-	0.058	0.047	-	-	-	-	-
HFC-134a (Gg CO_2 eq)	-	-	-	0.075	0.061	-	-	-	-	-
actual emissions during use (t)	-	-	-	0.006	0.005	-	-	-	-	-
TOTAL HFC-134a	24.88	3.9	37.28	178.7	318.5	12.56	0.07	6.469	4.912	4.428
HFC-134a (Gg CO_2 eq)	32.35	5.07	48.47	232.3	414.1	16.33	0.091	8.41	6.386	5.756
actual emissions during use (t)	2.488	0.39	3.728	17.87	31.85	1.256	0.007	0.647	0.491	0.442
HFC-152	2.613	0.41	3.915	18.76	33.44	1.319	0.007	0.679	0.516	0.465
HFC-152 (Gg CO_2 eq)	0.366	0.057	0.548	2.626	4.682	0.185	0.001	0.095	0.072	0.065
actual emissions during use (t)	0.261	0.041	0.391	1.876	3.344	0.132	7E-04	0.068	0.052	0.046
HFC-227ae (Tecfoam SP-27-B5/365/245)	-	2.9	2.7	2.5	-	-	-	-	-	-
HFC-227ae (Gg CO_2 eq)	-	8.41	7.83	7.25	-	-	-	-	-	-
actual emissions during use (t)	-	0.29	0.27	0.25	-	-	-	-	-	-
100% HFCs in products (Gg CO_2 eq) – potential emissions	32.35	13.48	56.3	239.5	414	16.33	0.091	8.41	6.386	5.756

Table 14 HFC–227ea emission estimation from fire extinguishing equipment

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Amount of HFC-227ea in installed equipment (t)	0.2435	0.2435	0.6085	1.232	0.793	0.2775	0.7635	1.2495	1.7355	2.2215	2.7075	3.1935
Amount of HFC-227ea held in containers (t)	195.5	195.5	195.5	195.5	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%	5%	5%	5%	5%
Emission from stocks (t)	9.78718	9.78718	9.80543	9.83660	9.81465	9.78888	9.81318	9.83748	9.86178	9.88608	9.91038	9.93468

Table 15 Potential HFC–227ea emissions estimation from fire extinguishing equipment

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Amount of HFC-227ea in installed equipment (t)	0.2435	0.2435	0.6085	1.232	0.793	0.2775	0.7635	1.2495	1.7355	2.2215	2.7075	3.1935
Amount of HFC-227ea held in containers (t)	195.5	195.5	195.5	195.5	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%	5%	5%	5%	5%
Emission from stocks (t)	9.78718	9.78718	9.80543	9.83660	9.81465	9.78888	9.81318	9.83748	9.86178	9.88608	9.91038	9.93468
Total emission from stocks (Gg CO_2 eqv.)	28.38281	28.38281	28.43573	28.52614	28.46249	28.38774	28.4582	28.5287	28.5991	28.6696	28.7401	28.8106

A.3.4 Agriculture

Distribution of different manure management systems for 2000-2012 is estimated according to studies of Latvia University of Agriculture researchers. The number and detailed explanation of calculation is available in the report *Lauksaimniecības rādītāju prognoze 2015. un 2020. gadam* (Forecast of Agricultural indicators 2015-2020), published in 2011, Riga.

A.3.5. LULUCF

Methodology of Activity 1.1 "Monitoring of Forest Resources" of the National Forest Inventory

Drafted in accordance with Cabinet Regulation No. 238 of 3 April 2013 "Regulations Regarding National Forest Inventory". Co-ordinated with the Letter No. 3.2-3e/1396/2013 of the Minister for Agriculture of 24 April 2013. Approved by the Order No. 7-v of the director of the Latvian State Forest Research Institute "Silava" of 26 April 20.

1. General Issues of the Monitoring of Forest Resources

1.1. The objectives of the monitoring of forest resources shall be as follows:

1.1.1 to obtain operational and accurate information regarding forest resources for national and international statistical needs;

1.1.2. to control the dynamics of the forest area;

1.1.3. to obtain accurate information regarding wood resources, their structure and dynamics;

1.1.4. to obtain information for assessment of the dynamics of the condition of forest ecosystems, damage to forest and biological diversity;

1.1.5. to obtain information for forecasting of the forest resources and for the needs of the GHG inventory;

1.1.6. to accumulate historical information regarding the course of development of forest stands.

1.2. The object of the monitoring of forest resources is the territory where growing and/or dead wood resources are found, regardless of the form of property.

1.3. The task of the monitoring of forest resources is to obtain the following information at large in the State and in division according to property groups (State properties and other properties):

1.3.1. forest land areas in division according to forest land categories;

1.3.2. division of areas covered with trees, outside the forest land;

1.3.3. forest stand areas and standing volumes in division according to the dominant tree species, age decades, site quality classes, height and basal area groups, limitations of economic activities and indications of nature protection, types of forest regeneration and forest types;

1.3.4. cutover areas in division according to forest types;

1.3.5. the annual increment of forest stands, the annual dead rate and the annual felled amount in division according to the dominant tree species;

1.3.6. the characterisation of damages to forest stands by the area and stock in division according to the dominant tree species and causes of damages (damages by insects, damages by disease, damages by wildlife, damages by storms, snowbreak and damages of similar types, damages by fire, other damages);

1.3.7. areas of forest stands with undergrowth in division according to the species of the undergrowth and the groups of covering;

1.3.8. areas of forest stands with advanced growth in division according to tree species and groups of covering;

1.3.9. areas and stocks of the forest land covered with trees and bushes, but not forming a forest stand, in division according to tree and bush species;

1.3.10. the total biomass of the wood (wood stock of growing trees and bushes and deadwood and biomass above the stump in division according to tree species, their stumps, roots, as well as biomass of the fallen deadwood) in division according to tree species;

1.3.11. information regarding wood resources growing outside the forest and their dynamics.

1.4. Information shall be collected in accordance with the definitions of the Forest Law and the Temperate and Boreal Forest Resources Assessment.

1.5. Inventory unit network of the monitoring of forest resources

1.5.1. The monitoring of forest resources shall be carried out according to the principle of bi-level selection:

1.5.1.1. a network of sample plots shall be created in the first level selection. Sample plot tracts with four sample plots in each shall be selected;

1.5.1.2. sample plot tracts shall be laid out evenly throughout the State territory in 4 x 4 km distance from each other following the principle that they form an equilateral triangle (Figure 1). Each year one fifth of all sample plots shall be surveyed, ensuring impartial layout of annual surveys evenly throughout the State territory;

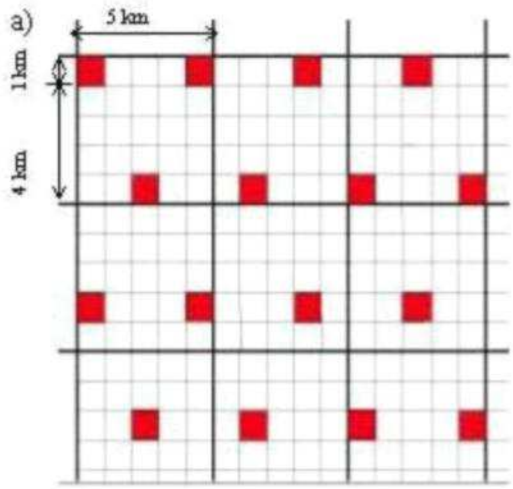

Figure 1 Scheme of the Layout of Sample Plot Tracts

1.5.1.3. sample plot tracts shall be laid out on a network of orthophoto map sheets (Figure 2). Sample plots shall be laid out in sample plot tracts, grouping them by four in one tract. Sample plots within the scope of a tract shall be laid out in vertices of a 250 x 250 m square;

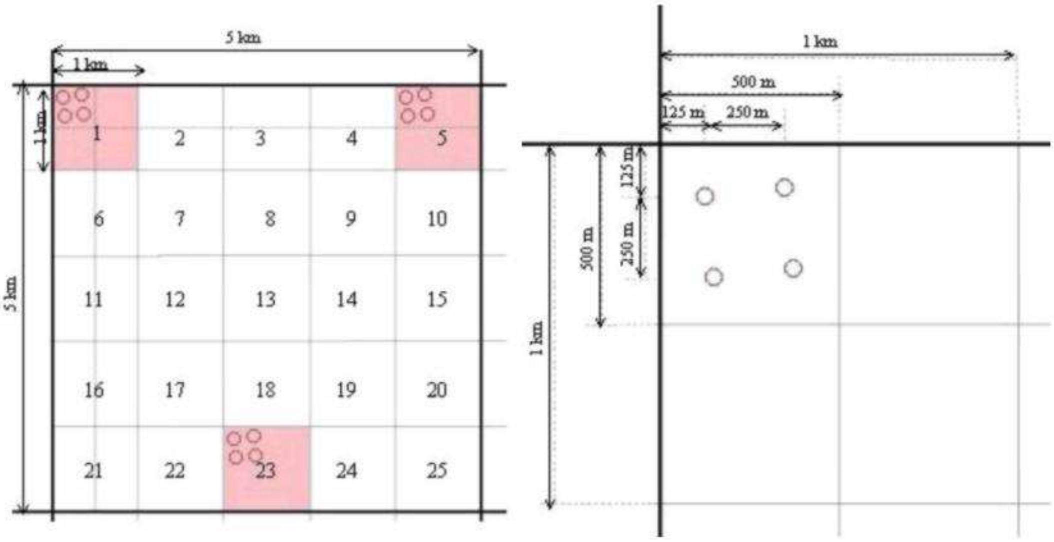

Figure 2 Tract and Sample Plot Selection Scheme on Orthophoto Map Sheets

1.5.1.4. in the second level of selection inventory trees shall be selected in all sample plots selected in the second round in order to assess the height, age, increment, quality and damages. Such trees shall be selected in proportion to the size (diameter) of the existing trees. The intensity of selection shall be 20-30% for all trees for which the diameter is measured;

1.5.2. a sample plot network shall be created according to a systematic layout scheme with a randomly selected reference point. Each sample plot shall be surveyed once during a complete cycle of the monitoring of forest resources, i.e., once every five years;

1.5.3. in performing re-measuring in sample plots, changes during a time period of five years shall be assessed. Annual indicators shall be obtained by dividing the total changes in the re-measurement period by the number of years of the time period.

1.6. Inventory element scheme

1.6.1. Inventory sample plots in a sample plot network shall be laid out in tracts, which have edges of 250 m in length and they are oriented in the direction of the North, East, South and West. The centre of the sample plot shall be deviated from the vertex of the tract by 25 m counter-clockwise (Figure 3);

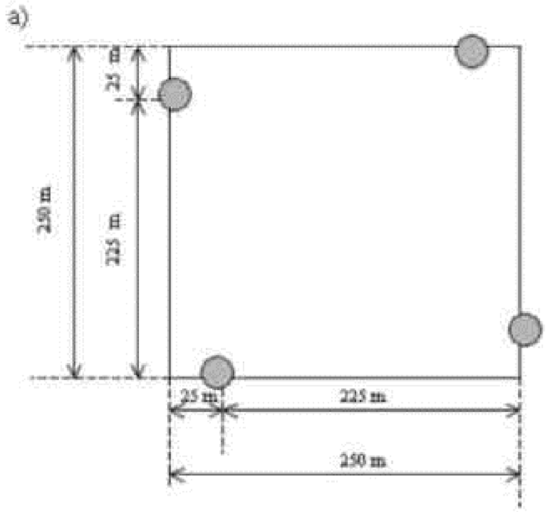

Figure 3 Layout Scheme of Sample Plots

1.6.2. The main element of inventory is a permanent inventory sample plot of a fixed radius, the area of which is 500 m^2 (radius in a plane is 12.62 m) and in which trees, as well as fallen deadwood with diameter of 14.1 cm or more are surveyed (Figure 4).

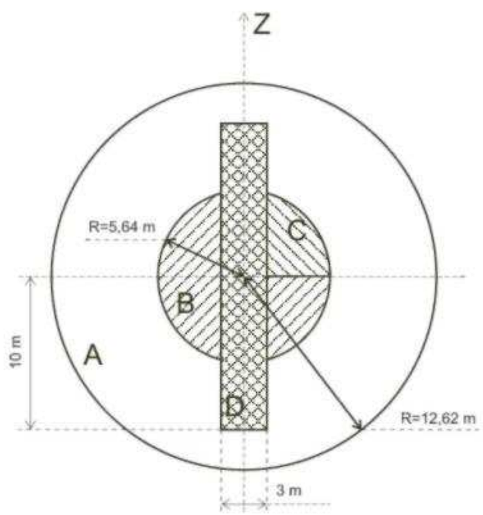

Figure 4 Sample Plot Scheme (A – 500 m^2 sample plot, B – 100 m^2 sample plot, C – 25 m^2 sample plot, D – sample plot of undergrowth and advanced growth inventory)

1.6.3. A second sample plot shall be earmarked at the centre of the sample plot 100 m^2 (R=5.64 m) in which all trees and fallen deadwood with the diameter of the butt-end 6.1 cm or more shall be surveyed. All trees of natural origin and their outgrowth, the diameter of which in height of 1.3 m above the root collar (hereinafter – in height of 1.3 m) is 2.1 cm, shall be surveyed in the first fourth of such sample plot, calculating from the northern direction (25 m^2);

1.6.4. the undergrowth and advanced growth shall be determined in a zone of the sample plot of 3 x 20 m, earmarked in a joint sample plot, in sample plots No. 1 and No. 3 in the eastern-western direction, in the sample plots No. 2 and No. 4 in the northern and southern direction;

1.6.5. fallen deadwood shall be surveyed at odd times of re-measuring of sample plots.

1.7. Earmarking of sectors into sample plots

1.7.1. Sectors shall be earmarked in a sample plot if:

1.7.1.1. they are a different form of property;

1.7.1.2. they are the territory of another state;

1.7.1.3. they have a different type of the use of land;

1.7.1.4. they are a different category of the forest land;

1.7.1.5. they have a different origin of the forest stand;

1.7.1.6. they are a different type of forest;

1.7.1.7. the age difference of forest stands exceeds 20 years;

1.7.1.8. the composition of species forming Level I of the stand differs by four or more units;

1.7.2. In identifying sectors of a sample plot, their point azimuths and distances to the centre of the sample plot in which the line dividing the sectors is crossing the border of the sample plot shall be recorded. In case of several breaking points of the line dividing sectors azimuths and distances to each breaking point shall be recorded.

1.8. Numbering of tracts and sample plots

1.8.1. The ten-digit identification number of sample plots shall consist of the tract number and the sample plot number.

1.8.2. Sample plot tracts shall be numbered according to the division sheets of the TKS-93 map sheet nomenclature system in the scale 1:1000 corresponding to geographical areas and shall be formed from numbering symbols 1-9.

1.8.3. The tenth symbol in the identification number shall be the number of the sample plot in the tract.

1.8.4. Sample plots within the scope of a tract shall be numbered from “1” to “4” clockwise (Figure 5).

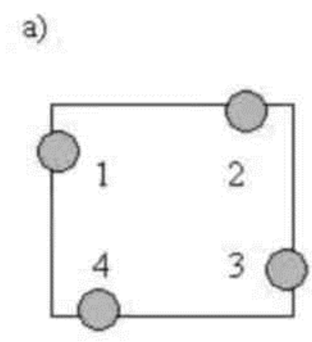

Figure 5 Numbering Scheme of Sample Plots

1.9. Determination of co-ordinates of the tract and sample plot centre

1.9.1.The Latvian Co-ordinate System is defined with the following parameters:

Ellipsoid	WGS84

Projection	Transversa Merkatora
Central meridian	24
Scale coefficient on meridian	0,9996
Deviation along x-axis	500000m
Deviation along y-axis	-6000000m

1.9.2. The following co-ordinates of the centre of sample plot tracts have been determined according to the Latvian Co-ordinate System:

1.9.2.1. the co-ordinates of centres of sample plot tracts shall be calculated according to orthophoto map sheets and the scheme presented in Figure 1. Sample plot tracts for the 5 x 5 km sheet of orthophoto maps in the centre of Latvia shall be laid out in three centres of 1 x 1 km squares. Co-ordinates of the subsequent tract centres in the distance of 4 km for the whole domestic territory of Latvia shall be calculated for the three sample plot tracts in the northern, eastern, southern and western direction in the central orthophoto map sheet of Latvia;

1.9.2.2. all co-ordinates of the next tract centre shall be calculated, using the co-ordinates of the adjacent tract centre and using the causations (1) and (2):

$X_n = X_i \pm 004.000.00$ or $X_n = X_i$ (1)

$Y_n = Y_i \pm 0.004.000.00$ or $Y_n = Y_i$, where (2)

X_i – co-ordinates of the width of the previous vertex;

Y_i – co-ordinates of the length of the previous vertex.

1.9.3. Co-ordinates of sample plot centres shall be calculated according to co-ordinates of tract centres in conformity with the principle that the tract centre is the centre of a 250 x 250 m square at the corners of which sample plots are placed. In addition the offset of the centre of the sample plot from corners of the square by 25 m shall be calculated, as shown in Figure 3.

1.10. Organisation of the monitoring of forest resources

1.10.1. Periodicity of the monitoring of forest resources

1.10.1.1. The monitoring of forest resources shall be carried out each year in the whole territory of Latvia.

1.10.1.2. The sample plot network shall be gradually increased for the first five years, surveying one fifth of the total number of sample plots each year.

1.10.1.3. During each next five years sample plots and inventory trees therein shall be re-measured. The time period between re-measuring of sample plots shall be five years +/-20 days.

1.10.2. Preparation works of the monitoring of forest resources

1.10.2.1. Preparation works shall be carried out in order to ensure timely and successful commencement and course of field works from 1 January until 1 April.

1.10.2.2. The following information shall be aggregated during the preparation works:

1.10.2.2.1. using orthopohoto maps (not more than five years old), compile a list of the sample plots to be surveyed on the site during the working year;

1.10.2.2.2. prepare print-outs of the cartographic material – print-outs of orthophoto maps S 1:10000, forest land plans (copies) S 1:10000 and cadastral maps, print-out of a satellite map S 1:50000 which characterises the situation in order to reach the relevant tract;

1.10.2.3. work forms shall be prepared in each next cycle of measurements, and they shall include the information on measurements from the previous cycle (the azimuth of the surveyed tree, the distance to the centre of the sample plot, the diameter in height of 1.3 m and the measured height of the tree);

1.10.2.4. the measuring instruments necessary for the field work season shall be prepared.

1.10.3. Organisation of field works

1.10.3.1. Measuring of sample plots in a forest shall be carried out by five field work groups.

1.10.3.2. A field work group shall consist of a leader and an engineering technical employee. The leader of the group shall organise the group work, trips, routes, finding and measuring of a tract in sample plots, shall be responsible for any documentation, as well as take care of the transport, measuring instruments, storing and inspecting thereof.

1.10.4.Quality control of field work

1.10.4.1. Field work shall be controlled:

1.10.4.1.1. in order to prevent surveying errors and the causes for occurrence thereof;

1.10.4.1.2. in the amount of at least five per cent from the number of permanent sample plots surveyed by each working group a year;

1.10.4.1.3. by an individual working group in the composition of two people.

1..10.4.2. In field work control all such indicators of the sample field shall be surveyed in the sample field, which are repeatedly measured during re-measuring (tree azimuth, distance, diameter at height of 1.3 m, height, undergrowth and advanced growth).

2. Methodology of field work of the monitoring of forest resources

2.1. Identification of sample plots on the site

2.1.1. The centre of sample plots on the site shall be found with the help of the global positioning system (hereinafter – GPS) according to the calculated co-ordinates, using it in navigation (point search) mode.

2.1.2. In case if it is not possible to find the centre of the sample plot with a GPS receiver (poor detection capability in forest conditions), then the point co-ordinates shall be determined in the closest open place where taking of GSP measurements is possible. Afterwards the distance and the azimuth to be followed shall be determined in order to identify the theoretical point. Then the centre of the sample plot shall be found, using a measuring tape and compass.

2.1.3. If a line must be marked off in a relief slope, the distances measured in the slope towards horizontal plane shall be recalculated, using trigonometric causations of a right-angled triangle. The angle of the relief slope and the distance between points must be measured and the distance in a plane must be recalculated.

2.1.4. All sample plots and their parts, which are planned for measuring in forest land, shall be divided into accessible and non-accessible after inspection on site. Such sample plots shall be considered as non-accessible, the centres of which cannot be reached due to different reasons – they are located in water reservoirs, marshes, etc. It shall be noted in the notes of the description of the sample plot.

2.1.5. The characteristics of sample plots with non-accessible centres shall be determined, performing measurements for trees outside the sample plot, performing the necessary measurements in plots the centre of which is located as close to the theoretical centre of the sample plot as possible. In such case the location of the sample plot centre used for measurements shall be described in the note section, marking the closest trees around it.

2.1.6. If the sample plot is accessible, however, its centre coincides with an obstacle (stone, asphalt, etc.), the centre of the sample plot shall be marked as close from the theoretical centre as possible, marking the closest trees around it, however, measurements shall be performed from the theoretical centre. Similar actions must be taken, if the centre of a sample plot touching the forest is in arable land or on an object of the forest infrastructure where destruction of the mark of the centre is possible. Such changes shall be recorded in the note box of the documents, drawing a sketch of the marked centre.

2.1.7. In establishing a permanent sample plot on the site, one must follow the principle that it should attract as less attention during the time period until the next survey time as possible. After the survey of the sample plot, a metal bar shall be driven in the centre thereof.

2.1.8. Trees shall be marked around the centre of the sample plot, driving nails in their root collar, leaving at least 3 cm of the nail above the root collar and bending it.

2.1.9. If it is not possible to mark the centre of a sample plot with the help of trees or stumps in the sample plot (for example, young stands), then other trees outside the sample plot shall be looked for.

2.1.10. Identification of the centre of a sample plot shall be documented, indicating the tree species used for identification, its distance from the centre of the sample plot and the azimuth.

2.1.11. In repeatedly surveying sample plots, their centre shall be found with the help of a metal detector, at first finding the trees marked for ensuring identification. After the trees (or their stumps) of identification are found, using their azimuth and distance, the place where the metal bar was driven in shall be found.

2.2. Division of sample plots into sectors

2.2.1. In dividing a sample plot into sectors, the following principles must be complied with:

2.2.1.1. the whole zone of the road belongs to roads. If a road zone is also used for other purposes (electricity, communications line, fireline, ditch), then they shall be included in the main function – road;

2.2.1.2. if there are only such ditches next to a forest road, which serve only the road, then they shall be included in the area of the road;

2.2.1.3. if there is a territory not covered with forest growth next to an embankment of a forest road and the forest, exceeding 4 m in width, it shall be treated as a glade;

2.2.1.4. ditches shall be classified into two different categories: ditches belonging to the forest land and field ditches. A ditch separating forest land from other land shall be divided into two different sectors (forest ditch and field ditch) according to the bottom line of the ditch;

2.2.1.5. ditch routes are the linear object of the forest land. The status of a ditch route shall only be assigned if the width thereof is not less than 4 m and not more than 10 m;

2.2.1.6. the beginning of the ditch route shall be measured from the beginning of the ditch edge (side);

2.2.1.7. if the edge of the ditch is rounded-off, the beginning thereof shall be determined according to the displacement of the land surface plane from the plane of the ditch edge, but not farther than 1 m from the line where the land plane and ditch edge plane projections are intersecting;

2.2.1.8. if the distance from the ditch edge (side) to the forest is less than 4 m, the sector of ditch route shall not be earmarked and the territory shall be included in the ditch;

2.2.1.9. if a group of trees is less than 0.1 ha or forms a zone that is narrower than 20 m, it shall be itemised as separate trees in an adjacent land category;

2.2.1.10. the owner of the forest roads shall be determined, taking into account the owner of the surrounding land;

2.2.1.11. linear objects of the forest land, which are located on the border with different properties, shall be divided into sectors with corresponding property rights according to the centre line;

2.2.1.12. measurements shall be taken by marking the number of the sector during measuring, and it shall be the basis for the performance of subsequent calculations;

2.2.1.13. the measurements to be taken for identification of sample plot sectors shall be documented.

2.3. Laying out of sample plots

2.3.1. If the border of a sector divides sample plots of 500 m^2, 100 m^2, 25 m^2, 60 m^2, inventory of trees of corresponding diameter, undergrowth and advanced growth shall be carried out according to sectors.

2.4. Determination of common characteristics in a sample plot

2.4.1. Determination of the forest type

2.4.1.1. In each sample plot or sector of the forest and cutover the forest type of the forest stand corresponding thereto shall be determined, using the Latvian forest typology developed by K. Bušs (*Bušs K. (1981) Meža ekoloģija un tipoloģija. Rīga: Zinātne, 65 lpp.*).

2.4.2. Inventory of advanced growth and undergrowth

2.4.2.1. Advanced growth and undergrowth shall be itemised in all sample plots.

2.4.2.2. The trees of the forest element which while being 1.3 m in height have not reached 2.1 cm in diameter shall be included in the advanced growth. If a forest element with a diameter of less than 2.1 cm forms a dominant stand, its trees shall not be included in the inventory of the advanced growth.

2.4.2.3. The undergrowth and the advanced growth shall be itemised in a zone that is 20 m long and 3 m wide. Sectors may also include a smaller plot or no plot at all. The inventory plot of the undergrowth belonging to sectors shall be determined in office work.

2.4.2.4. The number of species and specimens for undergrowth and advanced growth trees, as well as the height and diameter of a visually selected average woody plant in the middle of it shall be determined.

2.4.2.5. The average age shall be determined for each undergrowth and advanced growth species – branch whorls shall be itemised or a tree shall be sawn outside the sample plot and its growth rings shall be counted. During inventory of the undergrowth and advanced growth all sprouts which have grown up from the earth or stump shall be counted.

2.5. Surveying of growing trees

2.5.1. Selection of inventory trees

2.5.1.1. Inventory trees shall be selected from the living trees in the sample plot, the diameter of which has been measured in height of 1.3 m. If an individual element of the stand is formed only by deadwood, the inventory trees shall also be measured for them. Generally not less than one tree out of seven trees should be selected.

2.5.1.2. If only one tree species is represented in the sample plot, then 3-5 trees from Kraft Class I, also 3-5 trees from Kraft Class II and Kraft Class III trees, as well as 1-2 trees from Kraft Classes IV and V shall be selected as inventory trees. If there is the second level in the stand, which is represented by one tree species, then at least three trees shall be selected as inventory trees. Inventory trees shall be selected in such a way that they have different diameters;

2.5.1.3. If several tree species are represented in the sample plot, then 2-3 trees from Kraft Classes I-III and 1-2 trees from Kraft Classes IV and V shall be selected as inventory trees for each of such species. If there is the second level in the stand, which is represented by more than one tree species, then at least 1-3 trees from each species shall be selected as inventory trees.

2.5.1.4. If the number of forest element trees in the sample plot is very high, then not less than one tree out of seven trees shall be selected. In selecting trees for inventory the third tree, then the 10th tree, the 17th tree, etc. shall be selected. If a sufficient number of inventory trees is not collected systematically, then the missing trees shall be selected from thicker trees.

2.5.1.5. Additional measurements shall be taken for inventory trees – the height of trees shall be determined, as well as the diameter of the tree at the root collar, the height of the first green branch, the height of the first dry branch shall be determined at each odd time of re-measuring.

2.5.1.6. In re-measuring sample plots, the same inventory trees shall be measured. Felled trees or deadwood shall be replaced with the next corresponding Kraft Class tree.

2.5.2. Determination of the distance of the tree to the centre of the sample plot

2.5.2.1. The distance from the centre of the sample plot to the centre of the tree in height of 1.3 m in horizontal direction shall be measured with the help of an ultrasonic measuring device.

2.5.2.2. The belonging of trees (growing trees, deadwood, fallen trees) to a sample plot shall be determined by their diameter in height of 1.3 m.

2.5.2.3. A stand shall be mounted at the centre of the sample plot, to which an ultrasonic reflector shall be attached, for the determination of the distance. The source of ultrasound with the measurement indicator shall be held horizontally to the reflector by the central axis of the tree.

2.5.2.4. The distance of only standing trees to the centre of the sample plot shall be recorded in the inventory card of trees.

2.5.2.5. The distance for fallen trees shall be measured only to determine their belonging to the sample plot.

2.5.3. Determination of azimuth in order to identify the location of the tree

2.5.3.1. Azimuth of a tree shall be measured from the centre of the sample plot with an instrument intended for measuring of angles (compass), which has been secured with the help of a stand, with accuracy of 1^{o}.

2.5.3.2. The stand shall be aligned at the centre of the sample plot with the help of a weight. The direction for trees which have toppled shall be determined according to the line connecting the centre of the sample plot with an imaginary perpendicular line drawn towards the centre of the stump.

2.5.3.3. Azimuth shall be registered as an instrument reading, without taking into account the magnetic variation.

2.5.3.4. Azimuth shall be measured only for growing trees and snags, azimuth need not be measured for stumps and fallen trees.

2.5.3.5. Surveying of trees shall begin from magnetic North, clockwise.

2.5.4. Determination of the distance of the tree to the centre of the sample plot

2.5.4.1. The distance to the tree shall be measured in height of 1.3 m, towards the axis line of the tree (half of the diameter). If the tree is located in a relief slope, then the distance to it shall be measured towards height of 1.3 m (parallel to the land surface), determining the land surface angle and recalculating the distance on the horizontal plane.

2.5.4.2. If due to a poor visibility of the tree (accurate determination of azimuth or measuring of the distance is hindered by the projection of another closer tree bole) or it is not possible to take an accurate measurement of the diameter of the tree in height of 1.3 m, the reason for the possible error shall be noted in the "Notes" of the tree measurement sheet.

2.5.5. Determination of the characteristics of a tree bole

2.5.5.1. Measurement and assessment of trees and stumps shall be performed in each sample plot or sector, which falls into forest, forest land or also an area covered with trees outside the forest land.

2.5.5.2. The following shall be determined for each tree and entered in the tree inventory table:

2.5.5.2.1. 1. the distance of the tree to the centre of the sample plot (+/- 1 cm);

2.5.5.2.2. the tree azimuth (+/- 1^{o});

2.5.5.2.3. the species (according to the classifier);

2.5.5.2.4. the level;

2.5.5.2.5. the Kraft Class;

2.5.5.2.6. the diameter of the tree in height of 1.3 m (+/- 1 mm);

2.5.5.2.7. the diameter of the tree for inventory trees at the root collar (+/- 1 mm) (at each odd time of re-measuring);

2.5.5.2.8. the height of the tree for inventory trees (+/-0.5 m);

2.5.5.2.9. the height of the first green, first dry branch (+/- 0.5 m);

2.5.5.2.10. damages (type of the damage, intensity of the damage, height (location on the tree)).

2.5.6. Determination of the level of a tree

2.5.6.1. For each tree diameter of which is measured belonging to the first or second level shall be determined.

2.5.6.2. All trees height differences of which do not exceed 20% shall be joined in the first level. Other trees shall form the second level, if their height is not less than one fourth of the height of the first level trees.

2.5.6.3. Trees of the advanced growth, diameter of which exceeds 2.1 cm and which do not belong to the second level, shall be marked as the trees of the third level. Measurements in relation to these trees shall be used in order to determine the total amount of biomass.

2.5.7. Determination of the Kraft Class

2.5.7.1. The Kraft Class shall be determined for each tree of the first level, for which the diameter is measured. Kraft Classes shall be grouped according to the following principles:

2.5.7.1.1. .Kraft Class I – pre-dominant trees – the tallest and thickest trees of the stand, which have a well-developed crown and the tops of which overlook the joint canopy of the stand, shall be included in the dominant stand;

2.5.7.1.2. Kraft Class II – dominant trees – form the main canopy of the stand, their boles have slightly smaller dimensions than Kraft Class I trees. Such trees shall form 20-40% of the total number of trees, and their stock shall form 40-70% of the total stock of the stand, they shall be included in the dominant stand;

2.5.7.1.3. Kraft Class III – co-dominant trees – crowns of trees are relatively less developed, narrower, squeezed in between crowns of Kraft Class I and II trees and are located at the lower part of the joint canopy, however, they shall be included in the dominant stand;

2.5.7.1.4. Kraft Class IV – suppressed trees – tree crowns are shorter and narrower than those of Kraft Class III trees. They reach the lower part of the main canopy with theirs tops. Trees fall significantly behind Kraft Class I-III trees by dimensions, they are much thinner and shorter, they shall be included in the dominated stand;

2.5.7.1.5. Kraft Class V – very suppressed trees – are located below the dominant canopy of the stand, their crown is either dying off or has already died off, they shall be included in the dominated stand.

2.5.8. Determination of the diameter of a tree

2.5.8.1. For all trees in the sample plot, which have reached the diameter of 2.1 cm in height of 1.3 m, the diameter shall be measured in height of 1.3 m with accuracy of 0.1 cm.

2.5.8.2. The place where the diameter was measured shall not be marked on trees.

2.5.8.3. In measuring the diameter of a tree, the following provisions of measuring shall be conformed to:

2.5.8.3.1. the place where the diameter will be measured in height of 1.3 m shall be determined using a ruler that is 1.3 m long. If trees branch lower than in height of 1.3 m, diameters of two trees shall be measured. If there is a scar or a protuberance at the height of 1.3 m, then the diameter shall be measured above and below this place, recalculating the average value afterwards;

2.5.8.3.2. the diameter shall not be measured for trees, which have not reached the diameter of 2.1 cm in height of 1.3 m;

2.5.8.3.3. if tree is located on the border of the sample plot, then its diameter in height of 1.3 m from the root collar shall be measured;

2.5.8.3.4. if the vertical axis of the tree is located in the sample plot, then it shall be surveyed, if it is located outside the border of the sample plot, it shall not be surveyed;

2.5.8.3.5. the diameter of all trees shall be measured including the bark; if trees are without bark, for example, dead, then the diameter shall be measured without bark and a relevant note shall be made in the note box.

2.5.9. Determination of the height of a tree

2.5.9.1. Height shall be measured only for trees selected for inventory and for all snags.

2.5.9.2. The total height of a tree shall be measured, as well as the height of the first green branch and the height up to the first dry branch at least 2 cm in width shall be measured at every odd time of survey.

2.5.9.3. The height shall be measured with the height measuring device, with accuracy of 0.5 m.

2.5.9.4. The height of a tree shall be measured from the place where the top of the tree is accurately visible.

2.5.9.5. In case if a tree is growing obliquely, the distance for taking of the measurements of height shall be determined from the place located athwart to the top from the ground. Height shall be measured from the place towards which the slope of the tree is oriented. Generally, if it is possible to select a corresponding inventory tree, the height of oblique trees shall not be measured.

2.5.9.6. In determining distance from the perpendicular projection of the top of the tree to the centre of the tree bole, it is possible to calculate the length of the tree.

2.5.9.7. The height projection of a tree H_v in vertical plane and the distance of the top from the base H_h shall be measured. The height of a tree shall be calculated using the formula (5):

$$H=\sqrt{H_v^2+H_h^2} \qquad (3)$$

where,

H_v – height projection of a tree in vertical plane;

H_h – distance of the top from the base.

2.5.9.8.The height of the beginning of the crown shall be measured in the same way. The beginning of the crown shall be determined according to the first green branches growing from the bole.

2.5.10. Determination of radial increment and age

2.5.10.1. Radial increment (hereinafter – increment) shall be determined using the method of drill holes during the first cycle of survey for such forest elements, the average diameter of which exceeds 10 cm.

2.5.10.2.Increment and age for trees shall be determined outside the sample plot in the same forest stand to which the trees of the sample plot (sector) belong. If trees corresponding to the forest element are not located outside the sample plot, trees of the sample plot shall be drilled, returning the core back into the drill hole and smearing the drill hole up with grafting wax.

2.5.10.3.For forest elements, the average diameter of which is less than 10 cm, the increment shall be determined as the division of the forest element stock by the age of the forest element. For such purpose the average tree selected by estimation by sight shall be sown outside the sample plot in height of 1.3 m and the growth rings shall be counted.

2.5.10.4. The age of forest elements, the diameter of which exceeds 10 cm, shall be determined in the following way:

2.5.10.4.1. if there are more than 40% in the stand of the forest element stock, two trees shall be drilled until the pith for determination of age. If the age difference is more than 15 years, a third tree shall be drilled;

2.5.10.4.2. if the forest element stock in a stand is less than 40%, one average tree selected by estimation by sight shall be drilled for determination of age;

4.5.10.4.3. age shall be determined for all forest elements.

2.5.10.4.4. In order to determine increment, trees in addition to those trees for which age has been determined shall be drilled. Width of growth rings of the last 5 and 10 years shall be measured for determination of increment.

2.5.10.4.5. The last growth ring shall not be measured for determination of increment – measuring shall be commenced from the end of the latewood layer of the previous year.

2.5.10.4.6. At least five trees shall be drilled for determination of increment for each forest element. If the necessary number of increment trees is not found on the sample plot and its vicinity, a smaller number of trees shall be drilled.

2.5.10.4.7. Drilled trees must represent as different diameters as possible. Generally increment shall be determined for the 1-2 thinnest, 1-2 thickest and 2-3 medium trees of the stand (including trees drilled for determination of age).

2.5.10.4.8. A drill hole for determination of the width of growth rings shall always be made in the thickest place of the bark.

2.5.10.4.9. Drill holes for determination of the width of growth rings, if possible, shall not be made in eccentric trees. If a drill hole must be made in trees damaged by wildlife, the drill hole shall be made on the opposite side of the tree.

2.5.10.4.10. Width of the last 5 years and 10 years (for coniferous trees and oak, ash with accuracy of 0.1 mm, other tree species – with accuracy of 0.5 mm), as well as bark thickness up to the growth ring of the current year shall be recorded in the forest.

2.5.10.4.11. In determining age for rotten trees, in addition the thickness of the part of the wood from the end of the bark to the beginning of rot shall be determined.

2.5.10.4.12. The current increment of a forest element in re-measuring cycles shall be determined as the difference of the living tree stock between survey times.

2.5.10.4.13. 1Age of a forest element in re-measuring cycles shall be determined:

2.5.10.4.13.1.adding five years to the previously determined age;

2.5.10.4.13.2.if the forest element was not surveyed during the last time of survey, its age shall be determined according to the methodology described in this Chapter.

2.5.11. Description of forest stands, if the diameter of a dominant stand is less than 2.1 cm

2.5.11.1. In forest stands, in which the diameter of dominant tree species in height of 1.3 m has not reached 2.1 cm or the height has not reached 1.3 m, trees shall be measured as follows:

2.5.11.1.1. the average tree of the forest element shall be selected;

2.5.11.1.2. the height of the average tree shall be determined;

2.5.11.1.3. the diameter of the average tree in height of 1.3 m shall be determined:

2.5.11.1.4. if height of 1.3 m has been reached, the diameter shall be measured; if the diameter is less than 1 cm, it shall be marked as 1 cm;

2.5.11.1.5. if height of 1.3 m has not been reached, the diameter shall be marked as 1 cm.

2.5.11.1.6. Any element of the forest stand shall be marked with one measured and described tree, azimuth and marking the distance from the centre of the sample plot with 1.

2.5.11.1.7. In forest stands, in which the height of the dominant tree species has not reached height of 1.3 m, the age of trees shall be determined at the root collar; for planted trees the age of the plant need not be taken into account, if determination thereof is possible.

2.5.12. Determination of damages to trees

2.5.12.1. A note regarding damages shall be made for each tree in the sample plot.

2.5.12.2. The following shall be indicated for a damaged tree – the type, intensity, location of the damage (location on the tree). The name of the damage shall be indicated according to the classifier.

2.5.12.3. The following types of damages shall be recorded:

2.5.13.3.1. damages by insects;

2.5.13.3.2. damages by diseases;

2.5.13.3.3. damages by wildlife;

2.5.13.3.4. damages by wind, damages by snow and damages caused by other abiotic factors;

2.5.13.3.5. damages by fire;

2.5.13.3.6. damages by water;

2.5.13.3.7. other, including anthropogenic damages.

2.5.12.4. Damages shall be characterised as follows in detail:

2.5.12.4.1. damages to the bole (tumour, other diseases, scares resulting from damages by wildlife, etc.) – shall be registered if vertical projection of the damages at the widest places forms more than 10% of the bole perimeter). All scars located one above the other shall be considered one scar. If scars are located horizontally, their width shall be added up;

2.5.12.4.2.1 gnawed off sprouts, buds, needles, leaves or sprouts, buds, needles, leaves otherwise damaged by wildlife and diseases – until 10 years of age shall be registered itemising each damage at the vertex of the bole. Damages to the remaining part of the bole shall be recorded, if they form 20% or more;

2.5.12.4.3. if a tree has died, the intensity of the damage shall be noted as 100 and the tree shall be included in the dead group “snags”;

2.5.12.4.4. if the tree has a broken top, but the crown is alive and the tree keeps growing, the intensity of the damage shall be noted as 99.

2.5.12.5. Intensity of the damage shall be assessed as follows:

2.5.12.5.1. damages to the bole – width of the damage (%) from the tree perimeter;

2.5.12.5.2. gnawed off or otherwise damaged sprouts, buds, needles, leaves – percentage of damages from the total number.

2.5.12.6. The place of the damage shall be indicated as a part of the tree where the damage is recorded. The following places of damages shall be indicated:

2.5.12.6.1. roots and stumps up to 30 cm above the root collar;

2.5.12.6.2. the lower part of the bole from the height of the stump up to the first green branch;

2.5.12.6.3. whole bole from the height of the stump up to the top;

2.5.12.6.4. the upper part of the bole from the first green branch up to the top;

2.5.12.6.5. the top;

2.5.12.6.6. branches in the living crown;

2.5.12.6.7. branches which have grown out of the bole and are more than 2 cm wide;

2.5.12.6.8. buds and sprouts;

2.5.12.6.9. leaves and needles.

2.5.12.7. If there is more than one type of damage to the tree, the damage which is the closest to the root collar shall be recorded.

2.5.12.8. New tree damages which have not been recorded in the previous time of measuring shall be recorded during re-measuring of sample plots.

2.6. Measuring of static death rate (fallen deadwood)

2.6.1. In measuring death rate, the species, position (stub or lying deadwood) and diameter at the thin-end and butt-end shall be determined.

2.6.2. If a bole length with a stump has remained for fallen deadwood, the diameter of the butt-end shall be measured in the distance of 1.3 m from the root collar, assuming that the diameter of the thin-end is 1 cm.

2.6.3. If the fallen deadwood is a broken top, the diameter of the butt-end shall be measured at the breaking point, assuming that the diameter of the thin-end is 1 cm.

2.6.4. If the fallen deadwood is a bole shiver, diameters shall be measured at both ends of the fallen deadwood.

2.6.5. The diameter of stubs shall be measured in height of 1.3 m and at the end of the stub. If a tree part (fallen deadwood) that has separated from the stub is visible, it shall be assumed that the diameter of the thin-end of the stub is the diameter of the butt-end of such fallen deadwood.

2.6.6. If the stub is less than 1.3 m long, the butt-end of the stub shall be measured at the root collar.

2.6.7. If direct measuring of the thin-end of the stub is not possible, it shall be determined by the height of the stub, assuming that the diameter of the thin-end of the stub is the same as the height of the stub.

2.6.8. Freshly prepared assortments, wood at delivery roads, sown tree stumps, as well as stumps of broken trees less than 0.5 m short shall not be included in death rate.

2.6.9. Such fallen deadwood shall be measured, which are more than 6.1 cm wide at the butt-end. The belonging of the fallen deadwood to the sample plot A or B shall be determined according to the location of the fallen deadwood in the sample plot.

2.6.10. If the butt-end of the fallen deadwood is located in a sample plot, the length of the whole fallen deadwood shall be measured also if part of the fallen deadwood is located outside the sample plot.

2.6.11. If the butt-end of the fallen deadwood is located outside the sample plot, the fallen deadwood shall not be measured.

2.6.12. Death rate shall be classified according to its quality groups:

2.6.12.1. fresh death (until the bark of the bole begins to peal);

2.6.12.2. death of average age (from the time when bark of the bole begins to peal until epiphytes begin to occur on less than 10% of the cover of the visible surface of the bole);

2.6.12.3. pieces of rotten wood (cover of epiphytes is more than 10% of the visible surface of the bole).

2.6.13. All types of death rate shall be measured at odd times of surveying sample plots. Only such death rate shall be surveyed at even survey times, which has occurred after the previous measuring.

2.7. Description of changes of growing trees in cycles of re-measuring

2.7.1. The belonging of a tree to the following groups of changes of growing trees surveyed during the previous measuring shall be recorded in cycles of re-measuring (if applicable):

2.7.1.1. the tree has been cut down and taken away (or logging is taking place at the time of surveying);

2.7.1.2. the tree has been cut down and left in the forest;

2.7.1.3. the tree has fallen in windfall and taken away;

2.7.1.4. the tree is standing and dead;

2.7.1.5. the tree has fallen in windfall;

2.7.1.6. the tree is broken and forms a stub;

2.7.1.7. the top of the tree has been broken;

2.7.1.8. the tree has been gnawed off by a beaver.

2.7.2. The wood volume of any the abovementioned tree group shall be determined as the living tree volume calculated in the previous cycle of surveying. The sum of tree volumes belonging to each group in a sample plot shall form the stock corresponding to each group. The annual death rate and the fallen amount shall be determined by diving the total amount of the group by the number of years of the cycle of surveying.

2.8. Data registration and storage

2.8.1. The data obtained as a result of surveying sample plots initially shall be registered in work tables or their equivalents on the field computer.

2.8.2. Data of the monitoring of forest resources shall be copied from field computers to the data base not less than once in two weeks.

2.8.3. Logical control of data shall be performed and the data errors detected shall be returned to the field working group for correction in order to take repeated measurements in the sample plot.

2.8.4. Data obtained in surveying of sample plots for each year of the monitoring of forest resources and a full cycle of five years shall be permanently stored in the form of data base, ensuring a possibility to analyse the information in historical development. Permanent data bases shall ensure a possibility to supplement them with new indicators to be determined at any time.

2.8.5. The information compiled during preparation work and cartographic materials shall be stored in printed form until the next survey when they are updated with as new data as possible.

3. Methodology for Calculation

3.1.Determination of division of the area according to the types of land use and the categories of forest land

3.1.1. Division of the area according to the types of land use initially shall be determined after the first level of selecting sample plots where the type of land use shall be determined at points located at every 250 m according to orthophoto maps or satellite images in accordance with the types of land use determined in the State.

3.1.2. The total area of forest land according to the annual sample plot survey data shall be determined as follows:

$$\mathbf{Q_m=Q*p_m} \quad \text{or} \quad (4)$$

$$\mathbf{Q_m=K_m*q_R} \quad (5)$$

$$\mathbf{Q_m=(q_m*q_R)/500} \quad (6)$$

where,

Q – the total territory of Latvia;

Q_m – the areas of forest land;

p_m – proportion of forest land.

$\mathbf{P_m=K_m/K}$ (7)

where:

K_m – sum of the sample plot or its parts, which are included in the forest land and have been itemised, in units;

K – the total number of sample plots in the State.

$\mathbf{K= Q/q_R}$ (8)

where:

q_R – the area represented by one sample plot;

q_m – the area of all sample plots and sectors falling into forest land.

3.1.3.The area assessment error in percentage shall be calculated:

$\mathbf{P_{Qm}=(((1-p_m)/((kK-1)*p_m))^{1/2})*100}$ (9)

3.2.General principles for the calculation of the indicators of wood resources in sample plots

3.2.1.In each sample plot or sample plot sector the indicators of wood resources shall be calculated differently for each forest element, considering the smallest cluster of trees of the stand, for which the values of taxation indicators are determined, as the forest element. It is the part of a stand, which consists of one level, advanced growth and trees of species.

3.2.2.Values of additive taxation indicators at the stand level shall be obtained as the relevant sums. Indicators that depend on the area shall be expressed per 1 ha.

3.3.Determination of the number of trees

3.3.1.Number of the forest element trees N_i:

$$N_i = \frac{n_i}{m}, \quad i=1,2,...,l \qquad (10)$$

where:

N_i – number of the forest element trees, ha^{-1};

l – number of the relevant forest elements (species of trees);

n_i – number of trees in the sample plot in i-th forest element;

m – recalculation coefficient of the sample plot concentric circle (concentric circle Am =0,0025, concentric circle B_m =0,01, concentric circle Cm = 0,05).

3.3.2.Number of trees of a stand (level of a tree stand) N, ha^{-1}:

$$N = \sum_i N_i, \quad i=1,2,...,l \qquad (11)$$

3.4.Determination of the basal area of the stand

3.4.1.Basal area of the forest element G_i:

$$G_i = \frac{\pi}{40000m}\sum_j d_j^2 \quad , j=1,2,...,n_i \qquad (12)$$

where:

G_i – basal area of the forest element, $m^2 * ha^{-1}$**;**

d_j – diameter in height of 1.3 m, *cm*.

3.4.2.Basal area of the stand (level of the tree stand) G, $m^2 * ha^1$:

$$G = \sum G_i \quad , i=1,...,l \qquad (13)$$

3.5.diameter in height of 1.3 m

3.5.1.Diameter of the forest element in height of 1.3 m D_i, *cm*:

$$D_i = 100\sqrt{\frac{4G_i}{\pi \cdot N_i}} \qquad (14)$$

3.6.Average height

3.6.1.Average height of the forest element H_i, *m*:

3.6.2.if the number of inventory trees of the forest element n_u is less than 5, its average height shall be calculated as the arithmetic mean:

$$H_i = \frac{\sum_j h_j}{n_i} \quad , i=1,...,l \qquad (15)$$

where:

h_j – height of the tree, *m*

3.6.2.1.if the number of inventory trees of the forest element n_u is more than 5, the height shall be calculated for each tree according to the measurements of inventory trees: heights shall be calculated for each of trees according to the measuring of the inventory trees performed:

Table 1 Output Information for Determination of Parameters of the Contour Line Equation

Diameters, cm	D_1	D_2	. . .	D_k
Height of trees, m	H_1	H_2	. . .	H_k

3.6.3.an equilateral hyperbola arc with the following equation shall be used for levelling of heights:

$$H = H_0 + \frac{D}{K \cdot D + C} \qquad (16)$$

where H_0 – 1,3 m.

3.6.4.the parameters of the contour line equation shall be found using formulas (20) and (21):

$$C=\frac{N\cdot\sum\frac{1}{D_i\cdot(H_i-1{,}3)}-\sum\frac{1}{D_i}\cdot\sum\frac{1}{H_i-1{,}3}}{N\cdot\sum\frac{1}{D_i^2}-\sum\frac{1}{D_i}\cdot\sum\frac{1}{D_i}} \quad (17)$$

$$K=\frac{\sum\frac{1}{H_i-1{,}3}-C\cdot\sum\frac{1}{D_i}}{N} \quad (18)$$

3.6.5.after determination of the contour line height of each $D_{13\ m}$ tree is known.

3.7.Stock of the tree stand

3.7.1.Stock of the forest element M_i, $m^3 * ha^{-1}$:

$$M_i=\frac{1}{m}\sum_j v_j \quad , j=1,2,...,l \quad (19)$$

where:

v_j – volume of the tree bole, m^3:

$$v_j=\psi\cdot h_j^{\alpha}\cdot d_j^{\beta\cdot\lg h_j+\varphi} \quad (20)$$

where:

h_j – height, *m*;

d_j – diameter in height of 1.3 m, *cm*;

Ψ, α, β, φ – volume coefficients of the bole which depend on the species of the tree (Table 2)

Table 2 Values of Volume Coefficients of the Bole

Tree species	Ψ	α	β	φ
Pine	1.6541*10-^{4}	0.56582	0.25924	1.59689
Spruce	2.3106*10-^{4}	0.78193	0.34175	1.18811
Birch	0.9090*10-^{4}	0.71677	0.16692	1.75701
Aspen	0.502010-^{4}	0.92625	0.02221	1.95538
Black alder	0.7950*10-^{4}	0.77095	0.13505	1.80715
Grey alder	0.7450*10-^{4}	0.81295	0.06935	1.85346
Oak	1.3818*10-^{4}	0.56512	0.14732	1.81336
Ash	0.8530*10-^{4}	0.73077	0.06820	1.91124

3.7.2.Stock of the stand M, $m^3 *ha^{-1}$:

$$M=\sum_i M_i \quad , i=1,2,...,l \quad (21)$$

3.7.3.Stock of snags M_s, $m^3 *ha^{-1}$ shall be calculated using the formulas (22), (23) and (24).

3.7.4.Stock of fallen deadwood M_k, $m^3 *ha^{-1}$ shall be calculated:

3.7.4.1.if the length of the trunk has remained for a fallen deadwood and it altogether is located within the borders of the concentric circle, its volume shall be calculated using the formulas (23) and (25):

$$M_{k1} = \frac{1}{m}\sum_j v_j \quad , j=1,2,...,n_{k1} \qquad (22)$$

where:

n_{k1} – the number of trees corresponding to Paragraph 154.1;

3.7.4.2.if the fallen deadwood is a shiver of a tree or a part in the concentric circle of a torn-up tree, its volume shall be calculated according to the simple centre plot formula of F. Huber:

$$v_j = \frac{\pi \cdot d_{1/2}^2}{4} L \qquad (23)$$

where:

v_j – volume of the fallen deadwood, m^3;

L – length of the part in the concentric circle of the fallen deadwood, m;

$d_{1/2}^2$ – diameter at the middle of the fallen deadwood, m.

$$M_{k2} = \frac{1}{m}\sum_j v_j \quad , j=1,1,...,n_{k2} \qquad (24)$$

where:

n_{k2} – number of the trees corresponding to Paragraph 15

3.7.4.3.Total stock of the fallen deadwood Mk, $m^3 * ha^{-1}$:

$$M_k = M_{k1} + M_{k2} \qquad (25)$$

3.7.5.Stock of stubs M_{st},$m^3 *ha^{-1}$:

$$v_{st} = \frac{\pi \cdot d_{1/2}^2}{4} h_{st} \qquad (26)$$

where:

v_{st}, m^3 – volume of an individual stub;

d_{12} – diameter at the middle of the stub (to be measured directly), m;

h_{st} – height of the stub, m.

$$M_{st} = \frac{1}{m}\sum_j v_{stj} \quad , j=1,2,...,n_{st}, \qquad (27)$$

3.8.Biomass of the tree crowns

3.8.1.Biomass of the tree crowns shall be calculated according to the volume of the tree bole (Table 3):

Table 3 Biomass of the Tree Crowns According to the Volume of the Tree Bole

Height of trees, m	Biomass of the tree crown (t) per 1 m^3 of the bole volume		
	for pine	for spruce	for deciduous trees
6	0.15	0.47	0.18
8	0.12	0.38	0.15
10	0.10	0.31	0.13
12	0.08	0.26	0.11
14	0.07	0.22	0.09
16	0.06	0.18	0.08
18	0.05	0.15	0.07
20	0.04	0.13	0.06
22	0.04	0.11	0.05
24	0.03	0.10	0.04
26	0.03	0.09	0.04
28	0.02	0.08	0.03
30	0.02	0.07	0.03

3.9.Actual current increment of the stock

3.9.1.Actual current increment of the stock Z_{Mi} shall be calculated, using the formula (51):

$$Z_M = 12732{,}4\psi G H^{\alpha} D^{\beta \lg H + \varphi - 2} \left[\frac{Z_H(\alpha + \beta \lg D)}{H} + \frac{Z_D(\varphi + \beta \lg H)}{10D}\right] \quad (28)$$

where:

Z_{Mi} – actual current periodical increment of the stock on average, $m^3 * ha^1 * g^{-1}$;

G – basal area of the forest element in height of 1.3 m, $m^2 * ha^{-1}$;

H – the average height of the forest element, *m*;

D – the average diameter of the forest element in height of 1.3 m, *cm*;

Z_D – the increment in diameter of the relevant lustrum of the forest element, *mm*:

$$\boldsymbol{Z_D = 2iu} \quad (29)$$

where:

i – the average width of the relevant lustrum growth ring of the forest element, *mm*;

u – coefficient of the thickness of the bark (Table 4);

Z_H – the increment in height of the relevant lustrum of the forest element, *mm*:

$$Z_H = \frac{2iH(aD + b)}{cD + 100} \quad (30)$$

where:

a,b,c – coefficients of the course of growth in height.

Table 4 Values of Empirical Coefficients

Tree species	Increment in height			Bark volume			u
	a	b	c	p	q	w	
P	-0,0642	6,356	27,105	20,6	143,9	19,53	1,103
S	-0,0256	1,693	5,794	5,25	117,6	5	1,046
B	-0,0728	-1,51	-35,71	0,2	110,2	0,02	1,095
A	-0,0357	2,352	12,829	0,78	109,9	0,67	1,061
BA	0,005	7,24	90,909	-0,55	119	-0,36	1,081
GA	0,0958	3,478	45,988	-49,1	93,3	-45,83	1,05
O	-0,0728	-1,51	-35,71	0,2	110,2	0,02	1,095
As	-0,0728	-1,51	-35,71	0,2	110,2	0,02	1,095

in stands which have not reached 10 cm in diameter, the annual increment shall be calculated as general quantity on the whole level of the stand according to the formula:

$$\mathbf{Z_{Mn}=((M_A*n)/A)} \tag{31}$$

where:

M_A – current stock of the stand, (m^3/ha);

A – age in years;

n – time period (years).

⊠ Actual current increment of the stand Z_M, $m^3 * ha^{-1} * g^{-1}$:

$$Z_M = \sum_i Z_{Mi} \quad ,i=1,2,...,l \tag{32}$$

3.10.Mass of the stock and current increment of the stock

3.10.1.Values of the abovementioned categories of the stock and current increment of the stock shall be expressed in mass units (*t*) multiplied by recalculation coefficient k_m $(t*m^3)$.

3.10.2.The following values of the coefficient k_m have been determined in the Latvian State Standard LVS 82 *1997*: for pine and aspen – 0.81, for spruce – 0.73, for birch – 0.94.

3.11.Assessment of the wood

3.11.1.Values of the abovementioned categories of the stock and current increment of the stock shall be calculated including bark. Values of the relevant part of the wood shall be obtained dividing them by the bark volume coefficient *s*:

$$s = \frac{pd_j + q}{wd_j + 100} \tag{33}$$

where:

p,q,w – bark volume coefficient (Table 5).

3.12.Assessment of bark

3.12.1.Values of the bark of the abovementioned categories of the stock and current increment of the stock shall be calculated as differences, deducting values of the relevant part of the wood from the stock or its increment.

3.13.Evaluation of stand parameters and their variation per unit of area

3.13.1.Taking into account that the size of the basic sample plot in the monitoring of forest resources is 500 m^2, but it is divided into smaller sample plots and sectors with different dimensions, the calculation method of average weighted values shall be used in evaluating the average indicators and their variation. Indicators of the stand per 1 ha shall be calculated as follows:

$$\ddot{Y} = \sum(Y_i * p_i) / \sum p_i$$, where dispersion (34)

$$\sigma(\tilde{Y})^2 = \sum((Y_i - \ddot{Y})^2 * p_i) / \sum p_i$$ (35)

where:

Yi – value of the parameter of the stand per 1 ha in i-th sample plot unit

$$\mathbf{Y_i = y_i / x_i}$$ (36)

where:

y_i – value of the parameter in i-th sample plot unit;

x_i – area of the sample plot unit, m^2;

$\ddot{Y}$ – average indicator of the stand per 1 ha;

p_i – part of the sample plot.

$$p_i = x_i/q$$ (37)

where:

area of the sample plot (0.05 ha).

3.13.2.The average indicator per 1 ha dispersion shall be determined as follows:

$$\sigma(\ddot{Y})^2 = \sigma(\tilde{Y})^2/n$$ (38)

3.13.3.Standard deviation of average indicators in absolute values:

$$\sigma(\ddot{Y}) = (\sigma(\ddot{Y})^2)^{1/2}$$ (39)

and percentage:

$$P_{\ddot{Y}} = ((\sigma(\ddot{Y})) / \ddot{Y}) * 100$$ (40)

where:

$\sigma(\tilde{Y})^2$ – dispersion of the parameter of the stand per 1 ha;

n – number of units of sample plots (sample plots, sectors).

3.14.Evaluation of indicators of the monitoring of forest resources in the object of inventory

3.14.1.The tree stand, increment and their number in the whole object of monitoring shall be calculated multiplying the values of such indicators per 1 ha by the number of corresponding stand groups (strata):

$$Y_i = \ddot{Y}_i * Q_i \qquad (41)$$

where:

$\ddot{Y}_i$ – value of the inventory indicator of a stand group;

Q_i – area of the i-th stand group, ha.

3.14.2.An error of a tree stock and their number in the whole area shall be determined according to the formula:

$$P_{Ti} = (P(\ddot{Y}_i)^2 + (P_{(Qi)}{}^2)^{1/2} \qquad (42)$$

where:

$P(\ddot{Y}_i)$ – error of the monitored indicators of the i-th stand group (%);

$P_{(Qi)}$ – error of the area of the i-th stand group (%).

3.14.3.The increment balance for a group of stands in an object of inventory shall be evaluated combining the whole stock of sample plots of such group and including the trees cut down between the monitoring of forest resources.

3.15.Determination of age of a forest element

3.15.1.Age of a forest element shall be determined according to the formula:

$$\mathbf{A_f = (A_m + Ai)} \qquad (43)$$

where:

A_f – actual age of the forest element (years);

A_m – the age of trees determined in the forest at height of 1.3 m (years);

A_i – correction of the actual age (Table 5).

Table 5 Correction of Actual Age of the Forest Element

Tree species	Correction (years)
Coniferous trees	7
Oak, flattering elm, elm	5
Birch, black alder, ash, linden, maple	3
Aspen, poplar, grey alder	2

Annex 1 to Methodology of Activity “Monitoring of Forest Resources” of the National Forest Inventory

Classifiers to be Used in the Monitoring of Forest Resources

1. Types of sample plots

Type of the sample plot	Code
Permanent sample plots	1

2. Accessibility of the centre of sample plots

Centre of the sample plot	Code
Accesible	1
Not accesible	2

3. Forms of property

Name of the form of property	**Code**
Public forests:	
State	1
Other public authorities (local governments)	2
Private forests:	
Private individuals	3
Undertakings	4
Other private institutions	5

4. Categories of forest land and other land

Name	**Code**
Forest	10
Stunted stand	11
Burn	12
Windfalls	13
Felled area	14
Marshes	
Moss marsh	21
Herbaceous marsh	22
Transitional swamp	23
Glade	30
Glade	31
Glade for feeding forest animals	32
Heath	33
Sands	34
Overflowing clearing	40
Land under forest infrastructure objects	
Forest road	51
Clearance	52
Block ride	521
Mineralised strip	522
Forest ditch	53
Forest channel	531
Ditch route	532
Other objects of the forest infrastructure	
Seed plantations	541
Recovered land	542

Name	**Code**
Forest water reservoir	543
Recreational area	544
Other land of special significance	545
Land outside the forest land	
Arable land	60
Grassland	61
Forest in agricultural land (number of trees > 1000 units/ha^{-1})	62
River	63
Overgrown agricultural land (bushes or trees < 1000 units/ha^{-1})	64
Lake, pond	65
Agricultural ditch	66
Motor road with a belt	67
Railway with a belt	68
Overgrown quarry	69
Fresh quarry	70
Alluvial land of a river	71
Yard (household plot)	72
Towns, villages	73
Industrial routes (electricity, gas, oil, etc.)	74

5. Origin of the stand

Type of origin	**Code**
Naturally from seed	11
Naturally from sprouts	12
Anthropogenic (by sowing or planting)	20

6. Types of forest

Name	Code
1. Dry forests	
Cladinoso Callunosa	1
Vacciniosa	2
Myrtillosa	3
Hylocomiosa	4
Oxalidosa	5
Aegopodiosa	6
2. Wet forests	
Callunoso-sphagnosa	7
Vaccinioso-sphagnosa	8
Myrtilloso-sphagnosa	9
Myrtilloso politichosa	10
Dryopteriosa	11
3. Marsh forests	
Sphagnosa	12
Caricoso-phragmitosa	14
Dryopterioso-caricosa	15
Filipendulosa	16
4. Dry mineral forests	
Callunosa mel.	17
Vacciniosa mel.	18

Name	Code
Myrtillosa mel.	19
Mer curaliosa turf. mel.	21
5. Turf forests	
Callunosa turf. mel.	22
Vacciniosa turf. mel.	23
Myrtillosa turf. mel.	24
Oxalidosa turf. mel.	25

7. Division of trees in Kraft Classes

Name	Code
Kraft Class I	1
Kraft Class II	2
Kraft Class III	3
Kraft Class IV	4
Kraft Class V	5

8. Belonging of Tress to a Stand Level

Name	Code
1^{st} level tree	1
2^{nd} level tree	2
3^{rd} level tree	3

9. Tree species

Name	**Code**
Pine	1
Spruce	3
Birch	4
Black alder	6
Aspen	8
Grey alder	9
Oak (common)	10
Ash	11
Linden	12
Larch	13
Other pines (Jack pine, Weymouth pine)	14
Other spruces (white spruce, Douglas fir)	15
Elm, flattering elm	16
Beech	17
Hornbeam	18
Poplar	19
Willow	20
Goat willow	21
Cedar	22
White fir	23
Maple	24
Crabapple	51
Cherry	56

Bush species

Name	**Code**

Name	Code
Osier	30
Junipers	31
Rowan-trees	32
Buckthorns	33
Hazel-trees	34
Bird-cherries	35
Honeysuckles	36
Viburnums	37
Spindle-trees	38
Ribes sp.	39
Currants	40
Hawthorns	41
Jasmines	42
Elders	43
Spiraea	44
Lilacs	45
Cotoneasters	46
Barberries	47
Dogwood	48
Rosa sp.	49
Siberian peashrub	50
Coniferous trees	52
Deciduous tree	53
Unidentifiable species	54
Mezereon	55
Common buckthorn	30

Damages

Name	Code
Windthrows, windfalls, snow-breaks, snow crushes	10
Water	20
Wildlife	30
Fire	40
Diseases	50
Insects	60
Others	70

Damaged place

Name	Code
Roots and stumps up to 30 cm above the root collar	1
Lower part of the bole from stump up to the first green branch	2
Whole bole from the height of the stump up to the top	3
Upper part of the bole from the first green branch up to the top	4
Top	5
Branches in the living crown	6
Branches which have grown out of the bole and are more than 2 cm wide	7
Buds and sprouts	8
Leaves and needles	9

Placement of fallen deadwood

Name	Code
Lying fallen deadwood	none
Stub	2

Death rate quality groups

Name	Code
Fresh	1
Old (epiphytes cover > 10% of the surface)	2
Rotten wood	3
Living stub	4

Group of changes in trees in re-measuring of the sample plot

Name	Code
Tree has been cut down and taken away (or logging is taking place at the time of surveying)	1
Tree has been cut down and left in the forest	2
Tree has fallen in windfall and taken away	3
Tree is standing and dead (snag)	4
Tree has fallen in windfall	5
Tree is broken and forms a stub	6
The top of the tree has been broken	7
The tree has been gnawed off by a beaver	8

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ANNEX 4: CO_2 REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH, LATVIA'S ENERGY BALANCE

Table 1 Reference Approach estimations (Table 1B)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/GCV (1)	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
Liquid Fossil	Primary Fuels	Crude Oil	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Orimulsion	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Natural Gas Liquids	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
	Secondary Fuels	Gasoline	TJ		10 332.95	307.79	NO	395.73	9 629.43	1.00	NCV	9 629.43	18.91	182.05	NO	182.05	0.99	660.86
		Jet Kerosene	TJ		11 104.97	7 345.70	4 969.15	-1 253.09	43.21	1.00	NCV	43.21	19.71	0.85	NO	0.85	0.99	3.09
		Other Kerosene	TJ		NO	172.80	NO	-172.80	0.00	1.00	NCV	0.00	19.71	0.00	NO	0.00	0.99	0.00
		Shale Oil	TJ		275.45	236.10		NO	39.35	1.00	NCV	39.35	21.05	0.83	NO	0.83	0.99	3.01
		Gas / Diesel Oil	TJ		50 010.73	8 965.39	3 696.63	2 166.99	35 181.72	1.00	NCV	35 181.72	20.40	717.71	NO	717.71	0.99	2 605.29
		Residual Fuel Oil	TJ		6 861.40	40.60	6 374.20	-121.80	568.40	1.00	NCV	568.40	21.11	12.00	NO	12.00	0.99	43.56
		Liquefied Petroleum Gas (LPG)	TJ		6 967.62	3 688.74		NO	3 278.88	1.00	NCV	3 278.88	17.13	56.15	NO	56.15	1.00	205.89
		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		3 055.78	NO		167.44	2 888.34	1.00	NCV	2 888.34	22.00	63.54	63.54	0.00	0.99	0.00
		Lubricants	TJ		1 674.40	837.20	NO	-83.72	920.92	1.00	NCV	920.92	20.01	18.43	18.37	0.06	0.99	0.22
		Petroleum Coke	TJ		98.94	98.94		NO	NO	1.00	NCV	NO	27.50	NO	NO	NO	0.99	NO
		Refinery Feedstocks	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other Oil	TJ		41.86	NO		41.86	0.00	1.00	NCV	0.00	20.01	0.00	NO	0.00	0.99	0.00
Other Liquid Fossil												351.48		7.54	0.84	6.70		6.08
Gasoline type jet fuel			TJ	NO	518.52	518.52	NO	NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
Paraffin Waxes			TJ	NO	293.02	NO	NO	41.86	251.16	1.00	NCV	251.16	20.00	5.02	NA	5.02	NA	NA
Used Oils			TJ	29.23	29.23	NO	NO	NO	58.46	1.00	NCV	58.46	28.66	1.68	NO	1.68	0.99	6.08
White Spirit			TJ	NO	41.86	NO	NO	NO	41.86	1.00	NCV	41.86	20.00	0.84	0.84	0.00	0.99	0.00
Liquid Fossil Totals												52 901.73		1 059.11	82.75	976.36		3 528.00
Solid	Primary	Anthracite (2)	TJ	NO	137.17	54.87		NO	82.30	1.00	NCV	82.30	26.80	2.21	NO	2.21	0.98	7.93

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/GCV (1)	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
Fossil	Fuels	Coking Coal	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other Bituminous Coal	TJ	NO	3 644.58	104.88	NO	-26.22	3 565.92	1.00	NCV	3 565.92	25.68	91.56	NO	91.56	0.98	328.99
		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	90.45	NO	130.65		-70.35	30.15	1.00	NCV	30.15	28.93	0.87	NO	0.87	0.98	3.13
	Secondary	BKB[3] and Patent Fuel	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
	Fuels	Coke Oven/Gas Coke	TJ		160.74	NO		NO	160.74	1.00	NCV	160.74	23.84	3.83	NO	3.83	0.98	13.77
Other Solid Fossil												NA		NA	NA	NA		NA
Solid Fossil Totals												3 839.11		98.47	NA,NO	98.47		353.82
Gaseous Fossil		Natural Gas (Dry)	TJ	NO	57 821.29	NO		7 009.08	50 812.21	1.00	NCV	50 812.21	15.12	768.28	NO	768.28	1.00	2 817.01
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												50 812.21		768.28	NA,NO	768.28		2 817.01
Total												107 553.05		1 925.85	82.75	1 843.10		6 698.83
Biomass total												55 934.49		1 661.92	NO	1 661.92		5 978.50
		Solid Biomass	TJ	78 282.00	878.00	24 211.00		2 406.00	52 543.00	1.00	NCV	52 543.00	29.90	1 571.04	NO	1 571.04	0.98	5 645.25
		Liquid Biomass	TJ	3 450.74	1 108.73	3 319.41		23.56	1 216.49	1.00	NCV	1 216.49	20.00	24.33	NO	24.33	1.00	89.21
		Gas Biomass	TJ	2 175.00	NO	NO		NO	2 175.00	1.00	NCV	2 175.00	30.60	66.56	NO	66.56	1.00	244.04

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 (3) (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) (4) (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
Liquid Fuels (excluding international bunkers)	52.90	48.80	3 528.00	49.47	3 597.33	-1.36	-1.93
Solid Fuels (excluding international bunkers) (5)	3.84	3.84	353.82	3.86	355.64	-0.57	-0.51
Gaseous Fuels	50.81	50.81	2 802.92	50.15	2 764.33	1.31	1.40
Other (5)	2.04	2.04	90.56	2.07	77.38	-1.41	17.03
Total (5)	***109.59***	***105.49***	***6 775.30***	***105.56***	***6 794.69***	***-0.06***	***-0.29***

Table 3 Energy balance of Latvia in year 2012 (TJ)

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Natural gas	Fuelwood	Used tires	Municipal waste	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Straw
NCV	-	39.35	45.54	43.97	43.21	43.2	42.49	40.6	41.86	41.86	41.86	41.86	32.98	41.86	29.23	26.22	10.05	0.02	26.79	33.69	-	27.98	17.05	30	0.03	0.04	19.02	20.49	14.4
Production of energy resources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90	7	-	-	78233	-	-	-	43	3365	2073	102	38
Primary product receipts	29	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-	84	51	-	-	-	-	-	-
Imports	90030	275	6968	10407	11105	-	48651	6861	42	1674	3056	293	99	42	29	3776	-	-	161	57814	877	252	2063	41	448	213	-	-	-
Exports	22289	236	3689	375	7346	173	8965	41	-	837	-	-	99	-	-	157	130	-	-	-	24201	-	-	309	214	2891	-	-	-
Bunkering	10071	-	-	-	-	-	3697	6374	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interproduct transfer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stock changes	-1182	-	-	-396	1253	173	-2167	122	-	85	-168	-42	-	-42	-	26	70	-3	0	-7008	-2406	-	-119	0	2	-28	-	-	-
Statistical differences	1870	-	-	510	-	-	1360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross energy - total	58387	39	3279	10146	5012	-	35182	568	42	922	2888	251	-	-	58	3645	30	4	161	50806	52503	336	1995	-268	279	659	2073	102	38
Transformation sector	-514	-	-9	-	-	-	-140	-365	-	-	-	-	-	-	-	-579	0	-	-	-32445	-8273	-	-	327	-	-39	-1788	-102	-24
Autoproducer electricity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-126	-	-	-	-	-	-	-	-

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Natural gas	Fuelwood	Used tires	Municipal waste	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Straw
plants																													
Public CHP	-162	-	-	-	-	-	-	-162	-	-	-	-	-	-	-	-498	-	-	-	-25504	-1307	-	-	-	-	-39	-1237	-102	-
Autoproducer CHP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-640	-404	-	-	-	-	-	-551	-	-
Public heat plants	-330	-	-	-	-	-	-127	-203	-	-	-	-	-	-	-	-15	0	-	-	-5391	-4360	-	-	-	-	-	-	-	-
Autoproducer heat plants	-22	-	-9	-	-	-	-13	-	-	-	-	-	-	-	-	-66	-	-	-	-910	-1520	-	-	-	-	-	-	-	-24
Energy sector	170	-	-	-	-	-	170	-	-	-	-	-	-	-	-	-	-	-	-	977	-	-	-	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	505	7	-	-	-	-	-	-	-	-
Final consumption:	57703	39	3270	10146	5012	-	34872	203	42	922	2888	251	-	-	58	3066	30	4	161	16879	44223	336	1995	59	279	620	285	-	14
Transport	43444	-	1858	9707	5008	-	25992	-	-	879	-	-	-	-	-	-	-	-	-	-	-	-	-	-	279	526	-	-	-
international air transport	4984	-	-	-	4984	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
domestic air transport	31	-	-	7	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
road transport	34815	-	1858	9697	-	-	22465	-	-	795	-	-	-	-	-	-	-	-	-	-	-	-	-	-	279	463	-	-	-
rail transport	3441	-	-	-	-	-	3357	-	-	84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63	-	-	-
inland shipping	173	-	-	3	-	-	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pipeline transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Industry and construction:	5886	39	364	44	-	-	1997	203	42	-	2888	251	-	-	58	2149	2	0	161	7614	12344	336	1995	0	-	4	19	-	0
Iron and steel	0	-	-	-	-	-	0	-	-	-	-	-	-	-	-	184	-	-	161	1449	-	-	-	-	-	-	-	-	-
Chemicals	196	-	137	-	-	-	17	-	42	-	-	-	-	-	-	0	-	-	-	371	210	-	-	0	-	0	19	-	-
Non-ferrous metals	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-	1	-	-	-	168	-	-	-	0	-	1	-	-	-
Non-metallic minerals	291	-	-	-	-	-	291	-	-	-	-	-	-	-	-	1910	-	-	-	1280	23	336	1995	-	-	-	-	-	-
Transport equipment	33	-	-	-	-	-	33	-	-	-	-	-	-	-	-	0	-	-	0	101	-	-	-	-	-	-	-	-	-
Machinery	14	-	-	-	-	-	14	-	-	-	-	-	-	-	-	2	-	-	-	236	86	-	-	-	-	-	-	-	-
Mining and quarrying	133	-	-	-	-	-	133	-	-	-	-	-	-	-	-	0	-	-	-	67	1	-	-	-	-	-	-	-	-
Food processing, beverages and tobacco	529	39	137	-	-	-	121	203	-	-	-	-	-	-	29	27	-	-	-	1718	511	-	-	-	-	1	-	-	0
Pulp, paper and print	6	-	-	-	-	-	6	-	-	-	-	-	-	-	-	0	-	-	-	68	102	-	-	-	-	-	-	-	-
Wood processing	508	-	45	-	-	-	338	-	-	-	-	125	-	-	-	1	2	-	-	943	11094	-	-	-	-	0	-	-	-

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Kerosene type jet fuel	Kerosene	Diesel oil	RFO	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Petroleum coke	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Natural gas	Fuelwood	Used tires	Municipal waste	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Straw
Construction	4020	-	45	44	-	-	1014	-	-	-	2888	-	-	-	29	12	-	0	-	708	134	-	-	-	-	2	0	-	-
Textiles and leather	4	-	-	-	-	-	4	-	-	-	-	-	-	-	-	9	-	-	-	438	5	-	-	-	-	-	-	-	-
Other non-specified	149	-	-	-	-	-	23	-	-	-	-	126	-	-	-	3	-	-	-	67	178	-	-	-	-	-	-	-	-
Other sectors:	8373	-	1048	395	4	-	6883	-	-	43	-	-	-	-	-	917	28	4	-	9265	31879	-	-	59	-	90	266	-	14
Commercial/Institutional	1839	-	91	44	4	-	1700	-	-	-	-	-	-	-	-	288	28	4	-	4110	3829	-	-	-	-	34	133	-	0
Residential	2236	-	911	263	-	-	1062	-	-	-	-	-	-	-	-	577	-	-	-	4481	27764	-	-	59	-	-	-	-	-
Agriculture/Forestry	4000	-	46	88	-	-	3824	-	-	42	-	-	-	-	-	52	-	-	-	674	281	-	-	-	-	56	133	-	14
Fisheries	298	-	-	-	-	-	297	-	-	1	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-

Table 4 The amounts of distribution losses, interproduct transfers and statistical differences in 1990-2012 (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Interproduct transfers																							
Shale oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-669.0	-1101.8	-826.4	-78.7	0.0	0.0	0.0
Gasoline type jet fuel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-475.3	-216.1	-86.4	0.0	0.0	0.0	0.0	0.0
Kerosene type jet fuel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2635.8	-4623.5	-43.2	0.0	0.0	0.0	0.0	0.0	0.0
Other kerosene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-129.6	-86.4	-43.2	-129.6	-216.0	0.0	0.0	0.0	0.0
Diesel oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	339.9	127.5	127.5	212.5	0.0	0.0	0.0	0.0
RFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8120.0	11814.6	852.6	1218.0	893.2	121.8	0.0	0.0	0.0
Lubricants	167.4	125.6	125.6	83.7	83.7	41.9	125.6	167.4	125.6	41.9	41.9	41.9	0.0	83.7	-5651.1	-7451.1	41.9	41.9	0.0	0.0	0.0	0.0	0.0
Other oil products	-167.4	-121.8	-121.8	-81.2	-83.7	-41.9	-125.6	-167.4	-125.6	-41.9	-41.9	-41.9	0.0	-83.7	-41.9	-41.9	-41.9	-41.9	-41.9	-41.9	0.0	0.0	0.0
Statistical differences																							
Shale oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1101.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6380.0	2508.0	2464.0	2948.0	746.3	526.8	263.4	-439.0	0.0	0.0	131.7	834.1	878.0	526.8
Other kerosene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-345.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diesel oil	0.0	0.0	0.0	254.9	-2082.0	-2719.4	424.9	1359.7	1232.2	2209.5	5141.3	1784.6	3569.2	3909.1	3781.6	4588.9	5948.6	5353.7	4334.0	7648.2	9602.7	5778.6	1359.7

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
RFO	0.0	1177.4	-162.4	40.6	0.0	0.0	0.0	0.0	0.0	-649.6	974.4	0.0	1421.0	324.8	284.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paraffin waxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-41.9	0.0	0.0	0.0	0.0
Other oil products	167.4	121.8	125.6	83.7	83.7	41.9	125.6	167.4	125.6	41.9	41.9	41.9	0.0	83.7	41.9	41.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.0	439.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Losses																							
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.5	45.5	45.5	45.5	45.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline	44.0	44.0	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diesel oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	127.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	134.7	1611.5	1481.5	1434.2	1004.1	977.8	1008.8	1042.4	1043.3	1009.0	674.7	472.6	572.3	739.9	537.1	167.6	268.6	335.4	336.2	640.4	269.4	505.4	505.0
Coal	113.8	113.8	113.8	56.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	0.0	0.0	0.0	0.0
Peat	108.4	31.0	15.5	46.5	0.0	0.0	0.0	0.0	15.5	15.5	92.9	0.0	0.0	371.8	15.5	0.0	0.0	0.0	62.0	15.5	92.9	0.0	0.0

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 2012 is evaluated by sectors in the tables below. The completeness is estimated by the gases (CO_2, CH_4, N_2O, 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

A.5.1 Energy

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				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2**	**CH_4**	**N_2O**	Explanation, -if not estimated -if included elsewhere
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	
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	NA,NO	NA,NO	NA,NO	Notation key "NA" put after the ERT expert's recommendation.
b. Natural Gas	X	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	NO	NO	
Underground storage	NO	X	NO	

A.5 2 Industrial Processes

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 separate because software did not provide possibility to input NOx and NMVOC emissions from cement production processes to original 2.A.1 sub-sector
Production of Bricks	IE	IE	IE	The data for 1990-1992 is reported in the aggregated level in this sector, data for other years are reported for each bricks production plant separately.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
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)	NO	NO	NO	
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	NE	NE	
Production of Glass Fibre	X	NE	NE	
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	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	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				

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
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	

A.5.3 F-gases

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFC-23	HFC-32	HFC-41	HFC-43-10mee	HFC-125	HFC-134	HFC-134a	HFC-152a	HFC-143	HFC-143a	HFC-227ea	HFC-236fa	HFC-245ca	Total PFCs	SF_6	Explanation, -if not estimated -if included elsewhere
C. Metal Production																
Aluminium Production																
SF_6 Used in Aluminium Foundries															NO	
SF_6 Used in Magnesium Foundries															NO	
E. Production of Halocarbons and SF_6																
1. By-product Emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Production of HCFC-22	NO															
Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2. Fugitive Emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3. Other *(as specified in table 2(II).C,E)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Other non-specified	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
F(a). Consumption of Halocarbons and SF_6 (actual emissions - Tier 2)																
1. Refrigeration and Air Conditioning Equipment	X	X	NO	NO	X	NO	X	X	NO	X	NO	NO	NO	NO	NO	
2. Foam Blowing	NO	NO	NO	NO	NO	NO	X	X	NO	NO	NO	NO	NO	NO	NO	
3. Fire Extinguishers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO	NO	NO	
4. Aerosols/Metered Dose Inhalers	NO	NO	NO	NO	NO	NO	X	NO	NO	NO	NO	NO	NO	NO	NO	
5. Solvents	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
6. Other applications using ODS(3) substitutes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	

7. Semiconductor Manufacture	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
8. Electrical Equipment															X	
9. Other *(as specified in table 2(II)F)*																
Production of shoes	NO	NO	NO	NO	NO	NO	X	NO	NO	NO	NO	NO	NO	NO	NO	
G. Other *(please specify)*																
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
F(p). Total Potential Emissions of Halocarbons (by chemical) and SF_6 [(4)]																
Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Import:																
In bulk	NO	NO	NO	NO	NO	NO	X	NO	NO	NO	NO	NO	NO	NO	NE	Emissions are not possible to estimate because of lack of this kind statistical information
In products	NO	X	NO	NO	X	NO	X	X	NO	X	NO	NO	NO	NO	NE	Emissions are not possible to estimate because of lack of this kind statistical information
Export:																
In bulk	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
In products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Destroyed amount	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	

A.5.4. Solvent and other product use

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	X		X	
B. Degreasing and Dry Cleaning	X	NO	X	
C. Chemical Products, Manufacture and Processing	X		X	
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	

A.5.5. Agriculture

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	NO		
10. Other *(as specified in table 4.A)*	NO		
Other non-specified	NO		
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	NO		
Other non-specified	NO		
B. Manure Management (continued)			
11. Anaerobic Lagoons		NO	
12. Liquid Systems		X	
13. Solid Storage and Dry Lot		X	
14. Other AWMS		NO	
C. Rice Cultivation			
1. Irrigated	NO		
2. Rainfed	NO		
3. Deep Water	NO		
4. Other *(as specified in table 4.C)*	NO		
Other non-specified	NO		

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	Explanation, -if not estimated -if included elsewhere
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	NO	NO	
2. Pulses	NO	NO	
3. Tubers and Roots	NO	NO	
4. Sugar Cane	NO	NO	
5. Other *(as specified in table 4.F)*	NO	NO	
Other non-specified	NO	NO	
G. Other			
Other non-specified	NO	NO	

A.5.6. LULUCF

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**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	IE,NO	IE,NO	
B. Cropland				
1. Cropland remaining Cropland	X	NO	NO	
2. Land converted to Cropland	X	NO	NE/NO	
C. Grassland				
1. Grassland remaining Grassland	X	X	X	
2. Land converted to Grassland	IE/NO	NO	NO	
D. Wetlands				
1. Wetlands remaining Wetlands	X	IE/NO	IE/NO	
2. Land converted to Wetlands	NO	NE/NO	X	
E. Settlements				
1. Settlements remaining Settlements [3]	NA	NE	NE	No data
2. Land converted to Settlements	X	NE	NE	No data
F. Other Land				
2. Land converted to Other Land	NO	NE	NE	No data
G. Other				
Harvested Wood Products	IE	IE	IE	HWP accounted under living biomass on forest land remaining forest as losses considering instant oxidation of all harvested biomass (above- and below-ground)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**Net CO_2 emissions/removals**	**CH_4**	**N_2O**	Explanation, -if not estimated -if included elsewhere
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

A.5.7. Waste

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	NO	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)*		NO	NO	
Other non-specified		NO	NO	
C. Waste Incineration	X	NO	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 activities:

QA/QC program, including check-lists and procedure description for independent experts for quality assurance of GHG inventory are defined according to 27.03.2012. Cabinet of Ministers Regulation No. 217 (Annex 4): http://www.likumi.lv/doc.php?id=246033.

The following table presents general schedule for implementation of QC/QA activities:

No.	Action	Month											
		05	06	07	08	09	10	11	12	01	02	03	04
Preparation of inventory													
1.	Annual meeting for the experts involved in the inventory in order to discuss and evaluate problems, methods, the QA/QC plan and the necessary activities for next inventory	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 UNFCCC									X	X	X	X
5.	Amending of the prepared National Inventory Report of the European Commission and the UNFCCC 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		X	X	X	X	X	X	X	X	X	X	
9.	UNFCCC GHG inventory review and Draft Review Reports				X	X	X	X	X				

No.	Action	Month											
		05	06	07	08	09	10	11	12	01	02	03	04
10.	Quality assurance (third part experts)								X	X	X	X	
11.	Sending of the inventory (final version) to the UNFCCC Secretariat and European Commission												X
12.	Amending the inventory pursuant to review reports of the UNFCCC 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	
16.	Entering of emissions in the common standardised reporting format software						X	X	X	X			
17.	Entering of emissions in the CRF Reporter if there are changes										X	X	
18.	Analysis and entering of the key sources in the CRF Reporter									X	X	X	
19.	Generatio the CRF and *XML* for sending									X		X, if changed	X, if changed
20.	Analysis of uncertainties						X	X	X	X	X		
21.	Verification	X	X	X	X	X	X			(X)	(X)	(X)	

Example of check – list for F-gases sector:

Year of the inventory examined	2013
Category of sources	2.F Consumption of Halocarbons and SF_6
Evaluation prepared by	Janis Rekis
Materials used	1. UNFCCC CRF Reporter Version 3.6.2 LATVIA-2013-v1.5; 2. Latvia's national inventory report. Submission under UNFCCC and the Kyoto Protocol. Common Reporting Formats (CRF). 1990 – 2011. Riga, 2013; 3. Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories. 2007; 4. IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. 2000; 5. Emission calculations file F-gazu_ datu baze_AP.xls (internal documentation); 6. recalculations 20130515.xlsx; 7. consistency 20130515.xlsx; 8. Uncertainties_2011_15042013.xls

Activity of QC	Procedures	Institution/person responsible for QC	Short description of the activity of QA (date/person/reference to document)	Conclusion regarding the examination	Necessary activities in order to improve the quality of inventory	Actions taken
1. Check that assumptions and criteria for the selection of activity data and emission factors are documented	Cross-check descriptions of activity data and emission factors with information on source categories and ensure that these are properly recorded and archived	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5]	The descriptions of activity data, emission factors and methodology used with information on source categories is recorded in the internal documentation and archived	No needed activities	
2. Check for transcription errors in data input and reference	Confirm that bibliographical data references are properly cited in the internal documentation	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5]	Activity data and emission factors are cited to references and documented in the [2]	To provide more clear information about activity data, emission factors and assumptions in [5] in more systematized way	

	Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5]	Emission data [1, 2] in general in line with [5]. Except: - check all values provided in table 4.33 of [2] (even total and subtotals are incorrect) with [1] and [5]. Provided data of SF6 in table 4.33 of [2]; - check value for 2001 - 2011 between [5] and [1] for 2.IIA.F.1.6; - check value for 2006 between [5] and [1] for 2.F.3; - check value for 2007 and 2008 between [5] and [1] for 2.F.4; - check value for 2010 between [5] and [1] for 2.F.8; - invalid formula for HFC-134a emission calculation in [5] for 2.F.9 but in [1] emissions reported correctly Activity data [1, 2] are in general in line with [5]. Except: - number of household in statistics is available from 1996	Correct errors	Values checked and corrections implemented in NIR Table 4.33 2.IIA.F.1.6 - It is done, values mach between [5] and [1]. 2.F.3 - Value for 2006. checked It is correct, because in year 2006 only one enterprise reported the amount of HFC-227ea disposed. So the emissions from disposal occur only in this year. 2.F.4. – checked, corrected 2.F.8. - checked, corrected 2.F.9. – corrected - number of households recalculated for all time series due to updated number of inhabitants. Number for 1995 extrapolated from 1996.
3. Check that emissions are calculated correctly	Reproduce a representative sample of emissions calculations	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 5]	Emissions are calculated correctly in [5], and reported in [1] and [2]. Except: - recharging with HFC-134a is incorrectly calculated for 2.IIA.F.1.1 – wrong use of formula and dynamic nature of time line should be taken into account (residual values and new equipment vs. lifetime of equipment); - in lines “Passenger cars equipped with MACs (%)” and “Trucks equipped with MACs (%)” circular references in formulas is observed for 2.IIA.F.1.6. Percentage should be calculated taking into account the dynamic nature of time line (residual values and new equipment vs.	Do the recalculation	2.IIA.F.1.1 – formula checked, corrected 2.IIA.F.1.6 – circular reference corrected 2.F.2 – all amount of HFC 134 a is taken into account.

				lifetime of equipment); - why in calculation of HFC-152 in 2.F.2 all amount of HFC-134a is not taken into account?		
	Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy	-	-	-	-	
4. Check that parameter and emission units are correctly recorded and that appropriate conversion factors are used	Check that units are properly labelled in calculation sheets	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 5]	Units are properly labeled in calculation sheets	No needed activities	
	Check that units are correctly carried through from beginning to end of calculations	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 5]	Units are correctly carried through from beginning to end of calculations	No needed activities	
	Check that conversion factors are correct	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5]	Conversion factors are correct	No needed activities	
	Check that temporal and spatial adjustment factors are used correctly	-	-	-	-	
5. Check the integrity of database files	Confirm that the appropriate data processing steps are correctly represented in the database	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [5]	A database is a excel file and steps for data processing are represented properly	No needed activities	
	Confirm that data relationships are correctly represented in the database	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [5]	Relationships are correctly represented	No needed activities	
	Ensure that data fields are properly labelled and have the correct design specifications	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [5]	Data fields are properly labeled and have the correct design specifications	No needed activities	
	Ensure that adequate documentation of database and model structure and operation are archived	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [5]	Required documentation of database archived	No needed activities	
6. Check for consistency in data between source categories	Identify parameters (e.g. activity data, constants) that are common to multiple source categories and	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5]	Values of parameters are consistent	No needed activities	

	confirm that there is consistency in the values used for these parameters in the emissions calculations					
7. Check that the movement of inventory data among processing steps is correct	Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1]	Emissions data are correctly aggregated	No needed activities	
	Check that emissions data are correctly transcribed between different intermediate products	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 5]	Emission data are copied from [5] to [1] and [2]	No needed activities	
8. Check that uncertainties in emissions and removals are estimated or calculated correctly	Check that qualifications of individuals providing expert judgement for uncertainty estimates are appropriate	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [2, 8]	Qualifications for uncertainty estimates are appropriate	No needed activities	
	Check that qualifications, assumptions and expert judgements are recorded. Check that calculated uncertainties are complete and calculated correctly	-	-	-	-	
	If necessary, duplicate error calculations or a small sample of the probability distributions used by Monte Carlo analyses	-	-	-	-	
9. Undertake review of internal documentation	Check that there is detailed internal documentation to support the estimates and enable duplication of the emission and uncertainty estimates	LEGMC / A.Pulke	03.06.2013. / J.Rekis	The detailed internal documentation is not presented	The detailed internal documentation is not presented	QC check lists are provided and stored in the central archiving system (on ftp folder), as well as instruction how to prepare GHG inventory (estimates and description) for Industrial

						Processes is provided on the common folder.
	Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5, 8]	Inventory data, supporting data, and inventory records are archived and stored at LEGMC and ftp://212.70.174.35/	No needed activities	
	Check integrity of any data archiving arrangements of outside organisations involved in inventory preparation	LEGMC / A.Pulke	-	-		
10. Check methodological and data changes resulting in recalculations	Check for temporal consistency in time series input data for each source category	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [5, 6, 7]	Emissions are consistent in time series	No needed activities	
	Check for consistency in the algorithm/method used for calculations throughout the time series	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [5, 6, 7]	Calculations is done according [3, 4]	No needed activities	
11. Undertake completeness checks	Confirm that estimates are reported for all source categories and for all years from the appropriate base year to the period of the current inventory	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1]	The completeness test passed for all years [1]	No needed activities	
	Check that known data gaps that result in incomplete source category emissions estimates are documented	-	-	-		
12. Compare estimates to previous estimates	For each source category, current inventory estimates should be compared to previous estimates. If there are significant changes or departures from expected trends, recheck estimates and explain any difference	LEGMC / A.Pulke	03.06.2013. / J.Rekis / [1, 2, 5, 6]	Comparison of current estimates with previous estimates is done.	No needed activities	

A.6.2: Emission trends

CO_2

Years 1990-2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**18 412.06**	**16 900.11**	**13 704.18**	**11 614.20**	**10 044.74**	**8 840.24**	**8 916.96**	**8 383.68**	**7 999.16**	**7 365.97**	**6 773.55**
A. Fuel Combustion (Sectoral Approach)	18 412.05	16 900.10	13 704.17	11 614.19	10 044.73	8 840.23	8 916.95	8 383.67	7 999.15	7 365.97	6 773.54
1. Energy Industries	6 267.55	5 747.49	4 923.30	3 969.77	3 731.92	3 417.88	3 549.52	3 305.68	3 349.94	2 923.74	2 472.58
2. Manufacturing Industries and Construction	3 742.90	2 804.05	2 368.39	2 097.88	1 899.68	1 863.11	1 826.91	1 780.98	1 559.86	1 411.70	1 151.91
3. Transport	2 897.89	2 714.09	2 419.58	2 229.80	2 115.01	2 013.78	1 980.38	1 972.17	1 947.93	1 901.88	2 111.87
4. Other Sectors	5 503.71	5 634.46	3 992.90	3 316.73	2 298.12	1 545.46	1 559.94	1 324.74	1 141.23	1 128.49	1 037.04
5. Other	NO	NO	NO	NO	NO	NO	0.19	0.10	0.19	0.15	0.14
B. Fugitive Emissions from Fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2. Industrial Processes	**597.35**	**535.56**	**256.54**	**81.43**	**141.99**	**154.91**	**167.08**	**172.22**	**172.80**	**205.93**	**155.10**
A. Mineral Products	584.53	526.85	250.81	74.43	135.44	150.48	163.59	164.22	164.30	198.22	146.67
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	42.91	42.75	42.50	41.58	40.86	40.21	39.71	39.32	38.93	38.58	38.30
5. Land Use, Land-Use Change and Forestry(2)	**-20 064.43**	**-21 152.45**	**-19 841.84**	**-19 644.93**	**-20 799.03**	**-18 847.05**	**-19 456.52**	**-16 646.44**	**-15 139.37**	**-14 827.31**	**-14 420.97**
A. Forest Land	-22 317.70	-23 382.81	-23 186.52	-22 580.54	-23 192.85	-20 955.98	-21 055.82	-17 349.89	-15 392.10	-14 897.52	-14 354.02
B. Cropland	1 853.56	1 873.71	1 895.68	1 916.84	1 938.14	1 957.55	1 622.13	1 623.90	1 628.72	1 631.69	1 636.69
C. Grassland	207.28	175.64	150.24	117.37	83.24	49.17	11.93	-27.44	-56.78	-96.48	-132.03
D. Wetlands	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80
E. Settlements	135.66	162.29	189.77	220.05	247.34	276.19	263.01	283.77	306.78	328.98	351.38
F. Other Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	36.96	-1.08	1 089.19	661.55	105.30	-193.77	-317.57	-1 196.58	-1 645.78	-1 813.78	-1 942.80
6. Waste	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0.74**	**1.18**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.74	1.18
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total CO_2 emissions including net CO_2 from LULUCF	**-1 012.11**	**-3 674.03**	**-5 838.62**	**-7 907.72**	**-10 571.44**	**-9 811.68**	**-10 332.77**	**-8 051.22**	**-6 928.48**	**-7 216.08**	**-7 452.84**
Total CO_2 emissions excluding net CO_2 from LULUCF	**19 052.32**	**17 478.42**	**14 003.22**	**11 737.21**	**10 227.59**	**9 035.36**	**9 123.75**	**8 595.22**	**8 210.89**	**7 611.22**	**6 968.13**
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**
Aviation	221.15	299.01	84.10	84.10	77.87	77.87	99.67	99.67	90.33	90.33	80.98
Marine	1 499.94	448.49	569.64	672.88	885.63	476.72	308.64	224.60	47.10	31.44	25.15
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	2 964.03	3 476.19	3 466.38	3 862.35	4 002.69	4 538.71	4 744.63	4 755.57	4 693.52	4 608.23	4 280.66

Years 2001-2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Change from base to latest reported year**
	(Gg)												**%**
1. Energy	**7 177.87**	**7 186.45**	**7 384.49**	**7 405.92**	**7 506.73**	**7 952.19**	**8 264.52**	**7 837.86**	**7 162.28**	**7 978.00**	**7 135.27**	**6 794.83**	**-63.10**
A. Fuel Combustion (Sectoral Approach)	7 177.87	7 186.44	7 384.49	7 405.92	7 506.72	7 952.19	8 264.52	7 837.85	7 162.28	7 978.00	7 135.26	6 794.83	-63.10
1. Energy Industries	2 419.14	2 314.55	2 246.69	2 059.10	2 047.78	2 073.32	1 943.80	1 916.58	1 867.06	2 249.50	2 072.05	1 855.24	-70.40
2. Manufacturing Industries and Construction	1 069.05	1 125.04	1 141.92	1 149.56	1 164.87	1 212.20	1 215.33	1 100.28	883.12	1 073.80	874.12	928.11	-75.20
3. Transport	2 502.24	2 580.90	2 725.06	2 864.10	2 990.42	3 298.23	3 735.21	3 528.57	3 130.27	3 205.48	2 839.14	2 736.95	-5.55
4. Other Sectors	1 187.27	1 159.07	1 264.65	1 323.52	1 296.02	1 360.91	1 367.32	1 289.00	1 276.48	1 441.35	1 342.74	1 267.19	-76.98
5. Other	0.17	6.89	6.17	9.63	7.63	7.53	2.86	3.42	5.35	7.87	7.22	7.33	100.00
B. Fugitive Emissions from Fuels	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-71.25
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-71.25
2. Industrial Processes	**176.79**	**186.88**	**200.73**	**212.45**	**201.14**	**231.18**	**233.91**	**224.00**	**216.24**	**480.35**	**569.83**	**590.08**	**-1.22**
A. Mineral Products	168.75	179.27	188.56	199.54	188.78	218.61	219.34	215.27	206.68	469.07	569.36	588.21	0.63
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal Production	8.04	7.60	12.16	12.92	12.36	12.57	14.57	8.73	9.56	11.28	0.48	1.87	-85.41
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Solvent and Other Product Use	37.85	37.71	37.12	36.61	36.55	41.47	43.07	43.93	39.41	41.69	45.44	48.51	13.05
5. Land Use, Land-Use Change and Forestry(2)	**-14 332.94**	**-12 008.23**	**-13 329.85**	**-13 269.49**	**-13 664.97**	**-15 603.43**	**-15 032.40**	**-16 600.49**	**-14 663.19**	**-11 415.76**	**-12 090.07**	**-12 558.60**	**-37.41**
A. Forest Land	-14 161.76	-12 075.08	-13 221.58	-13 109.38	-13 396.73	-15 746.98	-15 610.41	-17 527.37	-15 510.57	-11 460.73	-11 883.28	-13 254.30	-40.61
B. Cropland	1 600.85	1 616.61	1 626.68	1 605.03	1 605.35	1 604.94	1 608.42	1 606.66	1 507.71	1 430.48	1 400.50	1 345.45	-27.41

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
	(Gg)												%
C. Grassland	-173.32	-195.19	-226.34	-282.48	-334.45	-336.46	-457.66	-509.52	-551.16	-554.31	-526.86	-537.89	-359.50
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	0.00
E. Settlements	525.45	567.28	608.69	651.16	692.66	734.28	712.20	755.62	802.92	836.64	860.83	897.08	561.25
F. Other Land	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	-2 143.96	-1 941.66	-2 137.09	-2 153.63	-2 251.60	-1 879.01	-1 304.74	-945.68	-931.89	-1 687.64	-1 961.05	-1 028.74	-2 883.47
6. Waste	**2.34**	**0.30**	**0.37**	**0.44**	**0.44**	**1.51**	**1.18**	**0.50**	**0.34**	**0.34**	**0.33**	**0.31**	**100.00**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
C. Waste Incineration	2.34	0.30	0.37	0.44	0.44	1.51	1.18	0.50	0.34	0.34	0.33	0.31	100.00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.00**
Total CO_2 emissions including net CO_2 from LULUCF	**-6 938.09**	**-4 596.89**	**-5 707.14**	**-5 614.07**	**-5 920.11**	**-7 377.07**	**-6 489.71**	**-8 494.20**	**-7 244.92**	**-2 915.38**	**-4 339.21**	**-5 124.87**	**406.36**
Total CO_2 emissions excluding net CO_2 from LULUCF	**7 394.85**	**7 411.34**	**7 622.70**	**7 655.43**	**7 744.86**	**8 226.36**	**8 542.69**	**8 106.29**	**7 418.27**	**8 500.38**	**7 750.86**	**7 433.73**	**-60.98**
Memo Items:													
International Bunkers	**697.07**	**733.88**	**714.90**	**788.19**	**1 003.69**	**825.81**	**810.74**	**950.79**	**1 181.67**	**1 156.28**	**1 038.54**	**1 125.20**	**-34.62**
Aviation	80.98	84.10	121.50	148.08	179.57	201.59	245.82	296.15	311.90	357.76	359.15	363.38	64.32
Marine	616.09	649.79	593.40	640.11	824.12	624.22	564.93	654.64	869.77	798.52	679.39	761.83	-49.21
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 Emissions from Biomass	4 800.70	4 772.91	5 073.47	5 349.01	5 353.08	5 389.78	5 274.29	4 994.18	5 714.58	5 659.20	5 185.48	5 840.38	97.04

N_2O

Years 1990-2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)										
1. Energy	**0.55**	**0.54**	**0.48**	**0.43**	**0.41**	**0.42**	**0.42**	**0.41**	**0.39**	**0.38**	**0.37**
A. Fuel Combustion (Sectoral Approach)	0.55	0.54	0.48	0.43	0.41	0.42	0.42	0.41	0.39	0.38	0.37
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
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
3. Transport	0.27	0.26	0.22	0.16	0.15	0.15	0.15	0.16	0.15	0.14	0.15
4. Other Sectors	0.20	0.22	0.20	0.21	0.20	0.21	0.21	0.19	0.17	0.18	0.17
5. Other	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)										
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**
A. Mineral Products	NA,NE,NO	NA,NE,NO	NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Agriculture	**11.55**	**10.71**	**8.21**	**5.72**	**4.96**	**4.38**	**4.32**	**4.33**	**4.17**	**3.92**	**4.00**
B. Manure Management	1.84	1.76	1.42	0.88	0.75	0.75	0.69	0.65	0.60	0.53	0.52
D. Agricultural Soils	9.71	8.95	6.79	4.83	4.20	3.63	3.62	3.68	3.58	3.39	3.48
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**0.51**	**0.52**	**0.67**	**0.58**	**0.59**	**0.62**	**0.64**	**0.65**	**0.65**	**0.69**	**0.69**
A. Forest Land	0.47	0.47	0.53	0.47	0.47	0.48	0.48	0.48	0.48	0.49	0.49
B. Cropland	0.01	0.02	0.03	0.04	0.06	0.07	0.07	0.08	0.08	0.08	0.09
C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	0.02	0.03	0.10	0.05	0.06	0.08	0.09	0.09	0.09	0.11	0.11
6. Waste	**0.21**	**0.21**	**0.21**	**0.20**	**0.20**	**0.20**	**0.19**	**0.19**	**0.19**	**0.19**	**0.18**
B. Waste-water Handling	0.21	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.18
C. Waste Incineration	NO	NO	NO	NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00	0.00
D. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total N2O emissions including N2O from LULUCF	**12.82**	**11.99**	**9.57**	**6.92**	**6.16**	**5.62**	**5.57**	**5.58**	**5.40**	**5.17**	**5.24**
Total N2O emissions excluding N2O from LULUCF	**12.31**	**11.46**	**8.90**	**6.35**	**5.57**	**4.99**	**4.93**	**4.93**	**4.75**	**4.48**	**4.55**
Memo Items:											

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)										
International Bunkers	**0.19**	**0.04**	**0.04**	**0.06**	**0.11**	**0.05**	**0.04**	**0.03**	**0.02**	**0.02**	**0.01**
Aviation	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marine	0.18	0.03	0.03	0.06	0.11	0.04	0.03	0.03	0.02	0.01	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years 2001-2012

GREEN-HOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
	(Gg)												%
1. Energy	**0.40**	**0.40**	**0.44**	**0.45**	**0.45**	**0.43**	**0.43**	**0.41**	**0.41**	**0.41**	**0.40**	**0.42**	**-23.45**
A. Fuel Combustion (Sectoral Approach)	0.40	0.40	0.44	0.45	0.45	0.43	0.43	0.41	0.41	0.41	0.40	0.42	-23.45
1. Energy Industries	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	-34.87
2. Manufacturing Industries and Construction	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.05	0.06	0.07	154.05
3. Transport	0.16	0.17	0.19	0.20	0.20	0.19	0.20	0.19	0.17	0.17	0.17	0.17	-37.68
4. Other Sectors	0.19	0.18	0.20	0.20	0.19	0.18	0.18	0.16	0.17	0.17	0.15	0.15	-25.53
5. Other	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	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
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and Natural Gas	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
2. Industrial Processes	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**IE,NA, NE,NO**	**0.00**
A. Mineral Products	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	0.00
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Agriculture	**4.33**	**4.23**	**4.47**	**4.37**	**4.59**	**4.58**	**4.77**	**4.74**	**4.85**	**5.06**	**5.03**	**5.28**	**-54.31**
B. Manure Management	0.54	0.54	0.51	0.49	0.50	0.47	0.48	0.45	0.45	0.42	0.39	0.40	-78.44
D. Agricultural Soils	3.80	3.69	3.95	3.88	4.10	4.11	4.29	4.28	4.41	4.64	4.64	4.88	-49.74
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Land Use, Land-Use Change and Forestry	**0.68**	**0.72**	**0.70**	**0.70**	**0.70**	**0.77**	**0.72**	**0.73**	**0.74**	**0.73**	**0.72**	**0.71**	**40.60**

GREEN-HOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
						(Gg)							%
A. Forest Land	0.47	0.49	0.48	0.47	0.47	0.50	0.47	0.47	0.47	0.47	0.46	0.47	-1.67
B. Cropland	0.09	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	941.22
C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	282.55
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
E. Settlements	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
F. Other Land	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
G. Other	0.10	0.13	0.12	0.12	0.12	0.15	0.13	0.13	0.14	0.13	0.13	0.13	589.58
6. Waste	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.16**	**-23.53**
B. Waste-water Handling	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	-26.03
C. Waste Incineration	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. Other	NE	NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	100.00
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.00**
Total N_2O emissions including N_2O from LULUCF	**5.59**	**5.53**	**5.78**	**5.70**	**5.92**	**5.96**	**6.10**	**6.04**	**6.17**	**6.37**	**6.32**	**6.57**	**-48.73**
Total N_2O emissions excluding N_2O from LULUCF	**4.92**	**4.81**	**5.08**	**5.00**	**5.21**	**5.19**	**5.38**	**5.32**	**5.43**	**5.64**	**5.60**	**5.86**	**-52.41**
Memo Items:													
International Bunkers	**0.14**	**0.12**	**0.11**	**0.11**	**0.13**	**0.10**	**0.09**	**0.08**	**0.11**	**0.12**	**0.12**	**0.14**	**-27.00**
Aviation	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	97.76
Marine	0.14	0.12	0.10	0.11	0.13	0.09	0.09	0.07	0.10	0.10	0.11	0.12	-31.26
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

CH_4

Years 1990-2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
						(Gg)					
1. Energy	22.41	23.42	21.30	21.54	21.20	21.44	21.52	20.31	19.14	18.53	17.36
A. Fuel Combustion (Sectoral Approach)	12.51	13.88	12.60	13.22	13.07	13.53	13.89	13.19	12.31	12.02	11.34
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
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
3. Transport	0.78	0.72	0.69	0.67	0.63	0.58	0.55	0.52	0.49	0.47	0.49
4. Other Sectors	11.19	12.71	11.49	12.14	12.03	12.55	12.91	12.22	11.36	11.15	10.47
5. Other	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	9.90	9.54	8.70	8.32	8.13	7.92	7.63	7.12	6.83	6.51	6.03

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)										
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	9.90	9.54	8.70	8.32	8.13	7.92	7.63	7.12	6.83	6.51	6.03
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**
A. Mineral Products	NA,NE, NO	NA,NE, NO	NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other	**111.99**	**106.76**	**87.04**	**54.14**	**46.32**	**45.49**	**43.05**	**42.28**	**39.16**	**34.06**	**34.19**
4. Agriculture	102.32	97.84	80.54	50.19	42.56	41.53	39.56	38.93	35.97	31.11	30.71
A. Enteric Fermentation	9.67	8.92	6.50	3.95	3.76	3.96	3.49	3.35	3.19	2.95	3.48
B. Manure Management	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	**1.93**	**1.52**	**11.60**	**2.27**	**1.89**	**2.94**	**3.43**	**3.49**	**3.54**	**5.61**	**5.50**
5. Land Use, Land-Use Change and Forestry	0.96	0.76	5.74	1.13	0.94	1.46	1.71	1.74	1.77	2.79	2.73
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
C. Grassland	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	0.97	0.76	5.86	1.14	0.94	1.47	1.72	1.75	1.77	2.82	2.76
G. Other	**24.85**	**25.34**	**25.30**	**24.94**	**24.83**	**24.46**	**24.16**	**24.72**	**25.06**	**25.02**	**25.06**
6. Waste	15.71	16.29	16.76	17.13	17.40	17.57	17.78	18.05	18.37	18.74	19.15
A. Solid Waste Disposal on Land	9.14	9.05	8.54	7.81	7.43	6.88	6.38	6.67	6.70	6.29	5.91
B. Waste-water Handling	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA,NO	NA,NO
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
7. Other (as specified in Summary 1.A)	**111.99**	**106.76**	**87.04**	**54.14**	**46.32**	**45.49**	**43.05**	**42.28**	**39.16**	**34.06**	**34.19**
Total CH4 emissions including CH4 from LULUCF	**161.19**	**157.05**	**145.24**	**102.90**	**94.24**	**94.32**	**92.16**	**90.80**	**86.90**	**83.23**	**82.12**
Total CH4 emissions excluding CH4 from LULUCF	**159.26**	**155.53**	**133.64**	**100.63**	**92.36**	**91.38**	**88.73**	**87.31**	**83.36**	**77.62**	**76.62**
Memo Items:											

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)										
International Bunkers	0.10	0.03	0.04	0.04	0.06	0.03	0.02	0.01	0.00	0.00	0.00
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marine	0.09	0.03	0.04	0.04	0.06	0.03	0.02	0.01	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years 2001-2012

GREEN-HOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
	(Gg)												%
1. Energy	18.34	18.32	17.52	17.81	18.40	16.57	16.61	15.76	16.66	15.84	12.49	14.17	-36.79
A. Fuel Combustion (Sectoral Approach)	12.50	12.22	12.75	13.10	13.08	12.74	12.68	11.73	12.86	12.17	10.51	11.32	-9.51
1. Energy Industries	0.21	0.22	0.23	0.21	0.18	0.20	0.19	0.19	0.19	0.21	0.20	0.23	-17.25
2. Manufacturing Industries and Construction	0.20	0.19	0.19	0.23	0.26	0.29	0.26	0.27	0.33	0.41	0.46	0.52	97.70
3. Transport	0.54	0.50	0.48	0.45	0.39	0.37	0.34	0.28	0.25	0.24	0.21	0.20	-74.15
4. Other Sectors	11.55	11.30	11.86	12.21	12.24	11.88	11.88	10.99	12.09	11.32	9.64	10.37	-7.31
5. Other	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	5.84	6.10	4.76	4.71	5.33	3.82	3.92	4.03	3.81	3.66	1.98	2.85	-71.25
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and Natural Gas	5.84	6.10	4.76	4.71	5.33	3.82	3.92	4.03	3.81	3.66	1.98	2.85	-71.25
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**	**52.07**
A. Mineral Products	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA, NE	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	IE,NA,NE ,NO	0.00
B. Chemical Industry	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	52.07
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Agriculture	**36.11**	**35.92**	**35.84**	**34.71**	**35.84**	**35.72**	**37.31**	**36.04**	**35.83**	**36.19**	**36.27**	**37.34**	**-66.66**
A. Enteric Fermentation	32.29	32.07	32.01	30.90	31.92	31.55	32.99	31.81	31.55	31.73	31.83	32.74	-68.00
B. Manure Management	3.82	3.85	3.83	3.81	3.92	4.17	4.32	4.23	4.28	4.45	4.44	4.60	-52.43
C. Rice Cultivation	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	0.00
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Land Use, Land-Use Change and Forestry	**2.64**	**5.74**	**3.27**	**2.98**	**2.49**	**6.74**	**2.35**	**2.23**	**2.93**	**2.84**	**1.75**	**1.77**	**-8.58**
A. Forest Land	1.31	2.83	1.60	1.47	1.24	3.28	1.17	1.11	1.45	1.41	0.51	0.51	-47.01
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

GREEN-HOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
	(Gg)												%
C. Grassland	0.01	0.03	0.03	0.02	0.00	0.06	0.01	0.00	0.01	0.01	0.00	0.00	282.55
D. Wetlands	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00
E. Settlements	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
F. Other Land	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
G. Other	1.32	2.89	1.64	1.49	1.24	3.39	1.18	1.12	1.47	1.42	1.23	1.25	29.30
6. Waste	**26.34**	**26.17**	**24.60**	**24.75**	**24.78**	**24.73**	**25.24**	**27.16**	**26.52**	**26.78**	**25.84**	**26.16**	**5.26**
A. Solid Waste Disposal on Land	19.62	19.51	17.88	17.09	17.63	18.38	19.36	20.16	20.35	20.73	20.84	21.36	35.91
B. Waste-water Handling	6.72	6.66	6.71	7.63	7.13	6.30	5.85	6.96	6.11	5.97	4.91	4.73	-48.22
C. Waste Incineration	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
D. Other	NE	NE	0.01	0.03	0.03	0.05	0.04	0.04	0.06	0.07	0.09	0.07	100.00
7. Other (as specified in Summary 1.A)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.00**
Total CH4 emissions including CH4 from LULUCF	**83.43**	**86.16**	**81.23**	**80.26**	**81.52**	**83.76**	**81.52**	**81.20**	**81.94**	**81.64**	**76.35**	**79.44**	**-50.72**
Total CH4 emissions excluding CH4 from LULUCF	**80.79**	**80.41**	**77.96**	**77.28**	**79.03**	**77.02**	**79.17**	**78.96**	**79.01**	**78.80**	**74.60**	**77.67**	**-51.23**
Memo Items:													
International Bunkers	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.06	0.05	0.05	0.05	-47.45
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	122.47
Marine	0.04	0.04	0.04	0.04	0.05	0.04	0.03	0.04	0.05	0.05	0.04	0.05	-50.23
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

HFC, PFC, SF_6

Years 1990-2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**0.64**	**0.83**	**1.92**	**2.86**	**3.27**	**5.11**
HFC-23	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NE,NO	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-125	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-134a	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NE,NO	0.00	0.00	0.00	0.00	0.00	0.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-143a	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-227ea	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
CF4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
C2F6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
C 3F8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
C4F10	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
c-C4F8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
C5F12	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
C6F14	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO
Emissions of SF_6(3) - (Gg CO_2 equivalent)	**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**
SF6	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

Years 2001-2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**7.58**	**9.85**	**15.70**	**18.06**	**28.36**	**62.57**	**98.56**	**72.85**	**74.37**	**72.18**	**75.01**	**83.65**	**100.00**
HFC-23	0.00	0.00	0.00	IE,NE,NO	IE,NO	IE,NO	IE,NO	0.00	0.00	0.00	0.00	0.00	100.00
HFC-32	NE,NO	NE,NO	NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-41	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-43-10mee	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-125	NE,NO	NE,NO	NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-134	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-134a	0.01	0.01	0.01	0.01	0.02	0.04	0.07	0.04	0.04	0.04	0.04	0.05	100.00
HFC-152a	NE,NO	NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-143	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-143a	NE,NO	NE,NO	NE,NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-227ea	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
HFC-236fa	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
HFC-245ca	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0.00**
CF_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_2F_6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
$c-C_4F_8$	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Emissions of SF6(3) - (Gg CO_2 equivalent)	**1.98**	**3.38**	**4.41**	**5.37**	**7.53**	**7.12**	**8.60**	**10.08**	**13.53**	**12.25**	**12.45**	**13.69**	**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	100.00

A.6.3: Supplementary information under Article 6., 12., 17

In 2012 one Joint Implementation Project (Article 6) was registered in Latvia – The Liepaja Regional Solid Waste Management Project. The proposed Liepaja Regional Solid Waste Management Project introduces a state-of-the-art waste management system to the Liepaja Waste Management Region including remediation of the existing landfill sites and the operation of energy cells for methane capture and utilization. There are two basic sources of GHG emission reductions from the project – CH_4 and CO_2. Methane Capture and Combustion or Flare (Direct Effects): The captured methane at the Grobina and Skede Sites from the sanitary landfill gas collection system is destroyed by either combustion or flaring, thereby reducing GHGs that would otherwise be emitted into the atmosphere. Electric Generation Displacement (Direct Effects): Carbon dioxide emissions also are reduced by the project through the displacement of grid-based electricity by the landfill methane-based electricity produced at Grobina and Skede.

There are no Clean Development Mechanism (Article 12) projects in Latvia.

There are no specific limitation rules for the operators and/or person accounts in Latvia's of holding of Kyoto protocol units with exception of AAUs that could be held only in the National Holding Account.

The list given below includes the legal entities that have active accounts in Latvia's ETR at the end of 2013 and doesn't include accounts that were closed after the compliance period 30/04/2012 (the GHG permits of the installation were permitted at the end of 2013).

Legal entities authorised to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol

Legal entities authorised to participate in the mechanisms under Article 6, 12 and 17u of the Kyoto Protocol)	**Account ID**	**Role**
A/S "Olaines udens un siltums"	LV-HOLDING_ACCOUNT-5012073-0-4	Latvia's ETR operator (obligatory participation)
Pasvaldibas SIA "Ventspils siltums"	LV-HOLDING_ACCOUNT-5012074-0-96	Latvia's ETR operator (obligatory participation)
Pasvaldibas SIA "Ventspils siltums"	LV-HOLDING_ACCOUNT-5012075-0-91	Latvia's ETR operator (obligatory participation)
AS "Latvenergo" TEC-1	LV-HOLDING_ACCOUNT-5012078-0-76	Latvia's ETR operator (obligatory participation)
AS "Latvenergo" TEC-2	LV-HOLDING_ACCOUNT-5012079-0-71	Latvia's ETR operator (obligatory participation)
SIA "Fortum Jelgava"	LV-HOLDING_ACCOUNT-5012080-0-66	Latvia's ETR operator (obligatory participation)
SIA "Fortum Jelgava"	LV-HOLDING_ACCOUNT-5012081-0-61	Latvia's ETR operator (obligatory participation)
SIA "Livanu siltums"	LV-HOLDING_ACCOUNT-5012084-0-46	Latvia's ETR operator (obligatory participation)
SIA "Aizkraukles siltums"	LV-HOLDING_ACCOUNT-5012085-0-41	Latvia's ETR operator (obligatory participation)

Legal entities authorised to participate in the mechanisms under Article 6, 12 and 17u of the Kyoto Protocol)	**Account ID**	**Role**
A/S "Rigas siltums" katlu maja Gobas iela 33a	LV-HOLDING_ACCOUNT-5012086-0-36	Latvia's ETR operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale Daugavgriva	LV-HOLDING_ACCOUNT-5012087-0-31	Latvia's ETR operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale Vecmilgravis	LV-HOLDING_ACCOUNT-5012088-0-26	Latvia's ETR operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale Ziepniekkalns	LV-HOLDING_ACCOUNT-5012089-0-21	Latvia's ETR operator (obligatory participation)
A/S "Rigas siltums" iecirknis Zasulauks	LV-HOLDING_ACCOUNT-5012090-0-16	Latvia's ETR operator (obligatory participation)
A/S "Rigas siltums" siltumcentrale Imanta	LV-HOLDING_ACCOUNT-5012091-0-11	Latvia's ETR operator (obligatory participation)
SIA "Dobeles energija"	LV-HOLDING_ACCOUNT-5012092-0-6	Latvia's ETR operator (obligatory participation)
Ogres novada PA "Malkalne"	LV-HOLDING_ACCOUNT-5012093-0-98	Latvia's ETR operator (obligatory participation)
SIA "Wesemann Sigulda"	LV-HOLDING_ACCOUNT-5012094-0-93	Latvia's ETR operator (obligatory participation)
SIA "Jurmalas siltums" Dubulti	LV-HOLDING_ACCOUNT-5012096-0-83	Latvia's ETR operator (obligatory participation)
SIA "Jurmalas siltums" Kauguri	LV-HOLDING_ACCOUNT-5012097-0-78	Latvia's ETR operator (obligatory participation)
A/S "Cesvaines piens"	LV-HOLDING_ACCOUNT-5012100-0-63	Latvia's ETR operator (obligatory participation)
SIA "Rigas laku un krasu rupnica"	LV-HOLDING_ACCOUNT-5012101-0-58	Latvia's ETR operator (obligatory participation)
A/s "Putnu fabrika Kekava""	LV-HOLDING_ACCOUNT-5012102-0-53	Latvia's ETR operator (obligatory participation)
A/S "Rigas kugu buvetava"	LV-HOLDING_ACCOUNT-5012103-0-48	Latvia's ETR operator (obligatory participation)
A/S "BLB Baltijas Terminals"	LV-HOLDING_ACCOUNT-5012104-0-43	Latvia's ETR operator (obligatory participation)
SIA "Kraslavas nami"	LV-HOLDING_ACCOUNT-5012106-0-33	Latvia's ETR operator (obligatory participation)
SIA "Cesu siltumtikli"	LV-HOLDING_ACCOUNT-5012108-0-23	Latvia's ETR operator (obligatory participation)
PAS "Daugavpils siltumtikli" SC3	LV-HOLDING_ACCOUNT-5012110-0-13	Latvia's ETR operator (obligatory participation)
PAS "Daugavpils siltumtikli" SC1	LV-HOLDING_ACCOUNT-5012111-0-8	Latvia's ETR operator (obligatory participation)
PAS "Daugavpils siltumtikli" SC2	LV-HOLDING_ACCOUNT-5012112-0-3	Latvia's ETR operator (obligatory participation)
A/S "Ligija teks"	LV-HOLDING_ACCOUNT-5012113-0-95	Latvia's ETR operator (obligatory participation)
SIA "Jekabpils siltums"	LV-HOLDING_ACCOUNT-5012114-0-90	Latvia's ETR operator (obligatory participation)
A/S "Valmieras piens"	LV-HOLDING_ACCOUNT-5012117-0-75	Latvia's ETR operator (obligatory participation)

Legal entities authorised to participate in the mechanisms under Article 6, 12 and 17u of the Kyoto Protocol)	**Account ID**	**Role**
SIA "Lauma Fabrics"	LV-HOLDING_ACCOUNT-5012119-0-65	Latvia's ETR operator (obligatory participation)
SIA "Liepajas energija"	LV-HOLDING_ACCOUNT-5012120-0-60	Latvia's ETR operator (obligatory participation)
SIA "Liepajas energija"	LV-HOLDING_ACCOUNT-5012121-0-55	Latvia's ETR operator (obligatory participation)
A/S "Preilu siers"	LV-HOLDING_ACCOUNT-5012122-0-50	Latvia's ETR operator (obligatory participation)
SIA "Ogres Trikotaza"	LV-HOLDING_ACCOUNT-5012123-0-45	Latvia's ETR operator (obligatory participation)
SIA "Salaspils siltums"	LV-HOLDING_ACCOUNT-5012124-0-40	Latvia's ETR operator (obligatory participation)
A/S "Latvijas finieris" rupnica "Furniers"	LV-HOLDING_ACCOUNT-5012125-0-35	Latvia's ETR operator (obligatory participation)
A/S "Latvijas Finieris" rupnica "Lignums"	LV-HOLDING_ACCOUNT-5012126-0-30	Latvia's ETR operator (obligatory participation)
SIA "Sabiedriba Marupe"	LV-HOLDING_ACCOUNT-5012127-0-25	Latvia's ETR operator (obligatory participation)
A/S "Ventbunkers"	LV-HOLDING_ACCOUNT-5012129-0-15	Latvia's ETR operator (obligatory participation)
SIA "Papirfabrika Ligatne"	LV-HOLDING_ACCOUNT-5012130-0-10	Latvia's ETR operator (obligatory participation)
SIA "Saulkalne S"	LV-HOLDING_ACCOUNT-5012131-0-5	Latvia's ETR operator (obligatory participation)
SIA "Brocenu keramika"	LV-HOLDING_ACCOUNT-5012132-0-97	Latvia's ETR operator (obligatory participation)
A/S "Valmieras stikla skiedra"	LV-HOLDING_ACCOUNT-5012133-0-92	Latvia's ETR operator (obligatory participation)
LODE SIA, Liepas plant	LV-HOLDING_ACCOUNT-5012135-0-82	Latvia's ETR operator (obligatory participation)
A/S "Liepajas metalurgs"	LV-HOLDING_ACCOUNT-5012137-0-72	Latvia's ETR operator (obligatory participation)
LODE SIA, Ane plant	LV-HOLDING_ACCOUNT-5012141-0-52	Latvia's ETR operator (obligatory participation)
SIA "Olaines kimiska rupnica "BIOLARS""	LV-HOLDING_ACCOUNT-5012154-0-84	Latvia's ETR operator (obligatory participation)
SIA "Bolderaja Ltd"	LV-HOLDING_ACCOUNT-5012166-0-24	Latvia's ETR operator (obligatory participation)
SIA "Juglas jauda"	LV-HOLDING_ACCOUNT-5012169-0-9	Latvia's ETR operator (obligatory participation)
A/S "Valmieras Energija" Rigas iela 25	LV-HOLDING_ACCOUNT-5012171-0-96	Latvia's ETR operator (obligatory participation)
A/S "Valmieras Energija" Dzelzcela iela 7	LV-HOLDING_ACCOUNT-5012172-0-91	Latvia's ETR operator (obligatory participation)
A/S "Latvijas Gaze"	LV-HOLDING_ACCOUNT-5012173-0-86	Latvia's ETR operator (obligatory participation)
SIA "Fortum Jelgava"	LV-HOLDING_ACCOUNT-5012175-0-76	Latvia's ETR operator (obligatory participation)

Legal entities authorised to participate in the mechanisms under Article 6, 12 and 17u of the Kyoto Protocol)	**Account ID**	**Role**
SIA "Tennere"	LV-HOLDING_ACCOUNT-5012178-0-61	Latvia's ETR operator (obligatory participation)
SIA "Jaunpagasts Plus" Jaunpagasta spirta rupnica	LV-HOLDING_ACCOUNT-5012179-0-56	Latvia's ETR operator (obligatory participation)
A/S "Rezeknes Siltumtikli" Atbrivosanas aleja 155a	LV-HOLDING_ACCOUNT-5012180-0-51	Latvia's ETR operator (obligatory participation)
A/S "Rezeknes Siltumtikli" N.Rancana iela 5	LV-HOLDING_ACCOUNT-5012181-0-46	Latvia's ETR operator (obligatory participation)
A/S "Rezeknes Siltumtikli" Meza iela 1	LV-HOLDING_ACCOUNT-5012182-0-41	Latvia's ETR operator (obligatory participation)
SIA "Gamma - A"	LV-HOLDING_ACCOUNT-5012184-0-31	Latvia's ETR operator (obligatory participation)
SIA "CEMEX"	LV-HOLDING_ACCOUNT-5012185-0-26	Latvia's ETR operator (obligatory participation)
SIA Magnat Asset Management""	LV-HOLDING_ACCOUNT-5012183-0-36	Legal person
BERNIT GMBH	LV-HOLDING_ACCOUNT-5012186-0-21	Legal person
Aslam Wasim	LV-HOLDING_ACCOUNT-5012187-0-16	Legal person
SIA "KD LATGALE"	LV-HOLDING_ACCOUNT- 5021816-0-62	Legal person
Smartlynx Airlines	LV-HOLDING_ACCOUNT-5000042-0-19	Latvia's ETR aircraft operator (obligatory participation)
A/S AirBaltic Corporation""	LV-HOLDING_ACCOUNT-5000081-0-18	Latvia's ETR aircraft operator (obligatory participation)

ANNEX 7: TABLES 6.1 AND 6.2 OF THE IPCC GOOD PRACTICE GUIDANCE

A.7.1 Uncertainties without LULUCF

IPCC GHG Source and Sink Categories (LULUCF not included)	**Gas**	**1990 Estimate, Gg CO_2-eq**	**2012 Estimate, Gg CO_2-eq**	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3 051.264	37.418	2.00%	10.00%	10.20%	0.03%	-4.73%	0.14%	-0.47%	0.00%	0.47%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	338.628	48.347	2.00%	10.00%	10.20%	0.04%	-0.36%	0.18%	-0.04%	0.01%	0.04%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.313	1 703.017	2.00%	5.00%	5.39%	0.84%	2.27%	6.50%	0.11%	0.18%	0.22%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	24.784	12.577	2.00%	10.00%	10.20%	0.01%	0.01%	0.05%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CO_2	163.886	0.000	2.00%	10.00%	10.20%	0.00%	-0.26%	0.00%	-0.03%	0.00%	0.03%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.672	53.881	2.00%	5.00%	5.39%	0.03%	0.13%	0.21%	0.01%	0.01%	0.01%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	154.094	0.000	2.00%	10.00%	10.20%	0.00%	-0.25%	0.00%	-0.02%	0.00%	0.02%
1.A.2.a Iron and Steel - Solid Fuels	CO_2	4.587	31.358	2.00%	20.00%	20.10%	0.06%	0.11%	0.12%	0.02%	0.00%	0.02%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	234.464	79.827	2.00%	5.00%	5.39%	0.04%	-0.07%	0.30%	0.00%	0.01%	0.01%
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CO_2		0.222	2.00%	10.00%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2		0.092	2.00%	10.00%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	0.000	9.295	2.00%	5.00%	5.39%	0.00%	0.04%	0.04%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Liquid Fuels	CO_2	276.669	9.788	2.00%	10.00%	10.20%	0.01%	-0.40%	0.04%	-0.04%	0.00%	0.04%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.397	20.429	2.00%	5.00%	5.39%	0.01%	0.04%	0.08%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.547	0.444	2.00%	10.00%	10.20%	0.00%	-0.02%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.417	0.000	2.00%	10.00%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	149.415	3.728	2.00%	5.00%	5.39%	0.00%	-0.22%	0.01%	-0.01%	0.00%	0.01%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid	CO_2	798.124	39.553	2.00%	10.00%	10.20%	0.04%	-1.12%	0.15%	-0.11%	0.00%	0.11%

IPCC GHG Source and Sink Categories (LULUCF not included)	**Gas**	**1990 Estimate, Gg CO_2-eq**	**2012 Estimate, Gg CO_2-eq**	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
Fuels												
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	91.116	2.417	2.00%	10.00%	10.20%	0.00%	-0.14%	0.01%	-0.01%	0.00%	0.01%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	174.195	99.710	2.00%	5.00%	5.39%	0.05%	0.10%	0.38%	0.01%	0.01%	0.01%
1.A.2.f Other - Liquid Fuels	CO_2	944.946	151.655	2.00%	10.00%	10.20%	0.14%	-0.93%	0.58%	-0.09%	0.02%	0.09%
1.A.2.f Other - Solid Fuels	CO_2	38.690	180.475	2.00%	10.00%	10.20%	0.17%	0.63%	0.69%	0.06%	0.02%	0.07%
1.A.2.f Other - Gaseous Fuels	CO_2	835.236	221.737	2.00%	5.00%	5.39%	0.11%	-0.49%	0.85%	-0.02%	0.02%	0.03%
1.A.2.f Other - Other Fuels	CO_2	0.000	77.380	2.00%	5.00%	5.39%	0.04%	0.30%	0.30%	0.01%	0.01%	0.02%
1.A.3.c Civil Aviation - Aviation Gasoline	CO_2	0.011	0.491	2.00%	5.00%	5.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Jet Kerosene	CO_2	0.055	1.765	2.00%	5.00%	5.39%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gasoline	CO_2	1 689.330	690.232	2.00%	2.00%	2.83%	0.18%	-0.07%	2.63%	0.00%	0.07%	0.07%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	1 662.410	2.00%	2.00%	2.83%	0.43%	5.36%	6.34%	0.11%	0.18%	0.21%
1.A.3.b Road Transportation - LPG	CO_2	36.957	116.540	2.00%	5.00%	5.39%	0.06%	0.39%	0.44%	0.02%	0.01%	0.02%
1.A.3.b Road Transportation - Lubricants	CO_2	3.428	4.190	10.00%	5.00%	11.18%	0.00%	0.01%	0.02%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	19.580	0.000	2.00%	5.00%	5.39%	0.00%	-0.03%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	248.418	2.00%	5.00%	5.39%	0.12%	0.10%	0.95%	0.00%	0.03%	0.03%
1.A.3.d Naviagtion - Gasoline	CO_2	0.181	0.327	20.00%	5.00%	20.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Diesel Oil	CO_2	0.833	12.580	2.00%	5.00%	5.39%	0.01%	0.05%	0.05%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1 131.478	133.148	2.00%	10.00%	10.20%	0.12%	-1.30%	0.51%	-0.13%	0.01%	0.13%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1 331.987	34.937	2.00%	15.00%	15.13%	0.05%	-1.99%	0.13%	-0.30%	0.00%	0.30%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	337.481	270.200	2.00%	5.00%	5.39%	0.13%	0.49%	1.03%	0.02%	0.03%	0.04%
1.A.4.b Residential - Liquid Fuels	CO_2	329.914	154.254	50.00%	10.00%	50.99%	0.72%	0.06%	0.59%	0.01%	0.42%	0.42%
1.A.4.b Residential - Solid Fuels	CO_2	585.452	53.182	50.00%	10.00%	50.99%	0.25%	-0.73%	0.20%	-0.07%	0.14%	0.16%
1.A.4.b Residential - Gaseous Fuels	CO_2	219.607	246.988	50.00%	5.00%	50.25%	1.13%	0.59%	0.94%	0.03%	0.67%	0.67%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	694.469	314.121	2.00%	10.00%	10.20%	0.29%	0.09%	1.20%	0.01%	0.03%	0.04%

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1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	94.804	4.835	2.00%	10.00%	10.20%	0.00%	-0.13%	0.02%	-0.01%	0.00%	0.01%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	778.520	55.521	2.00%	5.00%	5.39%	0.03%	-1.03%	0.21%	-0.05%	0.01%	0.05%
1.A.5.b Mobile - Liquid Fuels	CO_2	0.000	7.333	2.00%	50.00%	50.04%	0.03%	0.03%	0.03%	0.01%	0.00%	0.01%
1.B.2.b Natural Gas	CO_2	0.011	0.003	25.00%	25.00%	35.36%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.A.1 Cement Production	CO_2	366.123	576.633	10.00%	5.00%	11.18%	0.59%	1.61%	2.20%	0.08%	0.31%	0.32%
2.A.2 Lime Production	CO_2	8.205	0.425	2.00%	50.00%	50.04%	0.00%	-0.01%	0.00%	-0.01%	0.00%	0.01%
2.A.3 Limestone and Dolomite Use	CO_2	141.005	5.065	2.00%	50.00%	50.04%	0.02%	-0.21%	0.02%	-0.10%	0.00%	0.10%
2.A.5 Asphalt Roofing	CO_2	0.003	0.060	20.00%	70.00%	72.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.A.6 Road Paving with Asphalt	CO_2	0.001	0.067	20.00%	70.00%	72.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.A.7 Other	CO_2	69.189	5.963	15.00%	60.00%	61.85%	0.03%	-0.09%	0.02%	-0.05%	0.00%	0.05%
2.C.1 Iron and Steel Production	CO_2	12.829	1.871	25.00%	5.00%	25.50%	0.00%	-0.01%	0.01%	0.00%	0.00%	0.00%
3.A Paint Aplication	CO_2	8.840	6.373	2.00%	75.00%	75.03%	0.04%	0.01%	0.02%	0.01%	0.00%	0.01%
3.B Degreasing and Dry Cleaning	CO_2	0.002	0.005	2.00%	75.00%	75.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3.C Chemical Products, Manufacture and Processing	CO_2	2.989	3.917	3.00%	20.00%	20.22%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
3.D Other	CO_2	31.078	38.213	2.00%	75.00%	75.03%	0.26%	0.10%	0.15%	0.07%	0.00%	0.07%
6.C Waste Incineration	CO_2	0.000	0.307	20.00%	50.00%	53.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.F(a).1 Refrigeration and Air Conditioning Equipment	HFCs	0.000	76.159	75.00%	75.00%	106.07%	0.74%	0.29%	0.29%	0.22%	0.31%	0.38%
2.F(a).2 Foam Blowing	HFCs	0.000	0.641	75.00%	75.00%	106.07%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
2.F(a).3 Fire Extinguisher	HFCs	0.000	0.463	75.00%	75.00%	106.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.F(a).4 Aerosols/ Metered Dose Inhalers	HFCs	0.000	2.315	75.00%	75.00%	106.07%	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%
2.F(a).8 Electrical Equipment	SF6	0.000	13.688	2.00%	10.00%	10.20%	0.01%	0.05%	0.05%	0.01%	0.00%	0.01%
2.F(a).9 Other	HFCs	0.000	4.072	75.00%	75.00%	106.07%	0.04%	0.02%	0.02%	0.01%	0.02%	0.02%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	2.529	0.031	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.916	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.004	0.649	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.275	3.691	20.00%	50.00%	53.85%	0.02%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.021	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CH_4	0.994	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.017	0.021	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4	0.000	0.350	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.086	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Solid Fuels	CH_4	0.011	0.058	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.445	0.152	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4		0.018	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.153	0.006	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.044	0.039	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.000	0.132	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.009	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.006		2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.284	0.007	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.000	0.064	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.443	0.022	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.224	0.006	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.331	0.190	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.144	0.337	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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1.A.2.f Other - Liquid Fuels	CH_4	1.413	0.131	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Solid Fuels	CH_4	0.094	0.412	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Gaseous Fuels	CH_4	1.585	0.422	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Biomass Fuels	CH_4	0.245	7.607	15.00%	50.00%	52.20%	0.04%	0.03%	0.03%	0.01%	0.01%	0.02%
1.A.2.f Other - Other Fuels	CH_4	0.000	1.304	2.00%	50.00%	50.04%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Aviation Gasoline	CH_4	0.000	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Jet Kerosene	CH_4	0.000	0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gasoline	CH_4	14.410	2.366	2.00%	50.00%	50.04%	0.01%	-0.01%	0.01%	-0.01%	0.00%	0.01%
1.A.3.b Road Transportation - Diesel Oil	CH_4	0.931	0.968	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - LPG	CH_4	0.105	0.573	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Lubricants	CH_4	0.014	0.011	10.00%	50.00%	50.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.356	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Biomass	CH_4	0.000	0.017	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Railways - Liquid Fuels	CH_4	0.639	0.299	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Gasoline	CH_4	0.002	0.004	20.00%	50.00%	53.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Diesel Oil	CH_4	0.001	0.014	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c. Railway (Biofuels for 1A3C)	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.203	0.418	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	7.365	0.287	2.00%	50.00%	50.04%	0.00%	-0.01%	0.00%	-0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.641	0.515	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Biomass	CH_4	32.873	32.869	20.00%	50.00%	53.85%	0.16%	0.07%	0.13%	0.04%	0.04%	0.05%
1.A.4.b Residential - Liquid Fuels	CH_4	1.031	1.079	50.00%	50.00%	70.71%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.b Residential - Solid Fuels	CH_4	43.019	3.634	50.00%	50.00%	70.71%	0.02%	-0.05%	0.01%	-0.03%	0.01%	0.03%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.417	0.471	50.00%	50.00%	70.71%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.b Residential - Biomass	CH_4	126.063	175.165	50.00%	50.00%	70.71%	1.13%	0.47%	0.67%	0.23%	0.47%	0.53%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	4.221	0.985	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	7.008	0.330	2.00%	50.00%	50.04%	0.00%	-0.01%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.478	0.106	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	7.686	1.972	15.00%	50.00%	52.20%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%
1.A.5.b Mobile - Liquid Fuels	CH_4	0.000	0.007	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.B.2.b Natural Gas	CH_4	193.495	55.871	25.00%	25.00%	35.36%	0.18%	-0.10%	0.21%	-0.02%	0.08%	0.08%
1.B.2.d Natural Gas	CH_4	14.475	3.922	10.00%	10.00%	14.14%	0.01%	-0.01%	0.01%	0.00%	0.00%	0.00%
2.C.1 Iron and Steel Production	CH_4	0.058	0.088	25.00%	10.00%	26.93%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4.A. Enteric Fermentation	CH_4	2 148.743	687.580	2.00%	20.00%	20.10%	1.26%	-0.81%	2.62%	-0.16%	0.07%	0.18%
4.B.Manure Management	CH_4	203.009	96.563	2.00%	30.00%	30.07%	0.26%	0.04%	0.37%	0.01%	0.01%	0.02%
6.A.1 Managed Waste Disposal on Land	CH_4		143.747	20.00%	52.00%	55.71%	0.73%	0.55%	0.55%	0.29%	0.16%	0.32%
#REF!	CH_4	329.978	304.720	20.00%	52.00%	55.71%	1.55%	0.64%	1.16%	0.33%	0.33%	0.47%
6.B.1 Industrial Waste Water	CH_4	34.233	11.529	2.00%	30.00%	30.07%	0.03%	-0.01%	0.04%	0.00%	0.00%	0.00%
6.B.2 Domestic and Commercial Waste Water	CH_4	157.669	87.837	10.00%	30.00%	31.62%	0.25%	0.08%	0.34%	0.02%	0.05%	0.05%
6.D Other	CH_4	0.000	1.480	20.00%	100.00%	101.98%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.466	0.092	2.00%	50.00%	50.04%	0.00%	-0.01%	0.00%	-0.01%	0.00%	0.01%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	2.709	0.228	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.482	0.958	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.541	7.248	20.00%	50.00%	53.85%	0.04%	0.03%	0.03%	0.01%	0.01%	0.02%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.063	0.032	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	N_2O	1.957	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.025	0.030	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.000	0.689	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.383	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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1.A.2.a Iron and Steel - Solid Fuels	N_2O	0.023	0.154	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.131	0.045	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CH_4		0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4		0.005	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.677	0.029	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.000	0.260	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.038	0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.012	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.084	0.002	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.000	0.126	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.962	0.100	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.464	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.098	0.056	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.283	0.663	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Liquid Fuels	N_2O	2.709	0.401	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Solid Fuels	N_2O	0.195	0.851	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Gaseous Fuels	N_2O	0.468	0.125	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Biomass Fuels	N_2O	0.482	14.972	15.00%	50.00%	52.20%	0.07%	0.06%	0.06%	0.03%	0.01%	0.03%
1.A.2.f Other - Other Fuels	N_2O	0.000	2.566	2.00%	50.00%	50.04%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Aviation Gasoline	N_2O	0.000	0.004	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Jet Kerosene	N_2O	0.000	0.019	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation -	N_2O	13.601	5.621	2.00%	50.00%	50.04%	0.03%	0.00%	0.02%	0.00%	0.00%	0.00%

IPCC GHG Source and Sink Categories (LULUCF not included)	**Gas**	**1990 Estimate, Gg CO_2-eq**	**2012 Estimate, Gg CO_2-eq**	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
Gasoline												
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.819	12.631	2.00%	50.00%	50.04%	0.06%	0.04%	0.05%	0.02%	0.00%	0.02%
1.A.3.b Road Transportation - LPG	N_2O	0.170	2.190	2.00%	50.00%	50.04%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.045	10.00%	50.00%	50.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.011	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Biomass	N_2O	0.000	0.322	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Railways - Liquid Fuels	N_2O	64.964	30.371	2.00%	50.00%	50.04%	0.14%	0.01%	0.12%	0.01%	0.00%	0.01%
1.A.3.d Naviagtion - Gasoline	N_2O	0.000	0.000	20.00%	50.00%	53.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Diesel Oil	N_2O	0.105	1.581	2.00%	50.00%	50.04%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.e. Railway (Biofuels for 1A3C)	N_2O		0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.823	0.357	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	7.306	0.190	2.00%	50.00%	50.04%	0.00%	-0.01%	0.00%	-0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.189	0.152	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Biomass	N_2O	6.470	6.484	20.00%	50.00%	53.85%	0.03%	0.01%	0.02%	0.01%	0.01%	0.01%
1.A.4.b Residential - Liquid Fuels	N_2O	0.913	0.531	50.00%	50.00%	70.71%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.b Residential - Solid Fuels	N_2O	3.306	0.250	50.00%	50.00%	70.71%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.123	0.139	50.00%	50.00%	70.71%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.b Residential - Biomass	N_2O	24.812	34.446	50.00%	50.00%	70.71%	0.22%	0.09%	0.13%	0.05%	0.09%	0.10%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	14.085	3.540	2.00%	50.00%	50.04%	0.02%	-0.01%	0.01%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.508	0.023	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.436	0.031	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.513	0.388	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.5.b Mobile - Liquid Fuels	N_2O	0.000	0.732	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3.D Other	N_2O	0.005	0.005	2.00%	2.00%	2.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

IPCC GHG Source and Sink Categories (LULUCF not included)	**Gas**	**1990 Estimate, Gg CO_2-eq**	**2012 Estimate, Gg CO_2-eq**	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
4.B.Manure Management	N_2O	569.751	122.826	40.00%	30.00%	50.00%	0.56%	-0.44%	0.47%	-0.13%	0.27%	0.30%
4.D.1. Direct Soil Emissions	N_2O	1 618.700	1 011.179	40.00%	25.00%	47.17%	4.34%	1.27%	3.86%	0.32%	2.18%	2.21%
4.D.2 Pasture, Range and Paddock Manure	N_2O	358.400	87.655	40.00%	25.00%	47.17%	0.38%	-0.24%	0.33%	-0.06%	0.19%	0.20%
4.D.3.Indirect Emissions	N_2O	1 033.935	414.495	30.00%	40.00%	50.00%	1.89%	-0.07%	1.58%	-0.03%	0.67%	0.67%
6.B.1 Industrial Waste Water	N_2O	2.436	0.104	10.00%	30.00%	31.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6.B.2 Domestic and Commercial Waste Water	N_2O	63.534	48.691	10.00%	30.00%	31.62%	0.14%	0.08%	0.19%	0.03%	0.03%	0.04%
6.C Waste Incineration	N_2O	0.000	0.011	20.00%	90.00%	92.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6.D Other	N_2O	0.000	1.639	20.00%	90.00%	92.20%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%
TOTAL	**CO_2 eq**	**26 212.92**	**10 978.48**	**20.02**	**76.15**	**83.24**	**0.21**	**0.00**	**0.42**	**0.00**	**0.07**	**0.10**
					Percentage uncertainty in total inventory		**20.67%**				Trend uncertainty	**9.84%**

A.7.2 Uncertainties with LULUCF

IPCC GHG Source and Sink Categories (LULUCF is included)	**Gas**	**1990 Estimate, Gg CO_2-eq**	**2012 Estimate, Gg CO_2-eq**	**Activity data uncertainty**	**Emission factor uncertainty**	**Combined uncertainty**	**Combined uncertainty as % of total national emissions in year t**	**Type A sensitivity**	**Type B sensitivity**	**Uncertainty in trend in national emissions introduced by emission factor uncertainty**	**Uncertainty in trend in national emissions introduced by activity data uncertainty**	**Uncertainty introduced into the trend in total national emissions**
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3 051.264	37.418	2.00%	10.00%	10.20%	-0.29%	10.55%	0.59%	1.06%	0.02%	1.06%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	338.628	48.347	2.00%	10.00%	10.20%	-0.37%	1.87%	0.76%	0.19%	0.02%	0.19%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2 644.313	1 703.017	2.00%	5.00%	5.39%	-6.94%	35.37%	26.84%	1.77%	0.76%	1.92%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	24.784	12.577	2.00%	10.00%	10.20%	-0.10%	0.28%	0.20%	0.03%	0.01%	0.03%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CO_2	163.886		2.00%	10.00%	10.20%		0.54%		0.05%		0.05%
1.A.1.c Manufacture of Solid Fuels and Other Energy	CO_2	44.672	53.881	2.00%	5.00%	5.39%	-0.22%	1.00%	0.85%	0.05%	0.02%	0.06%

IPCC GHG Source and Sink Categories (LULUCF is included)	**Gas**	**1990 Estimate, Gg CO_2-eq**	**2012 Estimate, Gg CO_2-eq**	**Activity data uncertainty**	**Emission factor uncertainty**	**Combined uncertainty**	**Combined uncertainty as % of total national emissions in year t**	**Type A sensitivity**	**Type B sensitivity**	**Uncertainty in trend in national emissions introduced by emission factor uncertainty**	**Uncertainty in trend in national emissions introduced by activity data uncertainty**	**Uncertainty introduced into the trend in total national emissions**
Industries - Gaseous Fuels												
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	154.094		2.00%	10.00%	10.20%		0.51%		0.05%		0.05%
1.A.2.a Iron and Steel - Solid Fuels	CO_2	4.587	31.358	2.00%	20.00%	20.10%	-0.48%	0.51%	0.49%	0.10%	0.01%	0.10%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	234.464	79.827	2.00%	5.00%	5.39%	-0.33%	2.03%	1.26%	0.10%	0.04%	0.11%
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CO_2		0.222	2.00%	10.00%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2		0.092	2.00%	10.00%	10.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2		9.295	2.00%	5.00%	5.39%	-0.04%	0.15%	0.15%	0.01%	0.00%	0.01%
1.A.2.c Chemicals - Liquid Fuels	CO_2	276.669	9.788	2.00%	10.00%	10.20%	-0.08%	1.06%	0.15%	0.11%	0.00%	0.11%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.397	20.429	2.00%	5.00%	5.39%	-0.08%	0.40%	0.32%	0.02%	0.01%	0.02%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.547	0.444	2.00%	10.00%	10.20%	0.00%	0.06%	0.01%	0.01%	0.00%	0.01%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.417		2.00%	10.00%	10.20%		0.01%		0.00%		0.00%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	149.415	3.728	2.00%	5.00%	5.39%	-0.02%	0.55%	0.06%	0.03%	0.00%	0.03%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	798.124	39.553	2.00%	10.00%	10.20%	-0.31%	3.24%	0.62%	0.32%	0.02%	0.32%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	91.116	2.417	2.00%	10.00%	10.20%	-0.02%	0.34%	0.04%	0.03%	0.00%	0.03%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	174.195	99.710	2.00%	5.00%	5.39%	-0.41%	2.14%	1.57%	0.11%	0.04%	0.12%
1.A.2.f Other - Liquid Fuels	CO_2	944.946	151.655	2.00%	10.00%	10.20%	-1.17%	5.48%	2.39%	0.55%	0.07%	0.55%
1.A.2.f Other - Solid Fuels	CO_2	38.690	180.475	2.00%	10.00%	10.20%	-1.39%	2.97%	2.84%	0.30%	0.08%	0.31%
1.A.2.f Other - Gaseous Fuels	CO_2	835.236	221.737	2.00%	5.00%	5.39%	-0.90%	6.23%	3.49%	0.31%	0.10%	0.33%
1.A.2.f Other - Other Fuels	CO_2		77.380	2.00%	5.00%	5.39%	-0.32%	1.22%	1.22%	0.06%	0.03%	0.07%
1.A.3.c Civil Aviation - Aviation Gasoline	CO_2	0.011	0.491	2.00%	5.00%	5.39%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Jet Kerosene	CO_2	0.055	1.765	2.00%	5.00%	5.39%	-0.01%	0.03%	0.03%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gasoline	CO_2	1 689.330	690.232	2.00%	2.00%	2.83%	-1.48%	16.38%	10.88%	0.33%	0.31%	0.45%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	1 662.410	2.00%	2.00%	2.83%	-3.56%	28.19%	26.20%	0.56%	0.74%	0.93%

IPCC GHG Source and Sink Categories (LULUCF is included)	Gas	1990 Estimate, Gg CO_2-eq	2012 Estimate, Gg CO_2-eq	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
1.A.3.b Road Transportation - LPG	CO_2	36.957	116.540	2.00%	5.00%	5.39%	-0.47%	1.96%	1.84%	0.10%	0.05%	0.11%
1.A.3.b Road Transportation - Lubricants	CO_2	3.428	4.190	10.00%	5.00%	11.18%	-0.04%	0.08%	0.07%	0.00%	0.01%	0.01%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	19.580		2.00%	5.00%	5.39%		0.06%		0.00%		0.00%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	248.418	2.00%	5.00%	5.39%	-1.01%	5.65%	3.91%	0.28%	0.11%	0.30%
1.A.3.d Naviagtion - Gasoline	CO_2	0.181	0.327	20.00%	5.00%	20.62%	-0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Diesel Oil	CO_2	0.833	12.580	2.00%	5.00%	5.39%	-0.05%	0.20%	0.20%	0.01%	0.01%	0.01%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1 131.478	133.148	2.00%	10.00%	10.20%	-1.03%	5.80%	2.10%	0.58%	0.06%	0.58%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1 331.987	34.937	2.00%	15.00%	15.13%	-0.40%	4.91%	0.55%	0.74%	0.02%	0.74%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	337.481	270.200	2.00%	5.00%	5.39%	-1.10%	5.36%	4.26%	0.27%	0.12%	0.29%
1.A.4.b Residential - Liquid Fuels	CO_2	329.914	154.254	50.00%	10.00%	50.99%	-5.95%	3.51%	2.43%	0.35%	1.72%	1.75%
1.A.4.b Residential - Solid Fuels	CO_2	585.452	53.182	50.00%	10.00%	50.99%	-2.05%	2.76%	0.84%	0.28%	0.59%	0.65%
1.A.4.b Residential - Gaseous Fuels	CO_2	219.607	246.988	50.00%	5.00%	50.25%	-9.39%	4.61%	3.89%	0.23%	2.75%	2.76%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	694.469	314.121	2.00%	10.00%	10.20%	-2.42%	7.22%	4.95%	0.72%	0.14%	0.74%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	94.804	4.835	2.00%	10.00%	10.20%	-0.04%	0.39%	0.08%	0.04%	0.00%	0.04%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	778.520	55.521	2.00%	5.00%	5.39%	-0.23%	3.43%	0.87%	0.17%	0.02%	0.17%
1.A.5.b Mobile - Liquid Fuels	CO_2		7.333	2.00%	50.00%	50.04%	-0.28%	0.12%	0.12%	0.06%	0.00%	0.06%
1.B.2.b Natural Gas	CO_2	0.011	0.003	25.00%	25.00%	35.36%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.A.1 Cement Production	CO_2	366.123	576.633	10.00%	5.00%	11.18%	-4.88%	10.28%	9.09%	0.51%	1.28%	1.38%
2.A.2 Lime Production	CO_2	8.205	0.425	2.00%	50.00%	50.04%	-0.02%	0.03%	0.01%	0.02%	0.00%	0.02%
2.A.3 Limestone and Dolomite Use	CO_2	141.005	5.065	2.00%	50.00%	50.04%	-0.19%	0.54%	0.08%	0.27%	0.00%	0.27%
2.A.5 Asphalt Roofing	CO_2	0.003	0.060	20.00%	70.00%	72.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.A.6 Road Paving with Asphalt	CO_2	0.001	0.067	20.00%	70.00%	72.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2.A.7 Other	CO_2	69.189	5.963	15.00%	60.00%	61.85%	-0.28%	0.32%	0.09%	0.19%	0.02%	0.19%
2.C.1 Iron and Steel Production	CO_2	12.829	1.871	25.00%	5.00%	25.50%	-0.04%	0.07%	0.03%	0.00%	0.01%	0.01%

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3.A Paint Aplication	CO_2	8.840	6.373	2.00%	75.00%	75.03%	-0.36%	0.13%	0.10%	0.10%	0.00%	0.10%
3.B Degreasing and Dry Cleaning	CO_2	0.002	0.005	2.00%	75.00%	75.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3.C Chemical Products, Manufacture and Processing	CO_2	2.989	3.917	3.00%	20.00%	20.22%	-0.06%	0.07%	0.06%	0.01%	0.00%	0.01%
3.D Other	CO_2	31.078	38.213	2.00%	75.00%	75.03%	-2.17%	0.70%	0.60%	0.53%	0.02%	0.53%
5.A.1 Forest Land remaining Forest Land	CO_2	-22 314.616	-12 900.533	1.73%	20.00%	20.07%	195.89%	-286.61%	-203.28%	-57.32%	-4.97%	57.54%
5.A.2 Land converted to Forest Land	CO_2	-3.081	-353.766	3.40%	20.00%	20.29%	5.43%	-5.58%	-5.57%	-1.12%	-0.27%	1.15%
5.B.1 Cropland remaining Cropland	CO_2	1 311.566	1 198.109	0.78%	28.00%	28.01%	-25.38%	23.14%	18.88%	6.48%	0.21%	6.48%
5.B.2 Land converted to Cropland	CO_2	541.994	147.340	35.00%	28.00%	44.82%	-5.00%	4.10%	2.32%	1.15%	1.15%	1.62%
5.C.1 Grassland remaining Grassland	CO_2	207.286	125.037	0.92%	21.00%	21.02%	-1.99%	2.65%	1.97%	0.56%	0.03%	0.56%
5.C.2 Land converted to Grassland	CO_2	-0.003	-662.927	50.00%	21.00%	102.96%	-10.21%	2.59%	1.95%	2.33%	1.38%	2.71%
5.D.1 Wetlands remaining Wetlands	CO_2	19.800	19.800	0.53%	35.00%	35.00%	-0.52%	0.38%	0.31%	0.13%	0.00%	0.13%
5.E.1 Settlements remaining Settlements	CO_2	-54.268	-110.368	0.37%	32.00%	130.86%	-2.05%	0.37%	0.31%	0.35%	0.39%	0.53%
5.E.2 Land converted to Settlements	CO_2	189.932	1 007.446	19.00%	32.00%	37.22%	-28.36%	16.49%	15.87%	5.28%	4.27%	6.79%
5.G. Other	CO_2	36.959	-1 028.736	0.06%	30.00%	30.00%	23.34%	-16.09%	-16.21%	-4.83%	-0.01%	4.83%
6.C Waste Incineration	CO_2		0.307	20.00%	50.00%	53.85%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
2.F(a).1 Refrigeration and Air Conditioning Equipment	HFCs		76.159	75.00%	75.00%	106.07%	-6.11%	1.20%	1.20%	0.90%	1.27%	1.56%
2.F(a).2 Foam Blowing	HFCs		0.641	75.00%	75.00%	106.07%	-0.05%	0.01%	0.01%	0.01%	0.01%	0.01%
2.F(a).3 Fire Extinguisher	HFCs		0.463	75.00%	75.00%	106.07%	-0.04%	0.01%	0.01%	0.01%	0.01%	0.01%
2.F(a).4 Aerosols/ Metered Dose Inhalers	HFCs		2.315	75.00%	75.00%	106.07%	-0.19%	0.04%	0.04%	0.03%	0.04%	0.05%
2.F(a).8 Electrical Equipment	SF6		13.688	2.00%	10.00%	10.20%	-0.11%	0.22%	0.22%	0.02%	0.01%	0.02%
2.F(a).9 Other	HFCs		4.072	75.00%	75.00%	106.07%	-0.33%	0.06%	0.06%	0.05%	0.07%	0.08%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	2.529	0.031	2.00%	50.00%	50.04%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.916	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.004	0.649	2.00%	50.00%	50.04%	-0.02%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.1.a Public Electricity and Heat Production - Biomass	CH_4	0.275	3.691	20.00%	50.00%	53.85%	-0.15%	0.06%	0.06%	0.03%	0.02%	0.03%

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Fuels												
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.021	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CH_4	0.994		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.017	0.021	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4		0.350	15.00%	50.00%	52.20%	-0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.086		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.2.a Iron and Steel - Solid Fuels	CH_4	0.011	0.058	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.445	0.152	2.00%	50.00%	50.04%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4		0.018	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.153	0.006	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.044	0.039	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Biomass Fuels	CH_4		0.132	15.00%	50.00%	52.20%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.009	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.006		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.284	0.007	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4		0.064	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.443	0.022	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.224	0.006	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.331	0.190	2.00%	50.00%	50.04%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.144	0.337	15.00%	50.00%	52.20%	-0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.2.f Other - Liquid Fuels	CH_4	1.413	0.131	2.00%	50.00%	50.04%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Solid Fuels	CH_4	0.094	0.412	2.00%	50.00%	50.04%	-0.02%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.2.f Other - Gaseous Fuels	CH_4	1.585	0.422	2.00%	50.00%	50.04%	-0.02%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.2.f Other - Biomass Fuels	CH_4	0.245	7.607	15.00%	50.00%	52.20%	-0.30%	0.12%	0.12%	0.06%	0.03%	0.07%
1.A.2.f Other - Other Fuels	CH_4		1.304	2.00%	50.00%	50.04%	-0.05%	0.02%	0.02%	0.01%	0.00%	0.01%
1.A.3.c Civil Aviation - Aviation Gasoline	CH_4	0.000	0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Jet Kerosene	CH_4	0.000	0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gasoline	CH_4	14.410	2.366	2.00%	50.00%	50.04%	-0.09%	0.08%	0.04%	0.04%	0.00%	0.04%
1.A.3.b Road Transportation - Diesel Oil	CH_4	0.931	0.968	2.00%	50.00%	50.04%	-0.04%	0.02%	0.02%	0.01%	0.00%	0.01%
1.A.3.b Road Transportation - LPG	CH_4	0.105	0.573	2.00%	50.00%	50.04%	-0.02%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Lubricants	CH_4	0.014	0.011	10.00%	50.00%	50.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.356		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.3.b Road Transportation - Biomass	CH_4		0.017	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Railways - Liquid Fuels	CH_4	0.639	0.299	2.00%	50.00%	50.04%	-0.01%	0.01%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Gasoline	CH_4	0.002	0.004	20.00%	50.00%	53.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Diesel Oil	CH_4	0.001	0.014	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c. Railway (Biofuels for 1A3C)	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.203	0.418	2.00%	50.00%	50.04%	-0.02%	0.02%	0.01%	0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	7.365	0.287	2.00%	50.00%	50.04%	-0.01%	0.03%	0.00%	0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.641	0.515	2.00%	50.00%	50.04%	-0.02%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional - Biomass	CH_4	32.873	32.869	20.00%	50.00%	53.85%	-1.34%	0.63%	0.52%	0.31%	0.15%	0.35%

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1.A.4.b Residential - Liquid Fuels	CH_4	1.031	1.079	50.00%	50.00%	70.71%	-0.06%	0.02%	0.02%	0.01%	0.01%	0.02%
1.A.4.b Residential - Solid Fuels	CH_4	43.019	3.634	50.00%	50.00%	70.71%	-0.19%	0.20%	0.06%	0.10%	0.04%	0.11%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.417	0.471	50.00%	50.00%	70.71%	-0.03%	0.01%	0.01%	0.00%	0.01%	0.01%
1.A.4.b Residential - Biomass	CH_4	126.063	175.165	50.00%	50.00%	70.71%	-9.37%	3.17%	2.76%	1.59%	1.95%	2.52%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	4.221	0.985	2.00%	50.00%	50.04%	-0.04%	0.03%	0.02%	0.01%	0.00%	0.01%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	7.008	0.330	2.00%	50.00%	50.04%	-0.01%	0.03%	0.01%	0.01%	0.00%	0.01%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.478	0.106	2.00%	50.00%	50.04%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	7.686	1.972	15.00%	50.00%	52.20%	-0.08%	0.06%	0.03%	0.03%	0.01%	0.03%
1.A.5.b Mobile - Liquid Fuels	CH_4		0.007	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.B.2.b Natural Gas	CH_4	193.495	55.871	25.00%	25.00%	35.36%	-1.49%	1.52%	0.88%	0.38%	0.31%	0.49%
1.B.2.d Natural Gas	CH_4	14.475	3.922	10.00%	10.00%	14.14%	-0.04%	0.11%	0.06%	0.01%	0.01%	0.01%
2.C.1 Iron and Steel Production	CH_4	0.058	0.088	25.00%	10.00%	26.93%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4.A. Enteric Fermentation	CH_4	2 148.743	687.580	2.00%	20.00%	20.10%	-10.45%	17.83%	10.83%	3.57%	0.31%	3.58%
4.B.Manure Management	CH_4	203.009	96.563	2.00%	30.00%	30.07%	-2.20%	2.19%	1.52%	0.66%	0.04%	0.66%
5.A.1 Forest Land remaining Forest Land	CH_4	20.231	10.721	1.73%	70.00%	70.02%	-0.57%	0.24%	0.17%	0.16%	0.00%	0.16%
5.C.1 Grassland remaining Grassland	CH_4	0.025	0.094	0.92%	75.00%	75.01%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
5.G. Other (Harvested Wood Products)	CH_4	20.333	26.290	10.00%	30.00%	122.07%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
6.A.1 Managed Waste Disposal on Land	CH_4		143.747	20.00%	52.00%	55.71%	-6.06%	2.27%	2.27%	1.18%	0.64%	1.34%
#REF!	CH_4	329.978	304.720	20.00%	52.00%	55.71%	-12.84%	5.88%	4.80%	3.06%	1.36%	3.35%
6.B.1 Industrial Waste Water	CH_4	34.233	11.529	2.00%	30.00%	30.07%	-0.26%	0.29%	0.18%	0.09%	0.01%	0.09%
6.B.2 Domestic and Commercial Waste Water	CH_4	157.669	87.837	10.00%	30.00%	31.62%	-2.10%	1.90%	1.38%	0.57%	0.20%	0.60%
6.D Other	CH_4		1.480	20.00%	100.00%	101.98%	-0.11%	0.02%	0.02%	0.02%	0.01%	0.02%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.466	0.092	2.00%	50.00%	50.04%	0.00%	0.03%	0.00%	0.01%	0.00%	0.01%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	2.709	0.228	2.00%	50.00%	50.04%	-0.01%	0.01%	0.00%	0.01%	0.00%	0.01%
1.A.1.a Public Electricity and	N_2O	1.482	0.958	2.00%	50.00%	50.04%	-0.04%	0.02%	0.02%	0.01%	0.00%	0.01%

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Heat Production - Gaseous Fuels												
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.541	7.248	20.00%	50.00%	53.85%	-0.30%	0.12%	0.11%	0.06%	0.03%	0.07%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.063	0.032	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	N_2O	1.957		2.00%	50.00%	50.04%		0.01%		0.00%		0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.025	0.030	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O		0.689	15.00%	50.00%	52.20%	-0.03%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.383		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.2.a Iron and Steel - Solid Fuels	N_2O	0.023	0.154	2.00%	50.00%	50.04%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.131	0.045	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CH_4		0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4		0.000	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4		0.005	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.677	0.029	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.c Chemicals - Biomass Fuels	N_2O		0.260	15.00%	50.00%	52.20%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.038	0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.012		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.084	0.002	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O		0.126	15.00%	50.00%	52.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco -	N_2O	1.962	0.100	2.00%	50.00%	50.04%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%

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Liquid Fuels												
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.464	0.011	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.098	0.056	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.283	0.663	15.00%	50.00%	52.20%	-0.03%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.2.f Other - Liquid Fuels	N_2O	2.709	0.401	2.00%	50.00%	50.04%	-0.02%	0.02%	0.01%	0.01%	0.00%	0.01%
1.A.2.f Other - Solid Fuels	N_2O	0.195	0.851	2.00%	50.00%	50.04%	-0.03%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.2.f Other - Gaseous Fuels	N_2O	0.468	0.125	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.2.f Other - Biomass Fuels	N_2O	0.482	14.972	15.00%	50.00%	52.20%	-0.59%	0.24%	0.24%	0.12%	0.05%	0.13%
1.A.2.f Other - Other Fuels	N_2O		2.566	2.00%	50.00%	50.04%	-0.10%	0.04%	0.04%	0.02%	0.00%	0.02%
1.A.3.c Civil Aviation - Aviation Gasoline	N_2O	0.000	0.004	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.c Civil Aviation - Jet Kerosene	N_2O	0.000	0.019	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gasoline	N_2O	13.601	5.621	2.00%	50.00%	50.04%	-0.21%	0.13%	0.09%	0.07%	0.00%	0.07%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.819	12.631	2.00%	50.00%	50.04%	-0.48%	0.22%	0.20%	0.11%	0.01%	0.11%
1.A.3.b Road Transportation - LPG	N_2O	0.170	2.190	2.00%	50.00%	50.04%	-0.08%	0.04%	0.03%	0.02%	0.00%	0.02%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.045	10.00%	50.00%	50.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.011		2.00%	50.00%	50.04%		0.00%		0.00%		0.00%
1.A.3.b Road Transportation - Biomass	N_2O		0.322	2.00%	50.00%	50.04%	-0.01%	0.01%	0.01%	0.00%	0.00%	0.00%
1.A.3.c Railways - Liquid Fuels	N_2O	64.964	30.371	2.00%	50.00%	50.04%	-1.15%	0.69%	0.48%	0.35%	0.01%	0.35%
1.A.3.d Naviagtion - Gasoline	N_2O	0.000	0.000	20.00%	50.00%	53.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.3.d Naviagtion - Diesel Oil	N_2O	0.105	1.581	2.00%	50.00%	50.04%	-0.06%	0.03%	0.02%	0.01%	0.00%	0.01%
1.A.3.e. Railway (Biofuels for 1A3C)	N_2O		0.001	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.823	0.357	2.00%	50.00%	50.04%	-0.01%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	7.306	0.190	2.00%	50.00%	50.04%	-0.01%	0.03%	0.00%	0.01%	0.00%	0.01%
1.A.4.a Commercial/Institutional -	N_2O	0.189	0.152	2.00%	50.00%	50.04%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%

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Gaseous Fuels												
1.A.4.a Commercial/Institutional - Biomass	N_2O	6.470	6.484	20.00%	50.00%	53.85%	-0.26%	0.12%	0.10%	0.06%	0.03%	0.07%
1.A.4.b Residential - Liquid Fuels	N_2O	0.913	0.531	50.00%	50.00%	70.71%	-0.03%	0.01%	0.01%	0.01%	0.01%	0.01%
1.A.4.b Residential - Solid Fuels	N_2O	3.306	0.250	50.00%	50.00%	70.71%	-0.01%	0.01%	0.00%	0.01%	0.00%	0.01%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.123	0.139	50.00%	50.00%	70.71%	-0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.b Residential - Biomass	N_2O	24.812	34.446	50.00%	50.00%	70.71%	-1.84%	0.62%	0.54%	0.31%	0.38%	0.49%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	14.085	3.540	2.00%	50.00%	50.04%	-0.13%	0.10%	0.06%	0.05%	0.00%	0.05%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.508	0.023	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.436	0.031	2.00%	50.00%	50.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.513	0.388	2.00%	50.00%	50.04%	-0.01%	0.01%	0.01%	0.01%	0.00%	0.01%
1.A.5.b Mobile - Liquid Fuels	N_2O		0.732	2.00%	50.00%	50.04%	-0.03%	0.01%	0.01%	0.01%	0.00%	0.01%
3.D Other	N_2O	0.005	0.005	2.00%	2.00%	2.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4.B.Manure Management	N_2O	569.751	122.826	40.00%	30.00%	50.00%	-4.65%	3.80%	1.94%	1.14%	1.09%	1.58%
4.D.1. Direct Soil Emissions	N_2O	1 618.700	1 011.179	40.00%	25.00%	47.17%	-36.08%	21.19%	15.93%	5.30%	9.01%	10.46%
4.D.2 Pasture, Range and Paddock Manure	N_2O	358.400	87.655	40.00%	25.00%	47.17%	-3.13%	2.56%	1.38%	0.64%	0.78%	1.01%
4.D.3.Indirect Emissions	N_2O	1 033.935	414.495	30.00%	40.00%	50.00%	-15.68%	9.91%	6.53%	3.96%	2.77%	4.84%
5.A.1 Forest Land remaining Forest Land	N_2O	146.638	144.192	1.73%	50.00%	50.03%	-5.46%	2.75%	2.27%	1.38%	0.06%	1.38%
5.B.2 Land converted to Cropland	N_2O	3.425	35.660	35.00%	100.00%	105.95%	-2.86%	0.57%	0.56%	0.57%	0.28%	0.64%
5.C.1 Grassland remaining Grassland	N_2O	0.018	0.070	0.92%	70.01%	70.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5.D.2 Land converted to Wetlands	N_2O	1.315	1.315	90.00%	95.00%	130.86%	-0.13%	0.03%	0.02%	0.02%	0.03%	0.04%
5.G. Other		5.760	39.717	10.00%	30.00%	130.86%	-0.14%	0.02%	0.02%	0.02%	0.03%	0.04%
6.B.1 Industrial Waste Water	N_2O	2.436	0.104	10.00%	30.00%	31.62%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
6.B.2 Domestic and Commercial Waste Water	N_2O	63.534	48.691	10.00%	30.00%	31.62%	-1.16%	0.98%	0.77%	0.29%	0.11%	0.31%
6.C Waste Incineration	N_2O		0.011	20.00%	90.00%	92.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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6.D Other	N_2O		1.639	20.00%	90.00%	92.20%	-0.11%	0.03%	0.03%	0.02%	0.01%	0.02%
TOTAL	CO2 eq	**6 346.23**	**-1 322.06**	**22.64**	**84.02**	**95.49**	**-0.30**	**0.04**	**-0.07**	**-0.08**	**0.33**	**1.37**
					Percentage uncertainty in total inventory		**29.64%**				Trend uncertainty	**137.09%**

ANNEX 8: OTHER

Additional information on CSB Integrated Statistical Data Management System (ISDMS)

ISDMS contents:

Following business application software modules are covering and supporting all phases of the statistical data processing:

Core metadata base module – the key part of the system ensures metadata collection and storage, defines all entire system processes starting from data collection and ending with output reports preparation. All System software modules are linked with the Core Metadata module.

Registers module – ensure system users with the full range of respondents data.

Data entry and validation module – generates date entry and validation applications, executes validation and data editing processes and storage clean data sets in the Micro Data Base.

Web based data collection module – ensures electronic data collection via Web.

Data aggregation module – ensures data aggregation on different conditions and storage of the aggregated data sets in the Macro Data Base.

Data analysis module – via micro data export to MS Excel and/or Access ensures data analysis processes, MS OLAP tools are available for data analysis as well.

Data dissemination module – ensures data storage for publication at CSB web.

User's administration module – administrates user roles and rights.

ISDMS advantages:

1. Standardized data entry, processing and storage procedures => process oriented data processing.

2. Centralized processing and storage of all types of statistical data, including metadata, by using data warehouse technologies and OLAP tools.

3. The system is connected to Business Register => direct respondent basic data retrieval and updating.

4. Special import and export procedure is created for data exchange with other systems.

5. A link with PC Axis is created for electronic data dissemination.