LATVIA'S
NATIONAL INVENTORY REPORT

Submission under UNFCCC and the Kyoto Protocol

Common Reporting Formats (CRF)

1990 – 2015

2017

PREFACE

Latvia's National Inventory Report under the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC contains following parts:

1. Latvia's National Inventory Report is prepared using the reporting guidelines of UNFCCC (adopted by decision 24/CP.19) 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 1990-2015 including KP-LULUCF data tables. The CRF tables are compiled with the UNFCCC CRF Reporter software (version 6.0.1.1);

3. SEF (Standard Electronic Tables) for reporting of Kyoto units (AAU, ERU, CER, t-CER, l-CER, RMU) in the registry. SEF tables are provided separately for units relevant to the second commitment period (SEF tables for 2016).

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The Latvia's National Inventory Report as well as the CRF tables can be downloaded from address: http://www.meteo.lv/

DISCLAIMER

The present report is the official inventory submission of Latvia for the year 2017 under the UNFCCC and the Kyoto Protocol in spite of the remaining deficiencies in the CRF Reporter and underlying CRF tables. Latvia should not be held liable for errors caused by the CRF Reporter in the review of the submitted information.

The CRF Reporter still contains several issues regarding the information required under Kyoto Protocol. For example, it is not possible to make the choice of accounting annually or at the end of the commitment period.

In CRF Reporter some information and data in the parent categories (green and grey cells) in CRF tables containing information regarding F-gases are missing due to CRF internal issue which does not allow to directly enter NO in green and grey cells without adding child nodes. It was confirmed by CRF help desk that this issue be improved in the future releases of the software.

Errors concern data that do not affect the calculation of the total national emissions.

CONTENT

LIST OF TABLES

LIST OF FIGURES

UNITS AND ABBREVIATIONS

t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g
Mg	1 megagram = 10^6 g = 1 tonne (t)
kt	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

AAU – Assigned Amount Units
AR – Afforestation and reforestation
AWMS - Animal waste management systems
CER – Certified Emission Reduction Units
CH_4 – Methane
CIS – Commonwealth of Independent States
CO_2 – Carbon dioxide
CO_2 eq. – Carbon dioxide equivalent
CO – Carbon monoxide
CR – Corinair emission factor
CRF – Common Reporting Format
CS – Country specific
CSB – Central Statistical Bureau
D – Default emission factor
EMEP/CORINAIR 2007 – Atmospheric emission inventory guidebook, Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe, The Core inventory of air emissions in Europe
EMEP/EEA 2013 - EMEP/EEA air pollutant emission inventory guidebook 2013
EMEP/EEA 2016 - EMEP/EEA air pollutant emission inventory guidebook 2016
EU – European Union
EU ETS – European Union Emission Trading Scheme
EU MMR – European Union Monitoring Mechanism Regulation
EU ESD – European Union Effort Sharing Decision
ERT – Expert review team
ERU – Emission Reduction Units
ETR – Emission trading registry
GHG – Greenhouse Gases
GDP – Gross domestic product
HFC – Hydrofluorocarbon
HWP – Harvested wood products
FM – Forest management
FMRL – Forest Management Reference Level
IE – Included elsewhere
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)
2006 IPCC GUIDELINES – 2006 IPCC Guidelines for National Greenhouse Gas Inventories
IPCC WETLANDS SUPPLEMENT - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands
IPCC KP SUPPLEMENT - 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol
IPE – Institute of Physical Energetics
IPPC - Integrated Pollution Prevention Control
l-CER – Long term Certified Emission Reduction Unit
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 of the Republic of Latvia
MEPRD - Ministry of Environmental Protection and Regional Development of the Republic of Latvia
MoT - Ministry of Transport
MMS – Manure management system
NFI – National forest inventory
NF_3 – Nitrogen trifluoride
N_2O – Nitrous oxide
NO_x – Nitrogen oxides
NA – Not applicable
NCV – Net calorific value
NE – Not estimated
NIR – National inventory report
NMVOC - Non-methane volatile organic compounds
NO – Not occuring in Latvia
OECD - Organisation for Economic Co-operation and Development
PFC – Perfluorocarbon
REB – Regional Environment Boards
RMU – Removal Units
RTSD – Road Traffic Safety Department
SAM – State Agency of Medicines of the Republic of Latvia
SEF – Standart Electronic Format
SFRS – State Firefighting & Rescue Service
SFS – State Forest Service
SF_6 – Sulphur hexafluoride
SO_2 – Sulphur dioxide
UN – United Nations
UNFCCC – United Nations Framework Convention on Climate Change
TERT – Technical expert review team
t-CER – Temporary Certified Emission Reduction units

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.

Latvia is a member of European Union since May, 2004 and therefore has reporting obligations also under 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 (EU MMR). This regulation comprises reporting to fulfil the EU Effort Sharing Decision (406/2009/EC) and the EU LULUCF Decision (529/2013/EU). Commission Implementing Regulation (EU) No 749/2014 and the Commission Delegated Regulation (EU) No 666/2014 determine implementation of the Regulation (EU) No 525/2013.

Under these above mentioned agreements Latvia is required to provide annually information on anthropogenic greenhouse gas emissions by sources and removals by sinks of all greenhouse gases not controlled by Montreal Protocol from following sectors: Energy, Industrial Processes and Product Use, Agriculture, Land Use, Land Use Change and Forestry and Waste.

For the second commitment period of the Kyoto Protocol (agreement under Article 4 of the Kyoto Protocol) until 2020 European Union and its Member States, and Iceland has agreed to achieve jointly their quantified emission limitation and reduction commitment (QELRC) by 20% compared to the emissions in the base year or period during the 2013- 2020. The efforts of the reduction (reduction targets) are shared out as follows:

- 21% reduction compared to 2005 level for the emissions from sectors covered by the European Union Emission Trading Scheme (EU ETS); this goal is EU-wide and defines that all EU ETS operators jointly reduce the total GHG emissions;
- around 10% reduction compared to 2005 for other emitters (sectors and activities not included in the EU ETS which are regulated by Effort Sharing Decision[1] (EU ESD)). Member States have taken on binding annual targets for reducing their GHG emissions from the sectors not covered by the EU ETS, such as housing, agriculture, waste and transport (excluding aviation). The national targets, covering the period 2013-2020, are differentiated according to Member States relative wealth (measured by Gross Domestic Product (GDP) per capita. In accordance with EU ESD

[1] *http://ec.europa.eu/clima/policies/effort/index_en.htm*

(406/2009/EC) Latvia's national target is to limit emission growth to +17% above the 2005 level by 2020.

Allocated emission level of Latvia for the period 2013-2020 set out in the terms of the joint fulfilment for the second commitment period under the Kyoto Protocol is 76633439 tonnes carbon dioxide equivalent (Assigned amount). In addition to non – ETS emissions Latvia is responsible for the emissions/removals related to the Kyoto Protocol LULUCF activities according to decision 2/CMP.7.

ES.1.2 Background information on greenhouse gas inventories

The annual greenhouse gas inventory contains information on the trends of national greenhouse gas emissions by sources and removals by sinks since 1990.

According to the Regulation No. 217 of Cabinet of Ministers (27.03.2012.) Ministry of Environmental Protection and Regional Development (MEPRD) is a single national entity with overall responsibility for the Latvia's GHG inventory. The main institutions involved in the compilation of the Latvia's GHG inventory are the MEPRD, Latvian Environment, Geology and Meteorology Centre (LEGMC), Latvian State Forest Research Institute "Silava", Latvia University of Agriculture (LUA), Institute of Physical Energetics (IPE). Description of the national greenhouse gas inventory system including the institutional arrangements is provided in Section 1.2.

The GHG inventory is prepared according to the UNFCCC Decision 24/CP.19[2] Annex I reporting guidelines "Guidelines for the preparation of national communications by Parties included in Annex I of the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories on annual inventories" (UNFCCC reporting guidelines) and tables of the common reporting format to implement the use of the 2006 IPCC Guidelines for National Greenhouse Gas inventories (2006 IPCC Guidelines), 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC Wetlands Supplement) and 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (IPCC KP Supplement).

For the preparation of the 2017 inventory submission CRF Reporter v6.0.1.1 software has been used. Due to problems remained in CRF software minor inconsistencies and data display issues may still exist in the reporting tables.

ES.1.2 Background information on supplementary information required under Article 7, paragraph 1 of the Kyoto Protocol

The required information is consistent with relevant decisions and guidelines under Article 7 paragraph 1 and includes information on Latvia's assigned amount for the second commitment period, corresponding emissions and removals (Chapter 12), changes in the national system (Chapter 13) and national registry (Chapter 14), information related to Article 3, paragraphs 3 and 4 (Chapter 11), and Article 3, paragraph 14 (Chapter 15). The summary of information on the accounting of Kyoto units is provided in Chapter 12.

[2] *http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2*

ES.2 SUMMARY OF NATIONAL EMISSION AND REMOVAL-RELATED TRENDS

ES.2.1 GHG inventory

In 2015, Latvia's greenhouse gas emissions constituted 11319.39 kt CO_2 eq (including indirect CO_2, without LULUCF) and 12696.54 kt CO_2 eq (including indirect CO_2, with LULUCF). Latvia's total GHG emissions including indirect CO_2, without LULUCF showed a decrease of 56.77% comparing to the base year, but GHG emissions including indirect CO_2, with LULUCF have decreased by 27.02% compared to base year.

If compared to 2014 total GHG emissions including indirect CO_2, without LULUCF have increased by 1.0%, but including indirect CO_2, with LULUCF GHG emissions have decreased by 18.4% mostly due to increase of CO_2 removals in living biomass in forest lands because in 2015 natural mortality decreased by 11% in comparison to 2013-2014, but increment of living trees increased by 12% in comparison to 2014 (Figure ES.1).

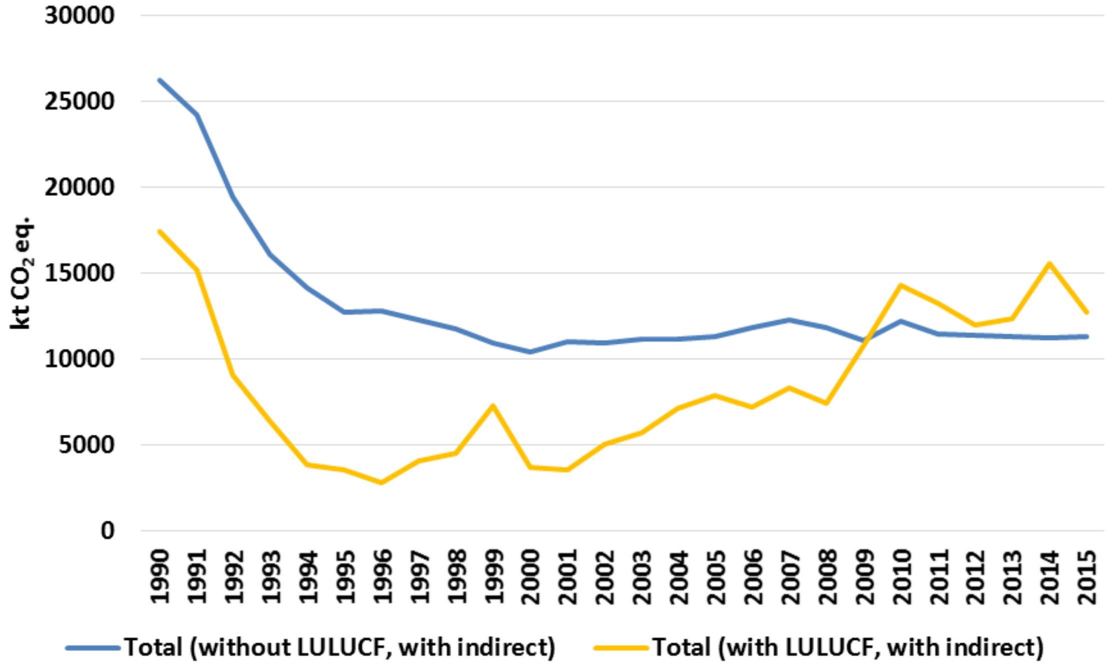

Figure ES.1 Latvia`s total GHG emissions (with and without LULUCF) 1990–2015 (kt CO_2 eq.)

Aggregated GHG emissions 1990 - 2015, kt CO_2 eq by gases are reflected in Table ES.1 a and Table ES.1 b and by sectors reflected in Table ES.2 a and Table ES.2 b.

Table ES.1 a Aggregated GHG emissions by gases (1990 - 2002), kt CO_2 eq.

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
kt CO_2 equivalent													
CO_2 emissions including net CO_2 from LULUCF	19780.53	18014.36	14246.67	11969.34	10402.29	9145.17	9220.45	8680.28	8303.08	7711.82	7072.96	7484.26	7511.84
CO_2 emissions excluding net CO_2 from LULUCF	10113.90	8059.64	2841.13	1435.04	-775.21	-932.34	-1671.62	-399.01	169.91	3088.00	-557.22	-813.30	662.49
CH_4 emissions including CH_4 from LULUCF	3539.14	3484.67	2996.66	2275.35	2104.58	2088.24	2051.49	2023.13	1937.81	1807.06	1848.12	1938.36	1924.59
CH_4 emissions excluding CH_4 from LULUCF	3842.93	3783.74	3380.03	2580.09	2407.22	2400.73	2367.13	2341.84	2257.65	2156.99	2185.89	2240.74	2255.15
N_2O emissions including N_2O from LULUCF	2821.77	2676.91	2173.21	1758.58	1602.61	1461.53	1480.77	1488.79	1446.64	1379.66	1404.85	1498.28	1461.60
N_2O emissions excluding N_2O from LULUCF	3397.51	3253.90	2761.87	2339.72	2184.78	2046.73	2068.20	2078.80	2038.76	1976.39	2002.09	2093.28	2062.02
HFCs	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	2.50	2.76	3.35	5.75	6.96	9.59	12.92	16.44
PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.17	0.18	0.37	0.52	0.71	0.88	1.39	2.62
NF_3	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Total (without LULUCF)	26141.43	24175.95	19416.54	16003.27	14109.48	12697.62	12755.65	12195.92	11693.78	10906.21	10336.41	10935.21	10917.09
Total (with LULUCF)	17354.34	15097.29	8983.02	6354.85	3816.79	3517.79	2766.65	4025.35	4472.58	7229.05	3641.24	3535.03	4998.72
Total (without LULUCF, with indirect)	26184.86	24217.00	19454.80	16039.46	14144.94	12731.79	12788.09	12226.40	11722.71	10934.19	10362.81	10961.14	10943.44
Total (with LULUCF, with indirect)	17397.77	15138.34	9021.27	6391.03	3852.25	3551.96	2799.10	4055.83	4501.50	7257.03	3667.63	3560.96	5025.06

Table ES.1 b Aggregated GHG emissions by gases (2003 - 2015), kt CO_2 eq.

GREENHOUSE GAS EMISSIONS	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from 1990 to latest reported year (%)
kt CO_2 equivalent														
CO_2 emissions including net CO_2 from LULUCF	7706.77	7713.19	7790.92	8292.90	8610.90	8174.33	7438.76	8529.66	7799.31	7519.14	7350.38	7151.01	7239.36	-63.40
CO_2 emissions excluding net CO_2 from LULUCF	1374.89	2799.57	3439.09	2745.08	3707.93	2867.05	6168.00	9596.39	8597.88	7141.96	7388.80	10413.46	7535.34	-25.50
CH_4 emissions including CH_4 from LULUCF	1847.00	1822.43	1880.66	1857.38	1913.67	1871.00	1851.99	1836.19	1766.80	1849.78	1886.41	1956.93	1883.88	-46.77
CH_4 emissions excluding CH_4 from LULUCF	2156.05	2125.48	2160.54	2180.51	2193.20	2149.75	2152.00	2144.65	2088.33	2186.14	2240.46	2332.89	2256.72	-41.28
N_2O emissions including N_2O from LULUCF	1515.18	1506.99	1563.25	1574.14	1628.75	1619.07	1642.88	1674.21	1683.25	1773.61	1807.60	1867.87	1942.25	-31.17
N_2O emissions excluding N_2O from LULUCF	2115.07	2108.21	2163.11	2183.09	2232.19	2224.18	2268.73	2317.90	2345.30	2454.26	2507.13	2572.77	2650.58	-21.98
HFCs	20.27	36.06	52.06	86.61	112.51	132.10	142.38	155.01	175.99	181.18	197.21	205.63	227.06	100.00
PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NA,NO	NA,NO	0.00
Unspecified mix of HFCs and PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NA,NO	NA,NO	0.00
SF_6	2.76	3.25	3.78	4.07	4.55	5.23	7.33	7.35	7.47	7.78	8.50	8.58	10.12	100.00
NF_3	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NA,NO	NA,NO	0.00
Total (without LULUCF)	11091.98	11081.92	11290.67	11815.09	12270.39	11801.73	11083.34	12202.43	11432.81	11331.49	11250.11	11190.02	11302.67	-56.76
Total (with LULUCF)	5669.04	7072.58	7818.58	7199.35	8250.38	7378.31	10738.45	14221.31	13214.96	11971.32	12342.10	15533.33	12679.81	-26.94
Total (without LULUCF, with indirect)	11113.04	11102.24	11312.30	11831.54	12288.33	11818.95	11099.68	12218.08	11443.23	11343.80	11265.27	11210.22	11319.39	-56.77
Total (with LULUCF, with indirect)	5690.10	7092.89	7840.21	7215.80	8268.33	7395.53	10754.79	14236.96	13225.39	11983.63	12357.25	15553.53	12696.54	-27.02

Table ES.2 a Aggregated GHG emissions by sectors (1990 - 2001), kt CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
kt CO_2 equivalent												
1. Energy	19386.62	17862.27	14511.48	12405.30	10770.85	9499.55	9567.70	8991.97	8572.90	7932.00	7310.01	7731.21
2. IPPU	705.05	623.70	311.00	150.99	197.15	208.02	217.51	229.64	237.86	270.43	223.37	245.76
4. Agriculture	5370.68	4978.09	3918.39	2841.69	2546.43	2383.04	2355.35	2340.31	2236.78	2047.54	2081.38	2201.84
5. LULUCF	-8787.09	-9078.66	-10433.52	-9648.42	-10292.69	-9179.82	-9988.99	-8170.57	-7221.21	-3677.16	-6695.18	-7400.18
6. Waste	679.09	711.88	675.67	605.29	595.05	607.00	615.09	634.01	646.25	656.24	721.66	756.41
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total emissions (including LULUCF)	17354.34	15097.29	8983.02	6354.85	3816.79	3517.79	2766.65	4025.35	4472.58	7229.05	3641.24	3535.03

Table ES.2 b Aggregated GHG emissions by sectors (2002 - 2015), kt CO_2 eq.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from 1990 to latest reported year (%)
kt CO_2 equivalent															
1. Energy	7734.19	7889.44	7916.18	8027.85	8458.55	8782.73	8327.93	7607.63	8404.69	7534.19	7217.40	7139.41	6974.24	7115.05	-63.30
2. IPPU	260.95	277.65	309.16	308.25	369.93	394.40	402.89	405.14	680.25	807.14	881.70	819.79	823.68	760.54	7.87
4. Agriculture	2183.59	2234.80	2168.01	2245.76	2253.68	2347.46	2325.77	2353.79	2376.00	2395.87	2506.49	2570.33	2663.32	2739.64	-48.99
5. LULUCF	-5918.37	-5422.94	-4009.35	-3472.09	-4615.74	-4020.01	-4423.42	-344.89	2018.88	1782.15	639.83	1091.99	4343.32	1377.15	-115.67
6. Waste	738.36	690.08	688.57	708.80	732.93	745.79	745.14	716.78	741.48	695.61	725.91	720.59	728.77	687.44	1.23
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total emissions (including LULUCF)	4998.72	5669.04	7072.58	7818.58	7199.35	8250.38	7378.31	10738.45	14221.31	13214.96	11971.32	12342.10	15533.33	12679.81	-26.94

ES.2.2 KP-LULUCF activities

For the LULUCF activities under Article 3 paragraphs 3 and 4, of Kyoto Protocol Latvia has chosen accounting at the end of period[3]. Therefore the accounting quantity will be reported in the annual report commitment submitted for the last year of the commitment period (in 2022) and calculated over the entire commitment period.

Article 3.3 covers human induced afforestation (A), reforestation (R) and deforestation activities, which should be accounted mandatory. Under Article 3.4 Latvia is accounting Forest Management (FM) in the second commitment period. Latvia's FM reference level (FMRL) for the second commitment period is -16302 kt CO_2 equivalent a year, including harvested wood products, and -14255 kt CO_2 equivalent a year assuming instantaneous oxidation of harvested wood products according to the appendix to the annex to decision 2/CMP.7[4]. Latvia will make technical corrections for the forest management reference level according to the requirements of decision 2/CMP.7 and 2/CMP.8. According to latest forest management data the corrected FMRL might be 4598.61 kt CO_2. The main reasons for recalculation is implementation of the new IPCC guidelines and improvement of activity data, particularly, on a harvest rate.

Summary 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*
	2013	2014	2015	2016	2017	2018	2019	2020	Total		
A. Article 3.3 activities											
A.1. Afforestation and Reforestation	-69.29	-73.31	-77.09						-219.69		-219.69
Excluded emissions from natural disturbances	NA	NA	NA						NA		NA
Excluded subsequent removals from land subject to natural disturbances	NA	NA	NA						NA		NA
A.2. Deforestation	1695.64	1727.50	1756.53						5179.67		5179.67
B. Article 3.4 activities											
B.1. Forest management									-5738.44		
Net emissions/removals	-3679.00	474.99	-2534.44						-5738.44		
Excluded emissions from natural	NA	NA	NA						NA		NA

[3] *Current version of CRF Reporter (v6.0.1.1) does not provide option to make the choice of accounting annually or at the end of the commitment period. "End of the period" option will be selected when this will be technically possible in CRF Reporter.*
[4] *http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf*

Greenhouse gas source and sink activities	Net emissions/removals									Accounting parameters	Accounting Quantity*
	2013	2014	2015	2016	2017	2018	2019	2020	Total		
disturbances											
Excluded subsequent removals from land subject to natural disturbances	NA	NA	NA						NA		NA
Any debits from newly established forest (CEF-ne)	NA	NA	NA						NA		NA
Forest management reference level (FMRL)										-16302.00	
Technical corrections to FMRL										11703.39	
Forest management cap[5]										7332.51	
B.2. Cropland management	NA	NA	NA						NA		NA
B.3. Grazing land management	NA	NA	NA						NA		NA
B.4. Revegetation	NA	NA	NA						NA		NA
B.5. Wetland drainage and rewetting	NA,NO	NA,NO	NA,NO						NA,NO		NO,NA

**Figures are not provided for B.1. Forest management and Forest management cap due to error in CRF Reporter*

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

ES.3.1 GHG inventory

The main sources of greenhouse gas emissions are divided into the following sectors (according to Decision 24/CP.19): Energy (CRF 1), Industrial processes and Product Use (CRF 2), Agriculture (CRF 3), Land use, Land use change and Forestry (LULUCF) (CRF 4) and Waste (CRF 5). GHG emissions by sectors are shown in the Figure ES.2.

[5] FM cap is calculated in accordance with paragraph 13 of the annex to decision 2/CMP.7, 3.5 per cent of the national total emissions including indirect CO_2, excluding LULUCF in the base year times eight.

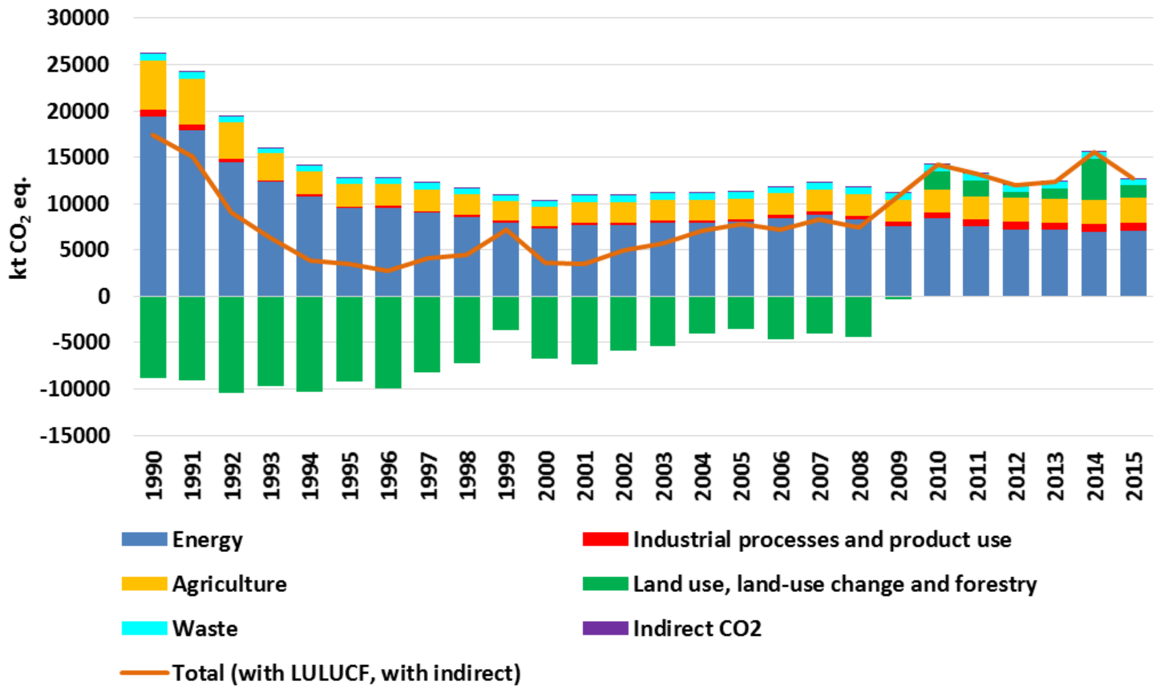

Figure ES.2 Latvia`s GHG emissions and removals by sectors 1990-2015 (kt CO_2 eq.)

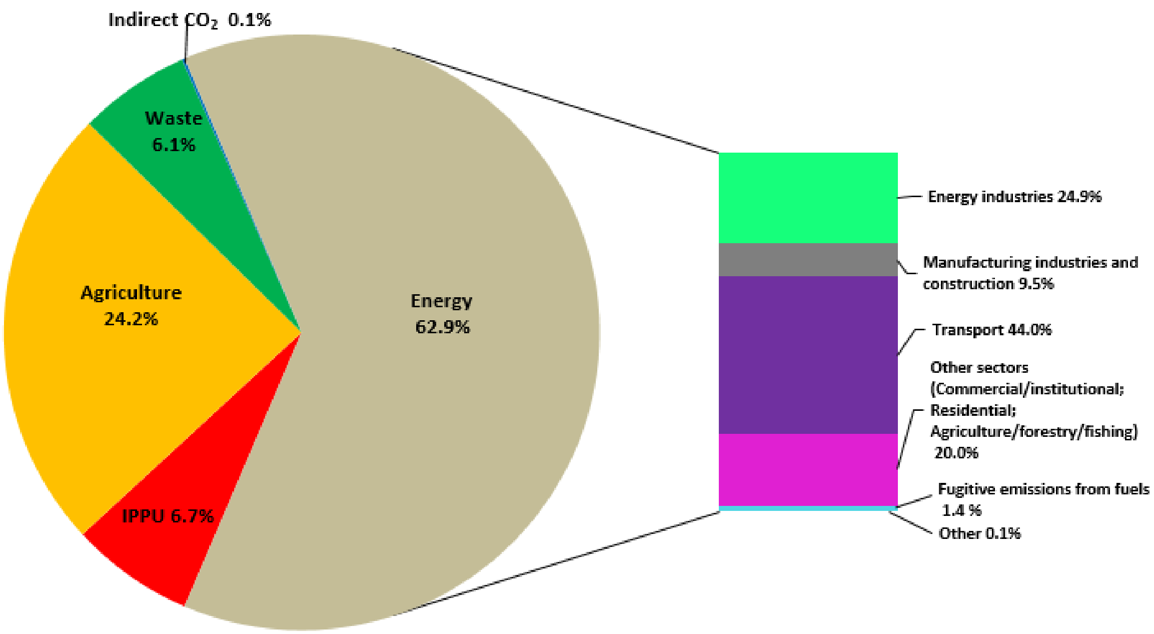

Figure ES.3 The composition of Latvian greenhouse gas emissions in 2015 (including indirect CO_2, excluding LULUCF)

The **Energy sector** is the most significant source of GHG emissions with 62.9% share of the total emissions in the 2015 (Figure ES.3). GHG emissions fluctuate in the latest years mainly due to the economic trend, the energy supply structure and climate conditions. Total emissions in Energy sector in 2015 decreased by 63.3% if compared to the base year. A large part of energy sector emissions comes from transport sector (44.0%). Emissions from transport increased by 6.1% compared to 2014 mainly due to GHG emission increase in road transport.

Agriculture is the second significant source of GHG emissions, with approximately 24.2% of Latvia's total GHG emissions excluding LULUCF in 2015. Emissions from agriculture include CH_4, N_2O emissions from enteric fermentation, manure management and agricultural soils and CO_2 emissions from liming and urea application. GHG emissions increased in 2015 by 2.9% comparing to 2014 due to increase of sheep, goats, poultry and rabbit numbers. Milk yield of dairy cows increased by 1.6%. Statistics also showed increase of synthetic N fertilizer consumption (+4.0%), sown area (+1.6%) and lime and urea application to soils (+5.3%, 31.4%). Also increase of emissions was promoted by increasing of liquid manure share in total manure management amount. The annual emissions have reduced approximately by 49.0% since 1990 due to decrease in agricultural production. In 2015, given in CO_2 eq, the N_2O contributed 64.0%, CH_4 contributed 35.0% of total GHG emission from the agricultural sector, remaining 1.0% refer to CO_2 emissions from liming and urea application.

The emissions from **Industrial Processes and Product Use (IPPU)** (referred to as non-energy related ones), include CO_2, CH_4, N_2O and F-gases (HFCs and SF_6). The category constitutes 6.7% of the total GHG emissions excluding LULUCF in 2015. Compared to 1990 emissions from IPPU have increased by 7.9%, but compared to 2014 emissions decreased by 7.7% mainly due to decrease of emissions from cement production.

The largest decrease in IPPU emissions occurred between years 1991 and 1993, when industry was affected by a crisis. Emission fluctuations in product uses sectors are also linked with the economic situation of the country. In the latest years emissions increased significantly due to overall increase of activity in industrial production processes.

F-gases emissions from 2.F Product uses as substitutes for ozone depleting substances (ODS) constitute 2.0% from total GHG emissions including indirect CO_2, excluding LULUCF in 2015. Emissions from HFC and SF_6 have grown significantly since 1995. Compared to 2014 F-gases emissions increased by 10.7% due to increase of activity data reported by F-gases importers and users.

In 2015 NMVOC emissions from Solvent Use sector have decreased by 0.3%, compared to 2014. Solvent Use sector was significant NMVOC emission source in Latvia and it covered 25.2% (10.38 kt) from the total Latvia's NMVOC emissions in 2015.

Emissions from the **Waste sector** contribute 6.1% of total GHG emissions excluding LULUCF in 2015. Emissions from Waste include CH_4 and N_2O emissions from solid waste disposal, biological treatment of solid waste, incineration and open burning of waste as well as waste water treatment and discharge. Waste emissions have been fluctuating since 1990. Trend could be explained with changes in economic situation in Latvia. In 2015, emissions were approximately 1.2% higher than in 1990, but compared to 2014 emissions decreased by 5.7% due to decrease of emissions from wastewater handling and increase of methane recovery in landfills.

Indirect CO_2 emission sources in Latvia are NMVOC emissions from road traffic evaporation - cars, CH_4 and NMVOC emissions from natural gas leakages, as well as NMVOC emissions from gasoline distribution and they are reported separately under Energy sector in CRF Table 6. Together they constitute 16.7 kt CO_2 eq. which is 0.1% from Latvia`s total GHG emissions without LULUCF, with indirect CO_2 in 2015.

Net GHG emissions from **Land use, Land use change and forestry (LULUCF)** in 2015 were 1377.1 kt CO_2 eq compared to -8787.1 kt CO_2 eq in the base year. Change from base to latest reported year of emissions/removals from LULUCF constitutes -116%. This decrease of removals from LULUCF sector is related to increase of harvesting stock (more than double), increase of natural mortality due to ageing of forest stands and reduction of increment in ageing forests. Increase of the GHG emissions in 1999 is associated with significant increase of harvesting stock in forest lands, but increase of the GHG emissions in 2014 is due to increase of the harvesting rate, higher mortality rate and slight reduction of increment of living biomass in forest lands according to the NFI data.

ES.4 OVERVIEW OF EMISSION ESTIMATES AND TRENDS OF INDIRECT GHG AND SO_2

Emissions from indirect GHGs are presented in Table ES.4.

Table ES.4. Indirect GHG emissions 1990-2015 (kt)

	NO_x	CO	NMVOC	SO_2
	kt			
1990	92.84	387.03	81.99	100.45
1991	85.36	354.36	76.98	81.68
1992	70.47	372.83	70.66	69.79
1993	61.55	336.67	65.60	65.74
1994	56.32	319.72	62.76	66.71
1995	51.81	294.75	60.82	49.39
1996	51.60	300.28	60.25	55.67
1997	49.79	271.71	57.14	43.96
1998	46.16	253.92	54.31	39.84
1999	44.76	253.59	52.16	31.95
2000	44.05	239.35	51.11	17.56
2001	46.87	239.25	53.70	14.10
2002	45.74	240.64	52.14	12.77
2003	47.34	230.15	50.89	11.32
2004	46.52	221.72	50.21	9.26
2005	44.92	202.54	48.83	8.44
2006	45.76	218.80	47.32	8.06
2007	45.49	185.80	46.56	7.87
2008	41.77	173.34	42.02	6.59
2009	39.27	185.13	42.67	6.41
2010	41.92	148.00	41.14	4.32
2011	36.04	151.98	40.06	4.29
2012	36.18	156.32	42.73	4.42
2013	35.99	142.65	41.64	3.91
2014	36.02	139.20	41.74	3.87
2015	36.21	133.03	41.15	3.76

In the period from 1990 to 2015 indirect GHG emissions have decreased: NO_x by 61%, CO by 66%, NMVOC by 50% and SO_2 by 96%.

Starting from 2001, slight fluctuations in NO_x, NMVOC and CO emissions can be observed as a reason of increasing firewood consumption in Residential sector as well as fuel consumption in Transport sector in particular years. SO_2 emissions have decreased significantly because of fuel switch and approved legislation.

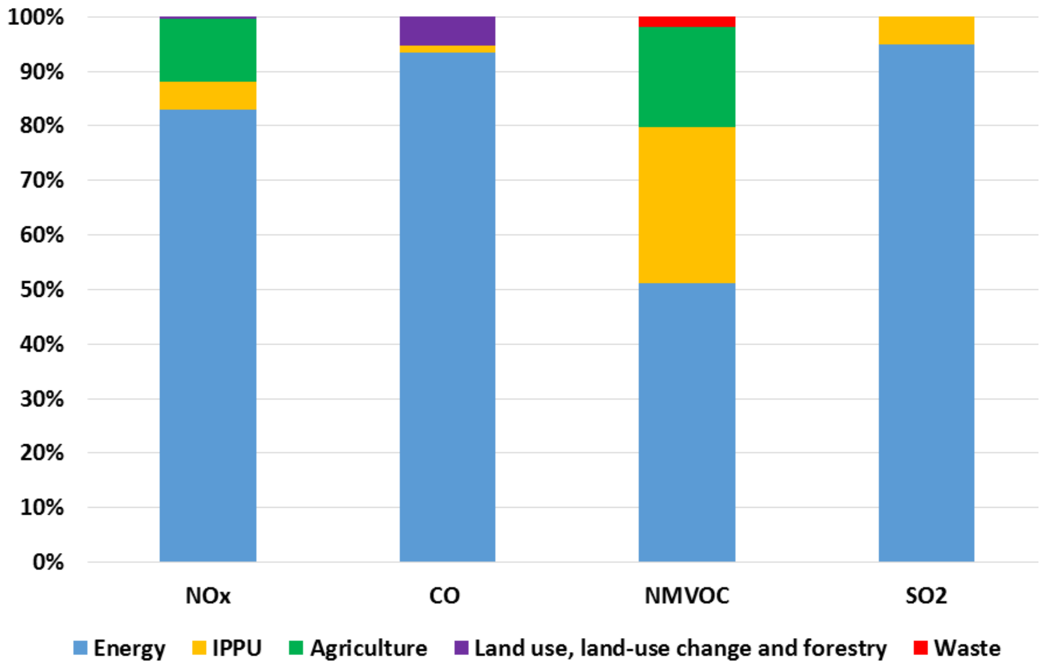

Figure ES.4 Indirect GHG emission by sector in 2015 (% of total indirect GHG emissions in sector)

In 2015, the most important sector producing indirect GHGs (including LULUCF) was Energy sector (including fugitive emissions). Fuel combustion in Energy sector causes the largest part of NO_x emissions (83.0% from total NO_x emissions in 2015), but IPPU and Agriculture sectors make 5.2% and 11.5%, accordingly. Very small part of NO_x emissions is produced in LULUCF sector (0.3% from total NOx emissions).

Almost all CO emissions (93.5%) appear in Energy sector, mainly from fuel combustion in Residential and Commercial/Institutional subsectors (72.7% from all CO emissions). A small part of CO emissions come from LULUCF sector (5.3%) and IPPU sector (1.2%).

The major part of SO_2 emissions (94.9%) comes from Energy sector (fuel combustion), but the other sulphur dioxide emissions come from Industrial processes (Cement production and Iron and Steel production), and a negligible part of SO_2 comes also from Waste sector (Waste incineration).

The largest amounts of NMVOC emissions are produced in Energy sector (51.3%; fuel combustion mainly in Residential sector) and 28.5% from total NMVOC emissions in 2015 are produced in IPPU sector, mainly from solvent use. 18.3% of NMVOC emissions are produced in Agriculture sector, but the remaining 1.9% in Waste sector.

In Agriculture sector, CO and SO_2 emissions, and in LULUCF sector, NMVOC and SO_2 emissions do not appear.

PART I: ANNUAL INVENTORY SUBMISSION

1 INTRODUCTION

1.1 BACKGROUND INFORMATION ON GHG 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 1 986 096 (2015) inhabitants[6]. Baltic coastline is approximately 498 km. Since the beginning of the previous century the forest area in Latvia has almost doubled reaching 3 299.38 kha (51% from the total area of the country in 2015). 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 hydro ecosystems 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-economic systems in Latvia[7].

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. Latvia is a member of EU since May 2004 and Latvia's climate change policy is based on Europe Union climate policy.

As a party of the UNFCCC, Kyoto Protocol and European Union Latvia is required to submit annual national GHG inventory covering emissions and removals of direct GHGs (CO_2, CH_4,

[6] *http://data.csb.gov.lv/pxweb/lv/Sociala/Sociala__ikgad__iedz__iedzskaits/IS0020.px/table/tableViewLayout1/?rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0*
[7] *Kļaviņš, M. Climate change in Latvia. University of Latvia.*

N_2O, HFC, PFC, SF_6 and NF_3) from the base year to the most recent inventory year. This report is the annual submission of the Latvia to the UNFCCC, Kyoto protocol and European Commission. It presents the GHG inventory, the process and the methods used for the compilation of the inventory for 1990 to 2015. The structure of NIR follows the UNFCCC reporting guidelines.
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 (MEPRD) Climate Change Department is responsible for the implementation and development of climate change mitigation and adaptation (and related) policies and measures. MEPRD is responsible for the actions (coordination, implementation and development) to meet the international and EU emission reduction targets. MEPRD also coordinates the monitoring and reporting of GHG emission data as well as is designated as the single national entity with overall responsibility for the Latvian GHG inventory.

1.1.3 Overview of inventory preparation and management, including for supplementary information 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 consistent with relevant decisions and guidelines under Article 7 paragraph 1.

1.2 DESCRIPTION OF THE INSTITUTIONAL NATIONAL INVENTORY ARRANGEMENTS

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

The national inventory arrangements are described below. The description is prepared according to requirements for reporting on national inventory systems under the Kyoto Protocol, EU MMR and UNFCCC reporting guidelines.

Latvian national GHG inventory system is designed and operated according to the Kyoto Protocol 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) according to the CoM Regulation No.217 (27.03.2012) is shown in Figure 1.1.

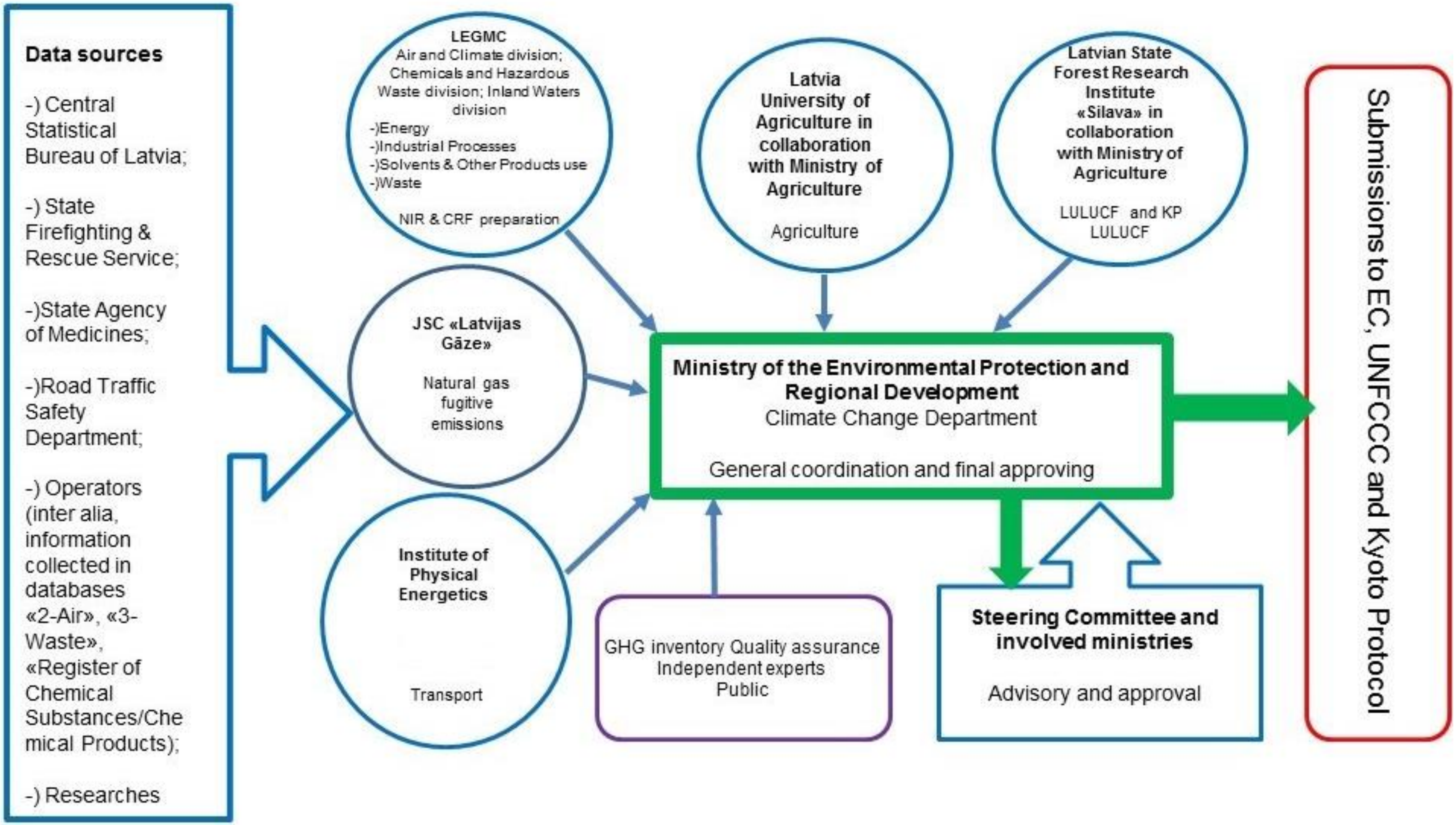

Figure 1.1 The structure of Latvia`s National Inventory System

The MEPRD Climate Change Department 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;
- 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);
- Timely submission of GHG inventory to the UNFCCC and European Commission;
- Keeping of archive of official submissions to UNFCCC and European Commission.

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

- Activity data collection for Energy, Industrial Processes and 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 and 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 compiles the final NIR using information from all involved institutions as well as summarizes emission data in CRF Reporter;
- Quality manager from LEGMC Air and Climate division performs the overall QC/QA procedures for all sectors according to the QA/QC plan;
- LEGMC is the National Emissions Trading Authority in Latvia and prepares relevant information for GHG inventory from registry – on emission reduction units, certified emission reductions, temporary certified emission reductions, long term certified emission reductions and assigned amount units for annual inventory submissions in accordance with guidelines for preparation of information under Article 7 of the Kyoto Protocol (SEF tables).

Calculation of emissions and removals from the LULUCF, KP-LULUCF sector were done by Latvian State Forest Research Institute "Silava" in collaboration with MoA. LSFRI "Silava" is responsible for activity data collection, estimation of emissions/removals, preparation of QC procedures as well as documentation and archiving of used materials for calculations.

Institute of Physical Energetic (IPE) calculates emissions from Transport sector. IPE is responsible for activity data collection, emission estimation from Transport, preparation of QC procedures as well as documentation and archiving of used materials for calculations.

Emission calculations 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 Central Statistical Bureau (CSB), preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculations.

The main data supplier for the Latvian GHG inventory is the CSB.

For ensuring the continuity of the functions of the national system, the delegation contracts are signed between the MEPRD, LEGMC, LSFRI "Silava", IPE and Latvia University of Agriculture.

Before final GHG inventory was submitted to European Commission and UNFCCC secretariat draft inventory submission to the EU 15 January was sent to the involved Latvia's ministries for comments and approving. Based on received comments inventory was corrected appropriate.

Several sectoral meetings 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 were discussions 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 of activity data and main experts responsible for the sectoral inventories and the corresponding charters and annexes are summarized in the Table 1.1.

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

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

- establishing of national entity with overall 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;
- implementing continuous improvements.

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 Regulation No. 217 (27.03.2012)[8]. The responsible institutions are reflected in the Table 1.1 and inventory preparation plan is presented in Table 1.2.

After the end of the annual reporting cycle in April, the institutions involved in inventory preparation start to plan the next annual inventory following received improvements and recommendations by ERT. Within the EU level the recommendations by a Technical Expert Review Team (TERT) are also taken into account. 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/ Responsible experts
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 (Asnate Skrebele), Institute of Physical Energetics (Gaidis Klāvs, Larisa Gračkova)
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 (Asnate Skrebele)
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 (Asnate Skrebele)
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 (Asnate Skrebele), JSC "Latvijas Gāze"
Table 1.D – International Bunkers and Multilateral Operations	Activity data	CSB Environment and Energy Statistics Section
	Calculations	Institute of Physical Energetics (Gaidis Klāvs, Larisa Gračkova)
Table 2(I).A-E,G-H – Industrial Processes and Product Use	Activity data	CSB Population Statistics Section State Agency of Medicines; Research of experts; LEGMC "2-AIR" and "Chemical" databases CSB Industrial Statistics Section EU Emission Trading Scheme operators
	Calculations	LEGMC Chemicals and Hazardous Waste

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

CRF sectors	**Data**	**Responsible institutions/ Responsible experts**
		Division (Liga Rubene), LEGMC Air and Climate division (Vita Ratniece)
Table 2(II) F – Industrial Processes - HFCs, PFCs and SF_6	Activity data	CSB Population Statistics Section, Environment and Energy Statistics Section Electricity supplying companies; State Agency of Medicines; Annual reports by operators using F-gases (reported to LEGMC) Data from Chemicals Register (maintained by LEGMC)
	Calculations	LEGMC Air and Climate division (Vita Ratniece)
Table 3.A – Agriculture, Enteric Fermentation	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture (Laima Bērziņa)
Table 3.B.1 - Agriculture, CH_4 Emissions from Manure Management	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture (Laima Bērziņa)
Table 3.B.2 - Agriculture, N_2O un NMVOC Emissions from Manure Management	Activity data	CSB Agricultural Statistics Section
	Calculations	Latvia University of Agriculture (Laima Bērziņa)
Table 3.D - Agriculture, Agricultural Soils	Activity data	LEGMC database "2-Water", Latvian State Forest Research Institute "Silava"
	Calculations	Latvia University of Agriculture (Laima Bērziņa)
Table 3 G Liming	Activity data	CSB
	Calculations	Latvia University of Agriculture (Laima Bērziņa)
Table 3 H Urea application	Activity data	CSB
	Calculations	Latvia University of Agriculture (Laima Bērziņa)
Table 4. A. Forest Land Table 4. B. Cropland Table 4. C. Grassland Table 4. D. Wetlands Table 4. E. Settlements Table 4. F. Other Land	Activity data	National Forest monitoring program (NFI)
	Calculations	Latvian State Forest Research Institute "Silava" collaborated with Ministry of Agriculture (Andis Lazdiņš, Arta Bārdule, Aldis Butlers, Ainārs Lupiķis)
Table 4. B. Cropland – 4.B.1 Cropland remaining Cropland	Activity data – Area of organic soil	NFI, National studies and expert judgement
	Calculations – Net carbon stock change in organic soils	Latvian State Forest Research Institute "Silava"
Table 4. C. Grassland – 4.C.1 Grassland remaining Grassland	Activity data - Area of organic soil	National studies and expert judgment
	Calculations – Net carbon stock change in organic soils	National studies and expert judgment, Latvian State Forest Research Institute "Silava"
Table 4. (V) Biomass Burning	Activity data	State Fire and Rescue Service of Latvia, State forest service of Latvia
	Calculations	Latvian State Forest Research Institute "Silava"

CRF sectors	Data	Responsible institutions/ Responsible experts
KP LULUCF NIR-1 NIR-2 NIR-2.1 NIR-3 4(KP)	Activity data	State Fire and Rescue Service of Latvia, State forest service of Latvia National Forest monitoring program (NFI) National studies and expert judgement
	Calculations	Latvian State Forest Research Institute "Silava" (Andis Lazdiņš, Arta Bārdule, Aldis Butlers, Ainārs Lupiķis)
Table 5 A - Waste, Solid Waste Disposal on Land	Activity data	LEGMC "3-Waste" database, Methane recovery installations
	Calculations	LEGMC Chemicals and Hazardous Waste Division (Intars Cakars)
Table 5 B – Biological Treatment and Solid Waste	Activity data	CSB, LEGMC Chemicals and Hazardous Waste Division
	Calculations	CSB, LEGMC Chemicals and Hazardous Waste Division (Intars Cakars)
Table 5.B.1 – Composting	Activity data	LEGMC Chemicals and Hazardous Waste Division
	Calculations	LEGMC Chemicals and Hazardous Waste Division (Intars Cakars)
Table 5 C – Incineration and open Burning of Waste	Activity data	LEGMC database "3-Waste"
	Calculations	LEGMC Chemicals and Hazardous Waste Division (Intars Cakars)
5.D Wastewater Treatment and Discharge	Activity Data	LEGMC "2-Water" database, CSB statistics on national population and production rates of certain industries
	Calculations	LEGMC Inland Waters Division (Lauris Siņics)

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

<u>The inventory preparation stage consists of:</u>

- Identification of key categories, which have a significant influence on a country's total inventory in terms of level or trend in emissions;
- 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, TERT and suggestions from the third-part experts etc.
- NIR compilation;
- QA/QC plan implementation (include basic checks on entire inventory (Tier 1) and more in-depth investigations into key categories (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;
- Submission 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.

Latvia prepares a NIR and Common Reporting Format (CRF) tables annually according to requirements of the UNFCCC, the Kyoto Protocol and the EU MMR.

Table 1.2 Inventory preparation plan

Element	Activity	Responsible performers	Procedures	Due date	
To reconsider the changes needed for the inventory, 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 inventory, 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)		Participation of all institutions involved in inventory preparation and approval process. Discussions on previous submissions’ review results and planned submission including necessary improvements, changes, recalculations, problems etc.	Till 30th June	
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.	till 30th March	
			LEGMC uses EU ETS data in GHG inventory for emission estimates in Energy and Industrial Processes sectors.		Starting from September
		Operators	LEGMC (Air and Climate division, Chemicals and Hazardous Waste division, Inland Waters Division) collects information for emission calculation in following databases: • “2-AIR” database;	till 15th June	

Element	Activity	Responsible performers	Procedures	Due date	
			• "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 1st October	
			LEGMC uses data from databases for emission estimates in Energy (CRF1), IPPU (CRF2), Waste (CRF5) sectors.		Starting from September
		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	
			LEGMC uses data from JSC "Latvijas Gāze for emission estimates in Energy (CRF1) sector.		Starting from 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 Anaesthesia (Solvent and other product use sector).	till 1st October	
			LEGMC uses data from SAM for emission estimates in IPPU sector.		Starting from October
Activity data and description	Submission to LEGMC, Latvia University of	Statistical Bureau of	CSB send activity data regarding Energy, Agriculture, Industrial Processes and Product	till 1st October	

Element	Activity	Responsible performers	Procedures	Due date	
	Agriculture	Latvia (CSB)	Use and Waste 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		
			LEGMC, Latvia University of Agriculture use received data for Energy, Agriculture, Industrial Processes and Product Use and Waste sectors emission calculation		Starting from October
	Submission to MEPRD/ LSFRI "Silava"	State Firefighting & Rescue Service (SFRS)	SFRS send to MEPRD activity data - area of last year`s grass burning (ha).	till 1st October	
			LSFRI "Silava" uses received data for emission calculation from biomass burning (CRF 4 (V)).		Starting from October
Emissions/CO_2 removals	Data entry in the CRF Reporter according to CRF Reporter User Manual	LEGMC, Latvia University of Agriculture, IPE, LSFRI "Silava"	Data entry in the CRF Reporter by responsible sectoral experts.	till 15 December	
Emissions/ CO_2 removals descriptions	Preparation of NIR chapters	LEGMC, Latvia University of Agriculture, IPE, LSFRI "Silava"	LSFRI "Silava"/ Latvia University of Agriculture (in coloboration with MoA), LEGMC, IPE and MEPRD prepare relevant chapters of NIR	till 15 December	
CRF Reporter	Data check by sectoral experts	LEGMC, Latvia University of Agriculture,	Sectoral experts check the data in the CRF Reporter for consistency and quality assurance (e.g. to check whether the sum of	till 15 December	

Element	**Activity**	**Responsible performers**	**Procedures**	**Due date**	
		IPE, LSFRI "Silava"	the following adds up to 100%, to check the year to year changes between values reported etc.). LEGMC (Quality manager) checks completeness, consistency and quality assurance.	till 30 December	
Data in CRF, Draft NIR according to Regulation (EU) No 525/2013 and Commission Implementing Regulation 749/2014	CRF, NIR, Annexes	MEPRD - Climate Change Department	After corrections in CRF tables, NIR \(if necessary) MEPRD uploaded CRF tables, XML, draft NIR, relevant Annexes to the EIONET CDR.	15th January	
Quality control checks: Draft NIR	QA	MEPRD - Climate Change Department Expert Public	According to the CoM Regulation No. 217, MEPRD send to involved institutions Draft NIR for comments and approving. NIR was uploaded in the LEGMC home page for review by public.	till 16th January	
		All institutions involved in GHG emissions and removals preparation	Expert meetings to improve inventory, quality control activities etc.	January-February	
		Involved institutions	Involved institutions send to MEPRD comments about NIR 1st draft and approval.		15th February

Element	Activity	Responsible performers	Procedures	Due date
	QC	All institutions involved in the GHG inventory preparation process	Answers to the compiled questions by EU review team, which based on 15/1 submissions (https://emrt.eea.europa.eu/). MEPRD approves provided answers from experts. Verification of national data in EC inventory and updates if necessary and response to EC. This process includes collaboration with involved institutions for preparing of response to EC.	28st February to 15th March
CRF data, NIR according to Regulation (EU) No 525/2013 and Commission Implementing Regulation 749/2014	CRF, NIR, Annexes	MEPRD - Climate Change Department	MEPRD uploaded CRF tables, XML and NIR to the EIONET CDR.	15th March
NIR and emission data in CRF to UNFCCC	Inventory submission (CRF, NIR)	MEPRD - Climate Change Department	MEPRD uploaded approved GHG inventory to the CRF Reporter Submission module.	15th April

1.2.3 Quality assurance, quality control and verification plan

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 Latvia`s 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.

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 QC procedures outlined in Table 6.1 of 2006 IPCC Guidelines 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 experts and 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.

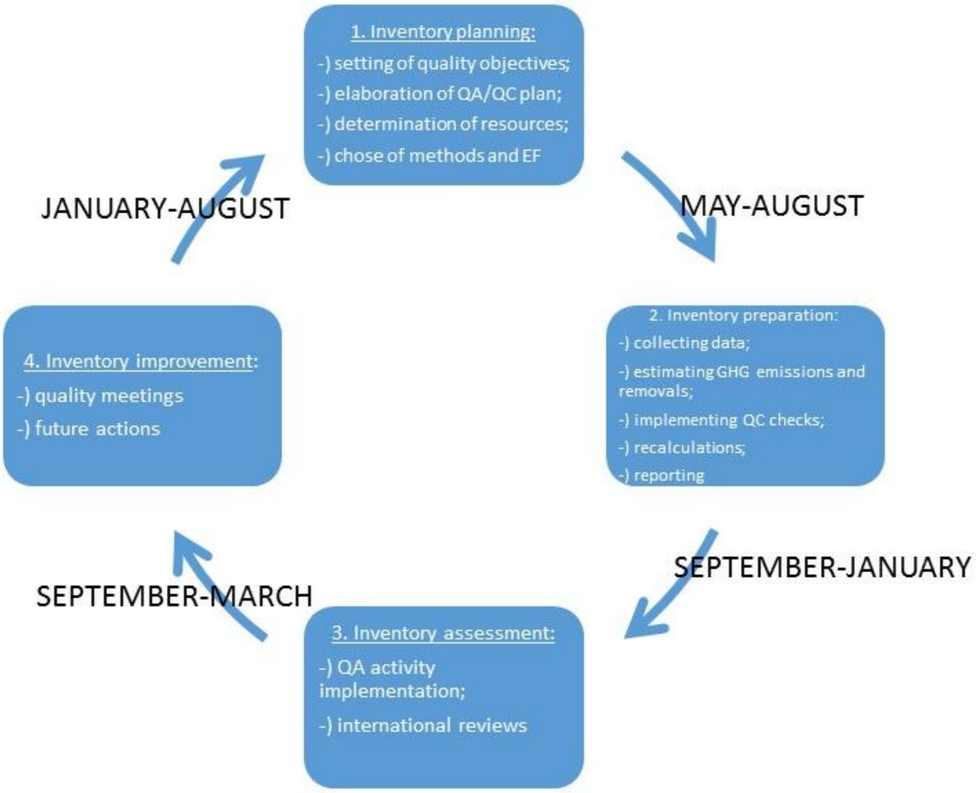

Figure 1.2 Inventory Process

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 2017 inventory were the following:

- strengthen QA/QC procedures for the inventory and ensure the completeness of all elements included in the appendix to Annex I to Decision 24/CP.19;

- implement specific QC procedure in QA/QC plan that monitors the use of notation keys and ensure that the use of the notation key "IE" is explained transparently in the NIR and CRF table 9.

In order to ensure improvements:

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

In order to ensure transparency:

- transparent information is included in the NIR and CRF (including information regarding the used methodology, activity data and emissions in tables);
- notation keys are used according to the IPCC guidelines;
- recommendations of inventory reviews regarding transparency are taken into account as far as possible;
- documentation regarding quality control check is indicated;
- information regarding the changes since the last inventory in relation to transparency is provided in the NIR under relevant subchapters.

In order to ensure consistency:

- recommendations received during inventory reviews regarding consistency is taken into account after evaluation as far as possible;
- information regarding consistency and recalculations is provided in the NIR;
- 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 guidelines.

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 NIR;
- 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 NIR;

In order to ensure timeliness:

- inventory reports reach their EU and UNFCCC within the set time.

1.2.3.1 Quality Control procedures

The general and category-specific QC procedures are performed by sectoral experts during inventory calculation and compilation according to the QA/QC and verification plan.

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

For submission 2017, 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 quality manager in LEGMC who is responsible for QC procedures before inventory submission for overall QC procedures and final approving in MEPRD.

The centralized archiving system (common FTP folder) is created where experts have to 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.

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;
- Correctness in use of notation keys (the use of the notation keys "NE" and "IE" is explained transparently in the NIR and CRF table 9);
- Integrity of database files;
- Consistency in data between source categories.

The QC procedures comply with the 2006 IPCC Guidelines. General inventory QC checks 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 2017:

-) The sectoral experts entered data in CRF Reporter software either manually or by importing MS Excel spreadsheets. Sectoral experts prepared quality control procedures according to 2006 IPCC Guidelines. All findings were documented by using check-lists and introduced in GHG inventory. All corrections are archived;

-) The sectoral experts prepared relevant NIR chapters and sent to LEGMC. Sectoral experts before sending chapter of NIR have 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. Final NIR is compiled by LEGMC according to UNFCCC reporting guidelines;

-) Emission consistency with other EU MMR requirements are performed according to European Commission Implementing Regulation (EU) No 749/2014 (MMR IR). GHG emission data are checked with the data used to prepare inventories of air pollutants under EU Directive 2001/81/EC, the actual or estimated allocation of the verified emissions reported by installations and operators under Directive 2003/87/EC, the energy data reported pursuant to Article 4 of, and Annex B to, Regulation (EC) No 1099/2008 and the data reported pursuant to Article 6(1) of Regulation (EC) No 842/2006;

-) LEGMC quality manager and MEPRD performed cross-checking for all sectors to verify that no mistakes occurred during input/import process. CRF completeness and consistency checks were carried out. As a result of CRF completeness check the list of gaps in CRF Reporter were summarized. After detailed re-checking in CRF Reporter it was concluded that all findings are related to CRF bugs (for example orange light in completeness check for categories which are obviously complete). Also incompleteness is caused by partially filled F-gas categories. As in the current CRF Reporter version v6.0.1.1 it is not possible to enter notation keys for F-gases which are not occurring in Latvia directly in grey and green cells, cells related to F-gases which are not occurring were left blank till it will be possible to fill in CRF without adding unnecessary child nodes;

-) Quality meetings between sectoral experts were held in order to discuss problems and possible improvements in GHG inventory as well as to ensure consistency between activity data used by experts in emission estimation for different sectors;

-) Detailed QA/QC procedures were done by institutions involved in the GHG inventory preparation (MoA, MEPRD, CSB). Meetings between sectoral experts and involved institutions were held according to comments received and improvements needed in NIR;

-) Experience exchange seminars with Lithuanian and Estonian GHG expert inventory teams were held within the framework of project Baltic Expert Network for Greenhouse Gas Inventory, Projections and Policies and Measures (PaMs) Reporting (BENGGI) with aim to share experience in reporting of GHG inventories, GHG projections and PaMs. During experience change seminars experts gained and shared experience on national systems for GHG emissions and projections reporting, QA/QC procedures established within the national system as well as discussed/identified common problems related to reporting in sectoral level.

Main activity data provider for Latvia's GHG inventory – CSB – has established Quality Guidelines[9] 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.

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

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 relevant chapter.

Quality control of EU Member States submissions` are performed in web-based tool hosted by the European Environmental Agency (EEA) to facilitate quality checks and reviews of national emission inventories reported by EU Member States under the EU MMR. From 2015 onwards the tool is used in the annual review process under the EU ESD.

1.2.3.2 Quality Assurance procedures

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.

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.

Improvements for GHG inventory are compiled based on the findings of the UNFCCC, EC, internal reviews and recommendations from third part experts (periodically all sectors are revised by third part experts).

1.2.3.3 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.

<u>Documentation system in CSB:</u>

- 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 5.

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 individual expert's computers.

Every annual inventory (CRF tables, XML, 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 categories and key category 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 LEGMC. Common, password protected FTP folder is used for information storage and exchange.

Printed copies of NIR are stored in LEGMC and MEPRD archives in May each year, after completion and submission of the inventory.

1.2.3.4 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 verification of raw data.

1.2.3.5 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.

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 some exceptions in food and drink sector. 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.

Data of EU ETS

Some of Latvia's industrial processes sector's companies are participating in EU ETS then data from these companies can be obtained from their annual GHG reports within compliance obligations under EU ETS.

ETR documentation

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

1.2.4 Changes in national inventory arrangements since previous annual GHG inventory submission

There are no changes to arrangements with institutions involved in the GHG inventory preparation. The agreements regarding responsibilities are maintained and continue to be in force according to the national legislation (Regulations of the Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units").

1.3 INVENTORY PREPARATION, DATA COLLECTION, PROCESSING AND STORAGE

1.3.1 GHG inventory and KP-LULUCF inventory

Each sector has an assigned one or more responsible sectoral experts who are responsible for conformity with the relevant reporting guidelines, selection of appropriate methods and data sources and activity data collection, processing and updating of data.

For the Energy (excluding Transport), IPPU and Waste – data collection and emission estimation is done by LEGMC experts from Air and Climate Division, Chemicals and Hazardous Waste Division and Inland Waters Division.

For Transport activity data is collected and emissions are calculated by experts from Institute of Physical Energetics.

For Agriculture, data collection and emission estimations are done by Latvia University of Agriculture in collaboration with Ministry of Agriculture.

Land-use, land use change and forestry data and KP- LULUCF data are collected and emissions/removals are calculated in Latvian State Forest Research Institute "Silava" in collaboration with Ministry of Agriculture and Latvia University of Agriculture.

All experts responsible for data collection and processing in a particular sector are preparing their data (activity data, emission factors) for import into CRF Reporter software.

1.4 BRIEF GENERAL DESCRIPTION OF METHODOLOGIES AND DATA SOURCES USED

1.4.1 GHG inventory

Latvia's GHG emissions inventory is based on:

- 2006 IPCC Guidelines;
- 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC Wetlands Supplement);
- 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (IPCC KP Supplement);
- EMEP/CORINAIR Guidebook 2007 and EMEP/EEA 2009;
- EMEP/EEA air pollutant emission inventory guidebook 2013;
- EMEP/EEA air pollutant emission inventory guidebook 2016.

The main sources for emission factors are guidelines mentioned above as well as 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.).

For 2017 submission (NIR and CRF tables) compilation the CRF Reporter version v6.0.1.1 was used. To calculate GHG emissions, supplemental locally developed database in Excel format was used for all sectors except for Road Transport where COPERT IV was 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 2006 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 1990–2015 (Tier-2 method). Emissions for other transport sub-sectors were estimated according to IPCC Tier 1 and Tier 2 methodologies (Tier 2 method for diesel oil CO_2 emission calculation in railway and navigation and Tier 2 method for jet kerosene emission calculation in aviation (civil and international). Rest of emissions have been calculated using Tier 1 method).

Emissions from Industrial Processes and Product Use were estimated according to 2006 IPCC Guidelines, EMEP/CORINAIR 2007 Guidebook, EMEP/EEA 2009, EMEP/EEA air pollutant emission inventory guidebooks 2013 and 2016 as well as using expert research and judgment about activity data and emission factors.

Emissions from Agriculture sector were estimated according to methodologies from 2006 IPCC Guidelines, IPCC Wetlands Supplement additionally using local researches related some parameters.

2006 IPCC Guidelines, IPCC KP Supplement and IPCC Wetlands Supplement for CO_2, CH_4 and N_2O emissions from drained and rewetted soils were used to estimate emissions from LULUCF and KP-LULUCF sector.

2006 IPCC Guidelines were used to estimate emissions from Waste sector.

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

Table 1.3 Main data sources for activity data and emission values

Sector	Data Sources for Activity Data	Emission Calculation
Energy	Central Statistical Bureau (CSB) Energy Balance; IEA/ OECD – EUROSTAT – UNECE Annual questionnaires; LEGMC "2-AIR" database; Research of experts.	LEGMC Air and Climate division, plant operators
Transport	CSB Energy Balance; IEA/AIE – EUROSTAT – UNECE Annual questionnaires; Data of Road Traffic safety Directorate; Research of experts.	IPE
Industrial Processes and Product Use	National production and sales statistics; Direct information from enterprises operating with pollutants; Central Statistical Bureau; Chemicals Register; Assumptions by experts; State Agency of Medicines; Research by experts; LEGMC "2-AIR" database	LEGMC Air and Climate division, plant operators 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 monitoring program 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

1.4.2 KP-LULUCF inventory

The land use matrix is based on the results of land use changes to forest derived from the National Forest inventory (NFI) of the period 2004-2008 and 2009-2013. Methodology for estimation of earlier land use changes, including deforestation activities is under development in the LSFRI Silava as a part of NFI. The assessment methods at the NFI grid points are described in Annex 1 of Report on improvement of QA/QC system in LULUCF sector in Latvia[10]. Estimation of afforested and deforested area in 2009-2013 is based on of the NFI data, 2014 and 2015 is linearly extrapolated for the 5 years average of previous years.

Historical figures of deforestation were estimated using remote sensing methods based on evaluation of LANDSAT satellite image series from 1990, 1995 and. The NFI is the main data provider for the GHG reporting in LULUCF sector and activities listed in Kyoto protocol Article 3, paragraph 3 and paragraph 4 (Article 3.3 and 3.4).

Forest soil properties (carbon stock in litter and mineral soil) in forest lands were determined in permanent 16 x 16 km grid of 95 sample plots of the 1st level forest monitoring programme. No soil carbon stock changes are considered in afforested lands, according to research data demonstrating insignificant carbon stock differences in forest land and grassland.

Methods for estimating carbon stock changes in forests (for Article 3.3 afforestation, reforestation, deforestation and Article 3.4 forest management) are the same as those used for the LULUCF inventory reported under the UNFCCC. Estimations of carbon stock changes in living biomass on forest land remaining forest in the 1st cycle of the NFI are based on measurements of radial increment of growing trees and calculation of actual gross increment of timber volume of all living trees; in the second and third, "floating", period increment is calculated as stock difference of living trees; mortality is accounted as the stock of trees changing status (destiny) from living trees to dead and left in the stand; harvesting stock is accounted as stock of trees changing status (destiny) to dead and extracted. The NFI data are harmonized with the State forest service data provided information by application of linear factor to the whole accounting period.

Since research data are available, historical figures (before 2004) on mortality are recalculated and provided in the inventory considering 20 years decay period for dead biomass, respectively; calculations are done for the period 1970-2015. Removals of CO_2 in living biomass on afforested areas are calculated on the base of weighed average of timber stock changes in 1-25 years old forest stands on non-forest lands.

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.

Losses in living biomass due to deforestation are reported based on average growing stock figures were used to extrapolate average losses in living biomass due to deforestation. 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 oxidizing during conversion, but carbon soil in mineral soils stabilizes in 20 years.

[10] *https://drive.google.com/open?id=0Bxv4jQ_04jXZdEhJVFJ4OVRPTkE*

For conversion to settlements it is assumed that 20 % of carbon in 0-30 cm deep soil layer turns into emissions in 20 years.

1.4.3 European Union Emission Trading Scheme (EU ETS) data

Latvia has fully implemented the Directive 2003/87/EC[11] of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community.

The European Union Emission Trading System (EU ETS) data obtained from annual emission reports submitted by operators to competent authority is used as source of activity and emission data for the GHG inventory particularly in Energy and Industrial Processes and Product use sectors. All emission reports for all years 2005-2015 are publicly available on the web page of competent authority and are fully available for the GHG inventory.

Latvia has implemented EU ETS and set all the requirements in 2003 and 2004 when amendments in Law On Pollution were made and all necessary Cabinet of Ministers regulations were approved for the stationary combustion installations – monitoring, reporting, verification and compliance obligations, setting the possibility of voluntary participation for the installations not exceeding thermal input of 20MW. In 2005 Latvia's Emission Trading Registry was developed and launched. Since that time 93 installations have received GHG permits. Operation of EU ETS in Latvia is ensured mainly by Ministry of Environmental Protection and Regional Development (MEPRD) and institutions under the supervision of MEPRD – State Environmental Service and its Environment State Bureaus that are responsible for approval of monitoring plans, issuance of permits, and approval of annual emission reports for stationary installations, Latvian Environment, Geology and Meteorology Centre that is Latvia's National Administrator of Emission Trading Registry (Union Registry since 2012).

Starting 2008 for Kyoto Protocol 1st period the EU ETS was linked to the international emissions trading under the Kyoto Protocol. The scope of EU ETS was enlarged still in Latvia no new installation was included in EU ETS due to enlarged scope.

Since 2012 the aviation activities were also included in EU ETS regarding all aircraft operators that perform flights to/from EU. Still in 2013 the exemptions were applied to the flights to/from countries outside European Economic Area (EEA) so in 2013-2016 only internal flights to/from EEA countries as well as to/from aerodromes in the same outermost region are included in EU ETS scope. Civil aviation agency (institution of Ministry of Transport) is main competent authority responsible for approval of monitoring plans and approval of annual emission reports for aircraft operators still MEPRD is fully responsible regarding the implementation of the requirements for the aviation activities in EU ETS.

Latvian National Accreditation Bureau (the institution of Ministry of Economy) is responsible for accreditation and monitoring of verifiers.

Starting 2013 in EU ETS Phase 3 the scope was again extended and three new installations of Latvia has started operations in EU ETS. Starting this period, the emission allowances are mainly auctioned. New harmonised requirements for the calculation and allocation of EU allowances were developed by European Commission in 2011 as well as harmonised

[11] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02003L0087-20140430&from=EN*

requirements for monitoring, reporting, accreditation and verification were developed by European Commission in 2012. Harmonised templates for monitoring plan, emission report (and tonnkilometer reports for aircraft operators), verification report as well as templates for emission allocation calculation and reporting were developed by European Commission. Latvia uses these developed harmonised templates. Since 2013 the calculation of EU allowances as well as the monitoring and control of annual allocation is done by MEPRD.

In 2015 there were 66 EU ETS installations in Latvia and 15 aircraft operators were set as administered by Latvia (only 3 aircraft operators were not exempted and was set as aircraft operators of EU ETS).

Unified emission trading registry system was developed and launched in 2012 so all EU Member States use the same registry for EU ETS compliance activities.

Latvia`s verified ETS emissions in 2015 were 2312.538 kt CO_2 eq.

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 identification of key categories is described in the 2006 IPCC Guidelines Chapter 4: Methodological Choice and Identification of Key Categories.

Key categories 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 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 categories: Approach 1 and Approach 2. In the Approach 1 method, the emission sources are sorted according to their contribution to emission level or trend. In the Approach 2 method, the relative uncertainties of the source categories are also taken into account. The key categories are the emission categories, which represent together 95% of the inventory uncertainty if using level and trend assessment and 90% of the total value of the total trend assessment with uncertainty.

For 2017 submission both approaches are used to identify key categories for time period 1990-2015. The identification was divided in two parts, key categories excluding LULUCF and key categories including LULUCF source categories. The starting point for the choice of source categories with LULUCF is the list presented in the 2006 IPCC Guidelines, Chapter 4 Methodological Choice and Identification of Key Categories, Table 4.1. The base year for CO_2, CH_4, and N_2O greenhouse gas emissions was 1990.

Summary of key categories is shown in Table 1.4. Key categories are identified by Approach 1 and Approach 2 (level and trend) in order to provide additional insight into the reasons why particular categories are key. The mandatory, detailed reporting tables of the key categories (Tables 4.2 and 4.3 of volume 1 of the 2006 IPCC Guidelines, including and excluding LULUCF) are provided in Annex 1 of this submission.

Table 1.4 Key categories in 2017 submission

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	T2		X
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	L1		X
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	T1		X
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	T1	X	X
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	T1	X	X
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	T1		X
1.A.2.c Chemicals - Liquid Fuels	CO_2	T1,T2	X	X
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	T1	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	L1	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	T1,T2	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	T1,T2	X	X
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	L1	X	X
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	L1,T1,T1	X	X
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	T1,T2	X	X
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.3.b Road Transportation - Diesel Oil	CO_2	L1,L2,T1,T2	X	X
1.A.3.b Road Transportation - Diesel Oil	N_2O	L2,T1,T2		X
1.A.3.b Road Transportation - Gasoline	CO_2	L1,L2,T1	X	X
1.A.3.b Road Transportation - LPG	CO_2	L1,T1,T2	X	X
1.A.3.c Railways - Liquid Fuels	CO_2	L1,T1	X	X
1.A.3.c Railways - Liquid Fuels	N_2O	L1,L2		X
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	L1,L2,T1	X	X
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	L1,L2,T1,T2	X	X

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	L1,T1,T2	X	X
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	L1,L2,T2		X
1.A.4.a Commercial/Institutional - Peat	CO_2	T1		X
1.A.4.b Residential - Biomass Fuels	CH_4	L1,L2,T1,T2	X	X
1.A.4.b Residential - Gaseous Fuels	CO_2	L1,L2,T1	X	X
1.A.4.b Residential - Liquid Fuels	CO_2	L1,L2,T1	X	X
1.A.4.b Residential - Solid Fuels	CO_2	L1,T1,T2	X	X
1.A.4.b Residential - Solid Fuels	CH_4	T2		X
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	T1,T2	X	X
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	L1,L2,T2		X
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	L1,L2,T1	X	X
1.B.2.b Natural Gas	CH_4	L1,L2	X	X
1.A.2.g Other - Gaseous Fuels	CO_2	L1,T1,T2	X	X
1.A.2.g Other - Liquid Fuels	CO_2	L1,T1,T2	X	X
1.A.2.g Other - Biomass Fuels	N_2O	T2		X
2.A.1. Cement Production	CO_2	L1,L2,T1,T2	X	X
2.A.2. Lime Production	CO_2	T1	X	X
2.A.4. Other process uses of carbonates	CO_2	T1,T2		X
2.C.1 Iron and Steel Production	CO_2	T1		X
2.D.3. Solvent Use	CO_2	L1		X
2.F.1. Refrigeration and air conditioning	HFCs	L1,L2	X	X
3.A.1 Enteric Fermentation - Cattle	CH_4	L1,L2,T1,T2	X	X
3.B.1.1 Manure Management - Cattle	CH_4	L1,L2,T1,T2		X
3.B.2.1 Manure Management - Cattle	N_2O	L1,L2		X
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	L1,L2,T2		X
3.D.1. Direct N_2O emissions from managed soils	N_2O	L1,L2,T1,T2	X	X
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	L1,L2,T1,T2	X	X
3.G. Liming	CO_2	T1,T2	X	X
4. G. Harvested wood products	CO_2	L1,L2,T1,T2	X	
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	L1,L2,T1,T2	X	
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	L1,L2,T1,T2	X	
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	L1,L2,T1,T2	X	
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other	N_2O	L1,L2,T1,T2	X	

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
management of organic and mineral soils				
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L1,L2,T1,T2	X	
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	L2,T1,T2	X	
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	L1,L2,T2	X	
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	L1,T1	X	
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	L1,T1	X	
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L1,L2,T2	X	
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	L2,T2	X	
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	L1,L2,T1,T2	X	
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	T2	x	
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	L1,L2,T1,T2	X	
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	L1,L2,T1,T2	X	
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L2	X	
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	T2	X	
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	L1,L2	X	
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	L1,L2,T1,T2	X	
4.C.2 Land converted to Grassland –Mineral soil	CO_2	L1,L2,T1,T2	X	
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	L1,L2,T1,T2	X	
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	L1,L2,T1,T2	X	
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	L1,L2,T1,T2	X	
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	L1,L2,T1,T2	X	

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	L1,L2,T1,T2	X	
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	L1,L2,T1,T2	X	
4.E.2 Land converted to Settlements – Mineral soils	CO_2	L1,T1	X	
4.E.2 Land converted to Settlements – Organic soils	CO_2	L1,L2,T1,T2	X	
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	L2,T2	X	
5.A.1. Managed Waste Disposal on Land	CH_4	L1,L2	X	X
5.A.2. Unmanaged Waste Disposal Sites	CH_4	L1,L2,T1,T2	X	X
5.D.1 Domestic Wastewater	CH_4	L1,L2,T1	X	X
5.D.2 Industrial Wastewater	CH_4	L1,L2,T1,T2	X	X
5.B.1. Composting	CH_4	L1,L2,T2		X
5.B.1. Composting	N_2O	L2,T2		X

1.5.2 KP-LULUCF inventory

There were several key categories in KP-LULUCF. The most significant key category of emissions in KP-LULUCF is CO_2 in forest management and due to deforestation. Other key categories of emissions are N_2O and CH_4 in forest management (forests on drained and rewetted organic soils).

1.6 GENERAL UNCERTAINTY EVALUATION

1.6.1 GHG inventory

This section provides an overview of the approach to uncertainty analysis for Latvia's inventory.

The uncertainty estimates of the 2017 submission have been done according to the Approach 1 method presented in 2006 IPCC Guidelines. The Approach 1 is based on emission estimates and uncertainty coefficients for activity data and emission factors. The mandatory, detailed reporting tables of the uncertainty analysis (Table 3.3 of volume 1 of the 2006 IPCC Guidelines with and without LULUCF) are provided in Annex 2 of this submission.

The uncertainty analysis was done for the all sectors: Energy, Industrial Processes and Product Use, Agriculture, Waste and LULUCF. Uncertainties are estimated for direct greenhouse gases, e.g. CO_2, CH_4, N_2O and F-gases only.

2017 submission total uncertainties are reflected in Table 1.5.

Table 1.5 Uncertainties of 2017 submission

	Uncertainty in total inventory %	Trend uncertainty %
With LULUCF	23%	13%
Without LULUCF	8%	3%

Uncertainties of activity data are taken from:

- CSB (generally 2% uncertainty is used according to received information from CSB);
- GHG reports from enterprises operating within EU ETS;
- Information by companies;
- National Forest Inventory;

In some cases uncertainty of activity data is calculated using trend line and measured data (Waste sector).

Uncertainties of emission factors are taken from:

- 2006 IPCC Guidelines;
- IPCC Wetlands Supplement;
- Expert judgments;
- National Forest Inventory;
- Specific research results.

All sources of uncertainties are documented and referenced.

The uncertainty calculation is based on Excel file, which is send to sectoral experts for updating annually. Responsible experts are requested to go through uncertainties and make an updates if necessary. When the information is received by experts, the inventory compiler summarizes all the uncertainties and does the uncertainty analysis. For each source, the combined uncertainty for activity data and emission factors was estimated and given in per cent.

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.

Within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy" in 2016 Norway GHG inventory experts evaluated uncertainty analysis of Latvia`s GHG inventory, checked uncertainties in the Excel calculation file and information in NIR as well as gave recommendations for improving uncertainty calculations which were taken into account into this submission. Also within the above mentioned project the Monte Carlo model has been developed inside of the integrated database which covers climate change and air quality data. In 2017 it is planned to continue and finish launching of database in order to use it starting from 2018 submission. Hence Monte Carlo model will be used starting from 2018.

Detailed about uncertainty assessment is described under each subsector.

1.6.2 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. More information available under Part II of this submission in Chapter 11.3.1.5 Uncertainty estimates.

1.7 GENERAL ASSESSMENT OF COMPLETENESS

1.7.1 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, SF_6 and NF_3), NMVOC, NOx, CO and SO_2. No additional sources and sinks identified.

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

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

NE (not estimated):

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

IE (included elsewhere):

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

NA (not applicable):

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

C (confidential):

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

Table 1.6 represents categories reported as "not estimated" (NE) in 2017 submission. Emissions/removals are not estimated mainly due to lack of available IPCC methodologies and/or lack of activity data.

Table 1.6 Sources and sinks not estimated ("NE") in 2017 submission

Sources and sinks not estimated ("NE")				
GHG	**Sector**	**Source/sink category**	**Explanation**	**Remarks**
CH_4	Agriculture	3.D Agricultural Soils	The amount of emissions is negligible.	
CO_2	LULUCF	4.A Forest Land 4.A.2 Land Converted to Forest Land	Carbon stock change in living biomass, dead wood, litter and mineral	"NE" notation key will be replaced with actual values of CO_2 removals and GHG

Sources and sinks not estimated ("NE")				
GHG	**Sector**	**Source/sink category**	**Explanation**	**Remarks**
		Carbon stock change 4.A.2.1 Cropland Converted to Forest Land	soils is negligible, method is not applicable.	emissions after completion of the spatial analysis of digitalized information of the NFI sample plots and extrapolation of obtained data to the time period not covered by the NFI (1990-2003).
CO_2	LULUCF	4.A Forest Land 4.A.2 Land Converted to Forest Land Carbon stock change 4.A.2.3 Wetlands Converted to Forest Land	Carbon stock change in living biomass, dead wood, litter and organic soils is negligible, method is not applicable.	
CO_2	LULUCF	4.A Forest Land 4.A.2 Land Converted to Forest Land Carbon stock change 4.A.2.4 Settlements Converted to Forest Land	Carbon stock change in living biomass, dead wood, litter and mineral soils is negligible, method is not applicable.	
CO_2	LULUCF	4.C Grassland 4.C.2 Land Converted to Grassland Carbon stock change 4.C.2.1 Forest Land Converted to Grassland	Carbon stock change in living biomass, dead organic matter, mineral and organic soils is negligible, method is not applicable.	"NE" notation key will be replaced with actual values for CO_2 removals and GHG emissions after completion of the third NFI cycle in 2018.
CO_2	LULUCF	4.C Grassland 4.C.2 Land Converted to Grassland Carbon stock change 4.C.2.3 Wetlands Converted to Grassland	Carbon stock change in living biomass, dead organic matter and organic soils is negligible, method is not applicable.	
CO_2	LULUCF	4.C Grassland 4.C.2 Land Converted to Grassland Carbon stock change 4.C.2.4 Settlements Converted to Grassland	Carbon stock change in living biomass, dead organic matter and mineral soils is negligible, method is not applicable	
CO_2	LULUCF	4.D Wetlands 4.D.2 Land Converted to Wetlands Carbon stock change 4.D.2.3 Land Converted to Other Wetlands	Carbon stock change in living biomass, dead organic matter and organic soils is negligible, method is not applicable.	
CO_2	LULUCF	4.E Settlements 4.E.2 Land Converted to Settlements Carbon stock change 4.E.2.2 Cropland Converted to Settlements	Carbon stock change in living biomass and dead organic matter is negligible, method is not applicable.	"NE" notation key will be replaced with actual values for CO_2 removals and GHG emissions after completion of the spatial analysis of digitized information of the NFI sample plots and extrapolation of the data obtained to the time period not covered by the NFI (1990–2003).
CO_2	LULUCF	4.E Settlements 4.E.2 Land Converted to Settlements	Carbon stock change in living biomass and dead organic matter is negligible, method is not	

Sources and sinks not estimated ("NE")				
GHG	**Sector**	**Source/sink category**	**Explanation**	**Remarks**
		Carbon stock change 4.E.2.3 Grassland Converted to Settlements	applicable.	
CO_2	LULUCF	4.E Settlements 4.E.2 Land Converted to Settlements Carbon stock change 4.E.2.4 Wetlands Converted to Settlements	Carbon stock change in living biomass and dead organic matter is negligible, method is not applicable.	
HFC-125	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.a Commercial Refrigeration/HFC-125	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-125	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.c Industrial Refrigeration/HFC-125	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-125	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.f Stationary Air-Conditioning/HFC-125	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-134a	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.e Mobile Air-Conditioning/HFC-134a	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-134a	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.f Stationary Air-Conditioning/HFC-134a	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-143a	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.a Commercial Refrigeration/HFC-143a	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-143a	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.c Industrial Refrigeration/HFC-143a	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-143a	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.f Stationary Air-Conditioning/HFC-143a	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE
HFC-152a	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.a Commercial Refrigeration/HFC-152a	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.

Sources and sinks not estimated ("NE")				
GHG	**Sector**	**Source/sink category**	**Explanation**	**Remarks**
HFC-23	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.a Commercial Refrigeration/HFC-23	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-32	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.a Commercial Refrigeration/HFC-32	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-32	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.c Industrial Refrigeration/HFC-32	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.
HFC-32	Industrial Processes and Product Use	2.F Product Uses as Substitutes for ODS/2.F.1 Refrigeration and Air conditioning/2.F.1.f Stationary Air-Conditioning/HFC-32	Emissions are not estimated due to the lack of statistical data.	Only disposal emissions are NE.

1.7.2 Completeness by geographical coverage

All statistical data sources covers the whole territory of Latvia, therefore, the GHG inventory represents the whole country.

1.7.3 Completeness by timely coverage

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 3-7 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 gases defined in the Kyoto protocol – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and nitrogen trifluoride (NF_3). The emission levels are presented in kt of carbon dioxide equivalents (kt CO_2 eq.).

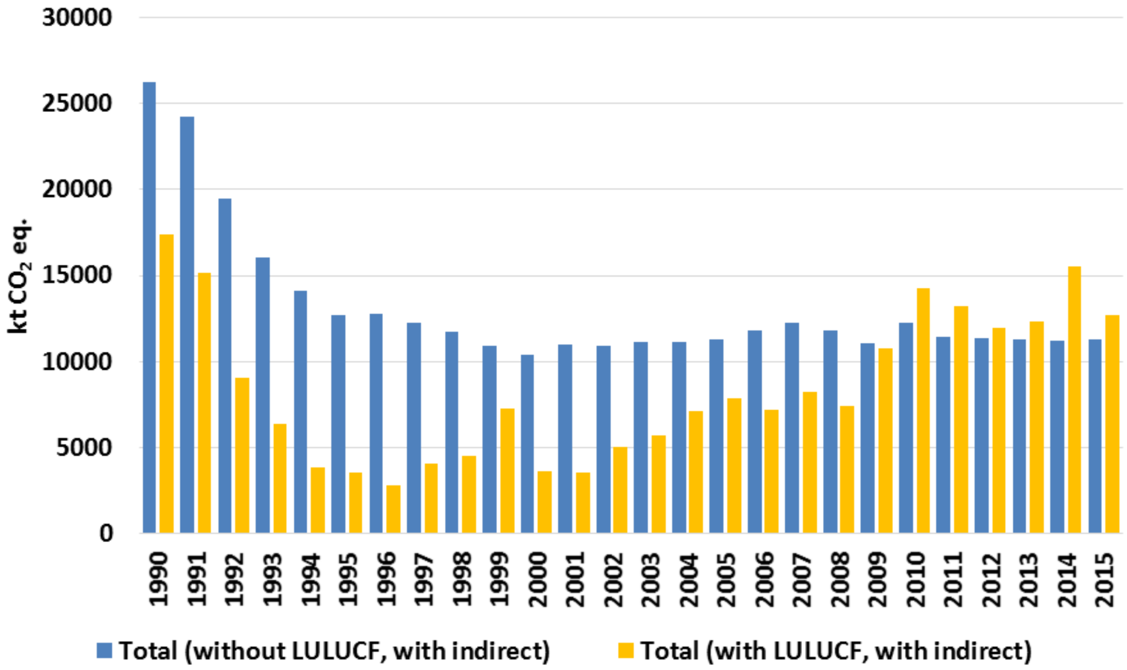

Figure 2.1 Latvia`s aggregated greenhouse gas emissions in 1990-2015 (kt CO_2 eq.)

As illustrated in Figure 2.1, since 1990 Latvia's GHG emissions have considerably decreased by 56.8% (excluding LULUCF, with indirect CO_2) and by 27.0% including LULUCF, with indirect CO_2. This decrease is influenced the economic situation in the country. In Latvia the transition period to market economy started after 1991. This process caused essential changes in all sectors of national economy and resulted in the decrease of GHG emissions after 1990.

The GHG emissions in LULUCF sector, in contrast, continuously increased since 1990. These changes are driven mostly by reduction of CO_2 removals in living biomass due to ageing of forests, increasing of mortality in mature forests. If compared to 1990, both figures are doubled since 1990; respectively, average mortality rate in forest in 1990 was 1.61 m^3 ha^{-1} annually, now (in 2015) it is 2.08 m^3 ha^{-1} annually, but felling rate in 1990 was 6.3 mill. m^3 annually, now it is close to 17.0 mill. m^3. LULUCF sector is also heavily affected by land use changes – in nineteenths considerable area of afforested lands were converted back to agricultural production, in the recent decade another trend is growing – conversion of forest land to settlements to build roads, industrial centers and other infrastructure.

2.2 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY GAS

Carbon dioxide (CO_2) is the main greenhouse gas causing the climate change. In 2015, CO_2 emissions constitute 64.1% of Latvia's total greenhouse gas emissions. In 2015, total CO_2 equivalent emissions without LULUCF had decreased by approximately 63.4% since 1990.

The most important source of CO_2 emissions (kt) in 2015 was fossil fuel combustion – 92.2%, including Energy Industries – 24.1%, Manufacturing Industries and Construction – 8.8%; Transport – 42.3%, Other sectors (Agriculture, Forestry, etc.) – 16.9%.

Other anthropogenic emission sources of CO_2 are Industrial Processes and Product Use – 7.2%, Agriculture 0.4% and Waste 0.002 %.

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 2015 contribute approximately 16.6% of total GHG emissions (excluding LULUCF, including indirect CO_2). The methane emissions (kt) decreased by 46.8% in 2015 since 1990.

Agricultural soils are the main source of N_2O emissions in Latvia generating 85.3% of all N_2O emissions (kt) in 2015. 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 31.1% in 2015, mainly due the decrease in the emissions from agriculture.

Emissions from HFCs and sulphur hexafluoride (SF_6) consumption are reported for the period 1995-2015. Total HFCs emissions increased by 10.4% in 2015 compared with 2014. Since 1995 HFC emissions have increased very significantly due to substitution of ozone depleting substances in refrigeration and air conditioning as well as due to increase of cars, trucks and busses equipped with mobile air conditioners. SF_6 emissions from electrical equipment contribute 10.12 kt CO_2 eq in 2015. Emissions of the PFCs and NF_3 does not occur (NO) in Latvia for all time series.

Emissions by sources are illustrated in the following Figure 2.2.

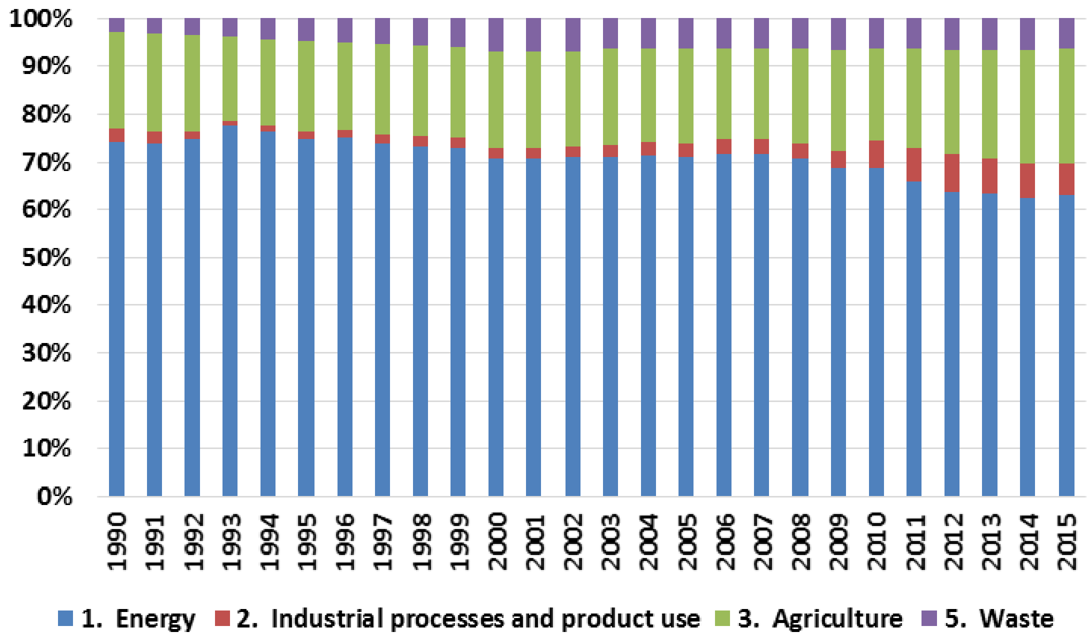

Figure 2.2 Latvia`s greenhouse gas emissions by source 1990-2015 excluding LULUCF, including indirect CO_2

2.3 DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY CATEGORY

2.3.1 Trends in ENERGY

Energy sector is the most significant source of GHG emissions in Latvia. Energy sector consists of stationary, mobile fuel combustion in following subsectors: Energy Industries (CRF 1.A.1 emissions from fuels combusted by the fuel extraction or energy producing industries), Manufacturing Industries and Construction (CRF 1.A.2 emissions from combustion of fuels in industry), Transport (CRF 1.A.3), Other Sectors (CRF 1.A.4 includes emissions from heating of buildings, other fuel use in agriculture, forestry, fishery), Other (CRF 1.A.5, consists of emissions from military activities) and Fugitive emissions (CRF 1.B) where leakages from oil and natural gas are reported.

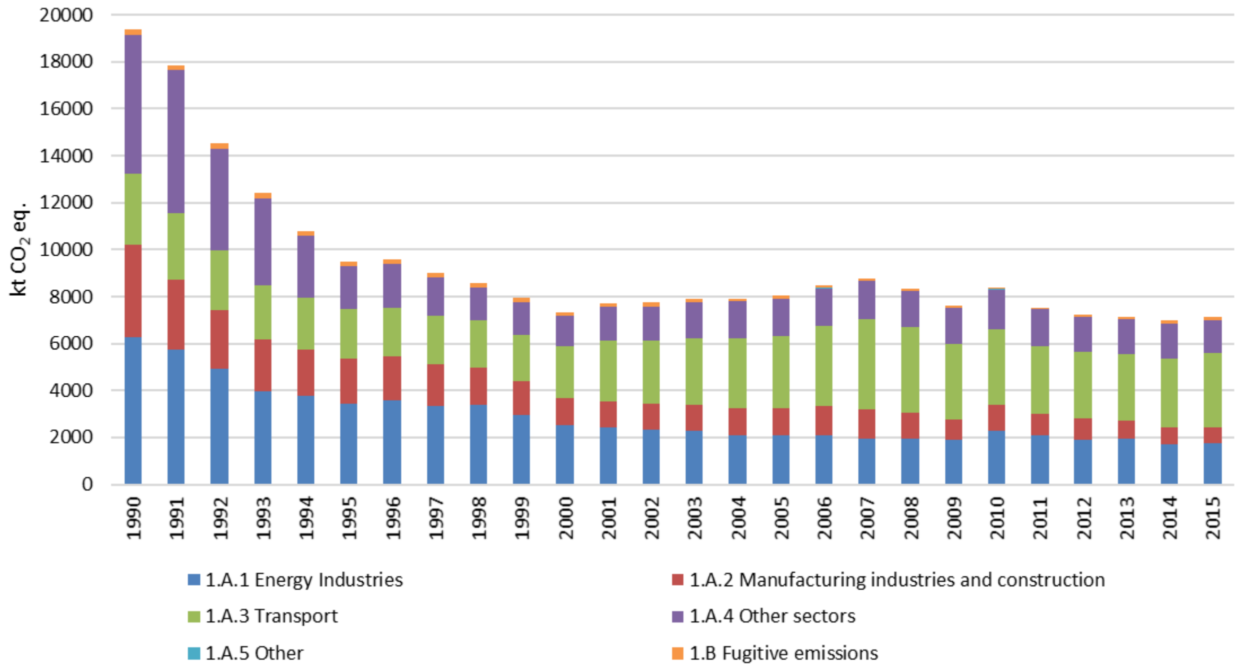

Figure 2.3 Trend in GHG emissions from Energy sector in 1990-2015 (kt CO_2 eq.)

Energy sector share of GHG emissions is 62.9% which makes it the largest emitter in 2015. Figure 2.3 shows GHG emission trends in Energy sector from 1990-2015. Most of Energy sector emissions in 1990 were produced in Energy Industries with 32.3% share and Other Sectors contributing 30.5% of emissions. In 2015 the situation has changed and largest GHG emitter is Transport 44.0% from total GHG emissions in Energy sector.

Comparing GHG emissions from 1990 with emissions from 2015, the emissions in Energy sector have decreased by 63.3%. There can be observed 71.7% decrease in Energy Industries, 82.8% decrease in Manufacturing Industries and Construction and 75.9% decrease in Other Sectors since 1990. Only in Transport sector overall GHG emissions have increased by 3.3% in comparison with emissions from 1990. In Fugitive sector the decrease in GHG emissions is 58.5%. One of the reasons for this is changes in fuel type that are used and amount of fuel consumed in sectors. Use of biomass has increased by 112.3% and usage of fossil fuels have significantly decreased - liquid fuel (-57.4%), solid fuel (-92.6%), peat (-99.7%) and natural gas (-54.0%) in 1990-2015. Biofuels (biodiesel and bioethanol) constitutes 2.0% of the total fuel consumption in the Transport sector (CRF 1.A.3) in 2015. The share of biomass has decreased from 34.8% in 2014 to 33.2% in 2015.

Overall emissions in Energy sector in 2015 have increased by 2.0% in comparison with previous year. Largest increase can be seen in Transport by 6.1% Energy Industries 4.6% and small increase in Other 1.3%. At the same time, a decrease in emissions can be seen in Manufacturing Industries and Construction by 7.0% and Other sectors by 2.3% as well as in Fugative emissions by 24.0%

After the decrease in the period 1990-1999, total GHG emissions from Transport (CRF 1.A 3) had the rapid growth in the period 2000 – 2007 (Figure 2.4). Peak of GHG emissions in Transport sectors has been recognized in 2007 when emissions exceeded 1990 level by

27.1%. The main reason for this increase of emissions was a sharp growth of economy and income of population resulting in rapid increasing of cars (mainly passenger cars).

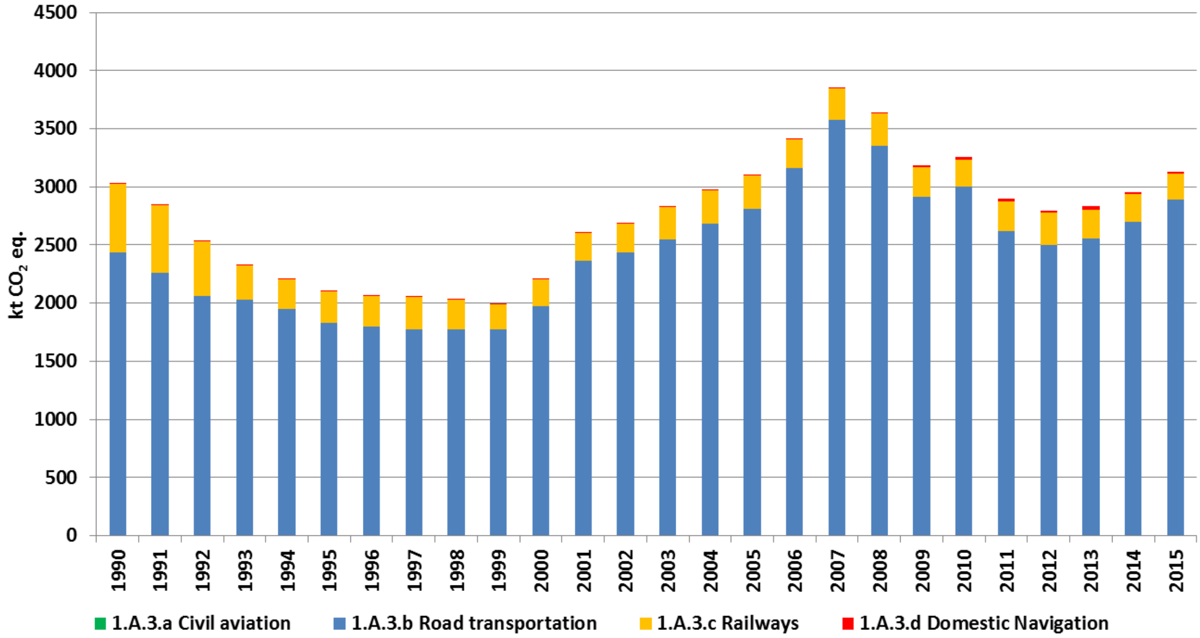

Figure 2.4 Trend in GHG emissions from Transport sector in 1990-2015 (kt CO_2 eq.)

Recession of the national economy was the major reason for decreasing of transport activities – decrease of passenger km by passenger cars and ton km by freight transport - and corresponding GHG emission decreasing in the time period 2008 – 2009. We can recognize solid GHG emission increase in past 3 years.

In 2015, total GHG emissions in the transport sector, compared to 1990 level, have increased by 3.3% and by 6.1% compared to 2014.

The increase of emissions in 2015 in the transport sector was caused by the rise of road transport emissions. In its turn, the road transport emissions increase was determined by the increases in number of passenger cars in 2015 by around 3.8% compared to 2014 and in the amount of fuel consumed. Increase in fuel consumption was partially impacted by comparatively low fuel prices during last two years resulting from low crude oil prices in the international market.

2.3.2 Trends in INDUSTRIAL PROCESSES AND PRODUCT USE

Emissions from IPPU use have increased by 7.9% since 1990 (Figure 2.5). Compared to 2014 emissions from IPPU sector in 2015 have decreased by about 7.7% mainly due to significantly lower produced clinker amount which has decreased by 16% due to decline of export amounts and reduced activity in building sector which caused lower demand for cement.

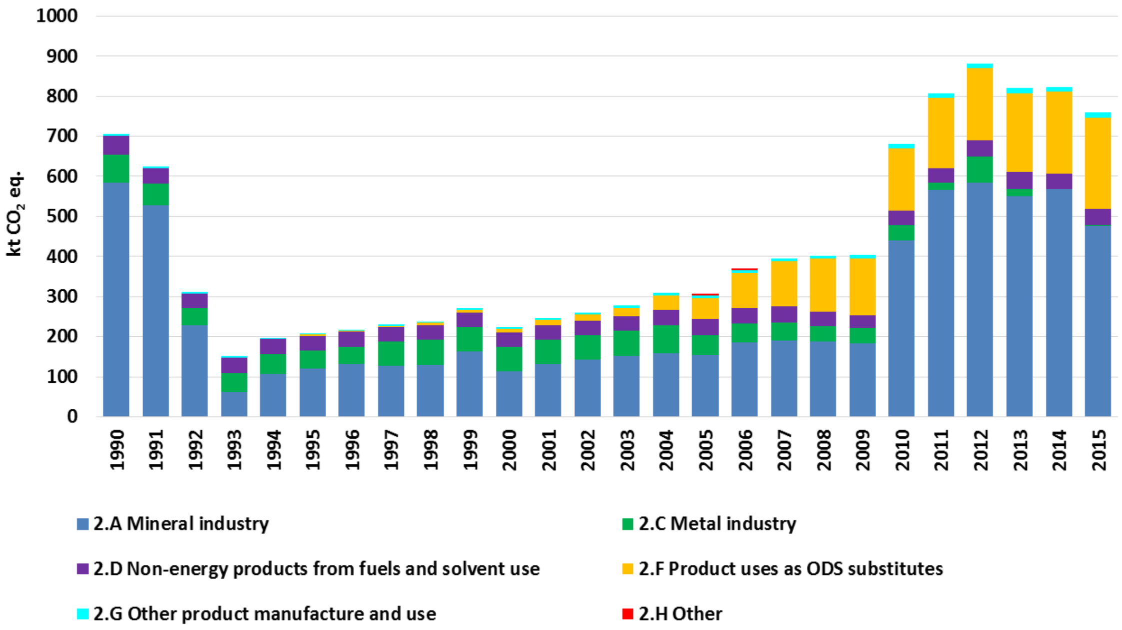

Figure 2.5 Trend in GHG emissions from IPPU sector in 1990-2015 (kt CO_2 eq.)

Largest part of GHG emissions in IPPU sector constitutes CO_2 emissions from 2.A Mineral industry (62.6% of total GHG emissions from IPPU sector and 4.2% from total CO_2 emissions without LULUCF, with indirect CO_2 in 2015). The second largest source is 2.F Product Uses as ODS Substitutes causing 29.9% from all IPPU emissions and 2.0% from total GHG emissions without LULUCF, with indirect CO_2 in 2015. Considerably smaller are rest of IPPU emission sources – 2.G Other Product manufacture and use, 2.D Non energy products from fuels and solvents use and 2.C Metal industry constituting together 7.5% from entire IPPU emissions in 2015.

Data on emissions in IPPU sector are linked with the economic situation of the country as well as availability of statistical data. The largest decrease of emissions occurred between 1990 and 1993 when industry was affected by a crisis. It has to be noted that in the beginning of 1990s during the countrywide change in government system and national economy statistics was not well kept. Therefore there is a lack of statistical data regarding industry during this time period or they are vague.

GHG emissions from IPPU sector have increased from 223.37 kt CO_2 eq in 2000 to 881.70 kt CO_2 eq in 2012. It can be explained with sharp development of Latvian industry when construction activities increased and industrial production of building materials also increased.

Due to Latvia's economic features since 2007–2008 the industry development was slowing down as the financing and real estate sectors started to dominate in national economy. In 2009-2010 emissions increased in mineral industry sector because cement production plant changed their production technology and installations and increased its capacity by approximately 2.4 times.

1995 is the base year for F-gases under the Kyoto Protocol. The total F-gas emissions increased significantly since that time. The main reason which caused emission growth was substitution of ozone depleting substances (ODS) with F-gases in refrigeration and air conditioning appliances. The usage of products which substitute ODSs in Latvia mainly depends on import. The imported amounts could be associated with economic situation in the country consequently this led to F-gases emission growth especially in latest years.

CO_2 emissions from Solvent Use sector have been constantly increasing 1990-2015. Solvent Use emissions in 2015 decreased by 0.3% compared to 2014.

2.3.3 Trends in AGRICULTURE

In 2015, agriculture sector contributed 24.2% of the total GHG emissions originated in Latvia or 2739.6 kt CO_2 eq. GHG emissions increased in 2015 by 2.9% comparing to 2014 due to increase of sheep, goats, poultry and rabbit numbers. Milk yield of dairy cows increased by 1.6%. Statistics also showed increase of synthetic N fertilizer consumption (+4.0%), sown area (+1.6%) and lime and urea application to soils (+5.3%, 31.4%). Also increase of emissions was promoted by increasing of liquid manure share in total manure management amount (Figure 2.6).

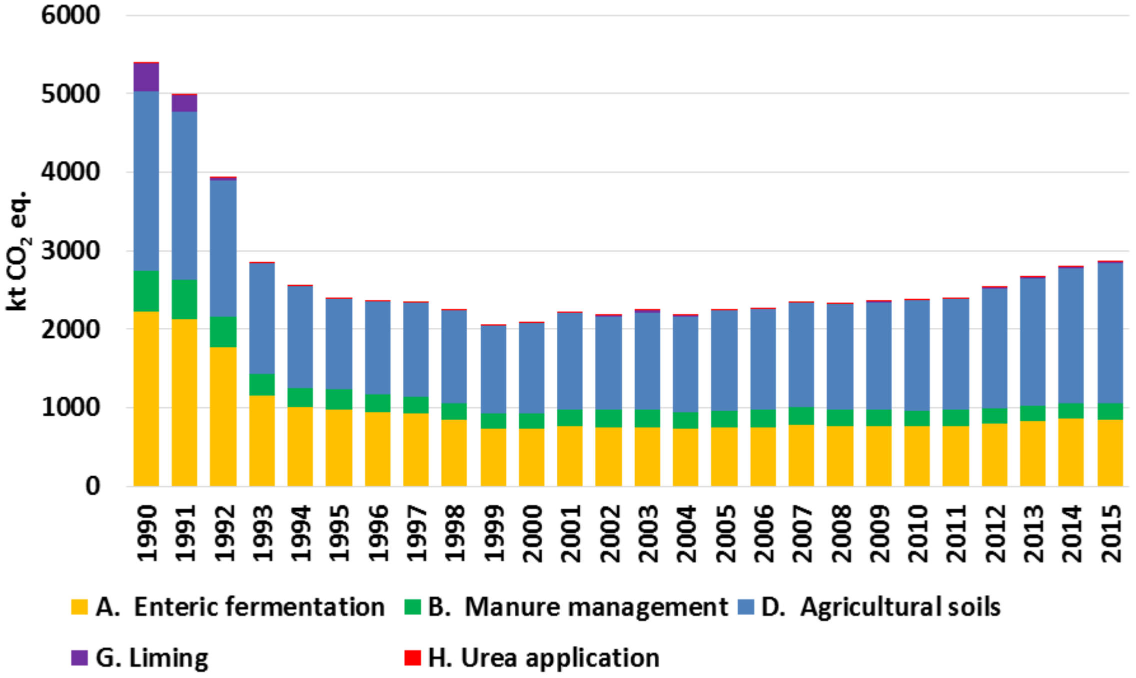

Figure 2.6 Trend in GHG emissions from Agriculture sector in 1990-2015 (kt CO_2 eq.)

Agricultural GHG emissions in Latvia consist of CH_4 emissions from enteric fermentation of domestic livestock, CH_4 and N_2O emissions from manure management, N_2O emissions from agricultural soils and CO_2 emissions from liming and urea application. The trend of emissions in CO_2 eq. by category is presented in Figure 2.6. Generally emissions from the agricultural sector have declined by 49.0% compared to 1990, due to the decrease of livestock population, crop production and amounts of synthetic fertilizer consumption.

Emissions from agricultural soils contributed major share of the total emissions from the sector – 60.5%, enteric fermentation emissions was second largest source from the sector – 31.3%. The share of manure management emissions was evaluated as 7.2% of total emissions in the sector, remaining 1.0% of emissions refer to liming and urea application.

2.3.4 Trends in LULUCF

Aggregated net removals of the GHG reduced by 116 % in 2015 in comparison to 1990 mostly due to increase of harvest rate in mature forests, however considerable role in the increase of the GHG emissions has conversion of forest land to settlements, as well as conversion of naturally afforested lands to cropland and grassland. The land use conversion to cropland is associated mostly to removal of woody vegetation from naturally afforested farmlands abandoned in 1980s and 1990s. Although the increment of living biomass in forest land remaining forest and afforested land is still larger than the carbon losses due to commercial felling and natural mortality, the gap between gains and losses is decreasing, causing reduction of the net removals of CO_2 in forest land. Hence the total growing stock of living biomass is still increasing in forest lands. Summary of the net emissions including harvested wood products is shown in Figure 2.7. Increase of the GHG emissions in 1999 and 2014 is associated with significant increase of harvesting stock in forest lands.

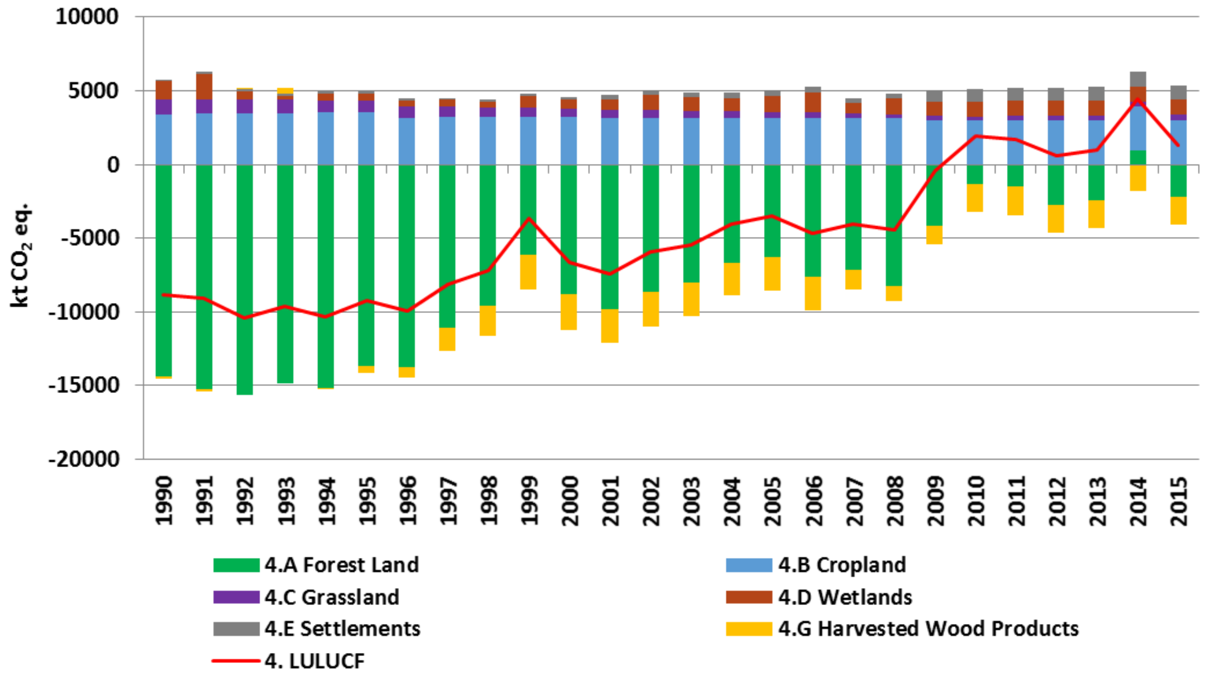

Figure 2.7 Trend in net emissions from LULUCF sector in 1990-2015 (kt CO2 eq.)

Absolute increase of the net annual GHG emissions in LULUCF sector in 2015 if compared to 1990 is 10164 kt CO_2 eq., mostly because of reduction of the net CO_2 removals in living biomass in forest lands (by 14106 kt CO_2 eq. between 1990 and 2015). Emissions increased also in settlements – by 881 kt CO_2 eq. between 1990 and 2015. In cropland, grassland and wetlands emissions decreased by, respectively 404, 607 and 233 kt CO_2 eq. between 1990 and 2015. Reduction of emissions in cropland is caused by conversion of cropland to grassland. Net decrease of annual removals in LULUCF sector in 2015 in compare to 1990 is 116 %.

2.3.5 Trends in WASTE

GHG emissions from Waste sector have been fluctuated from 1990-2015. Fluctuations in total GHG emissions in waste sector could be explained with changes of economic situation in last 20 years (Figure 2.8).

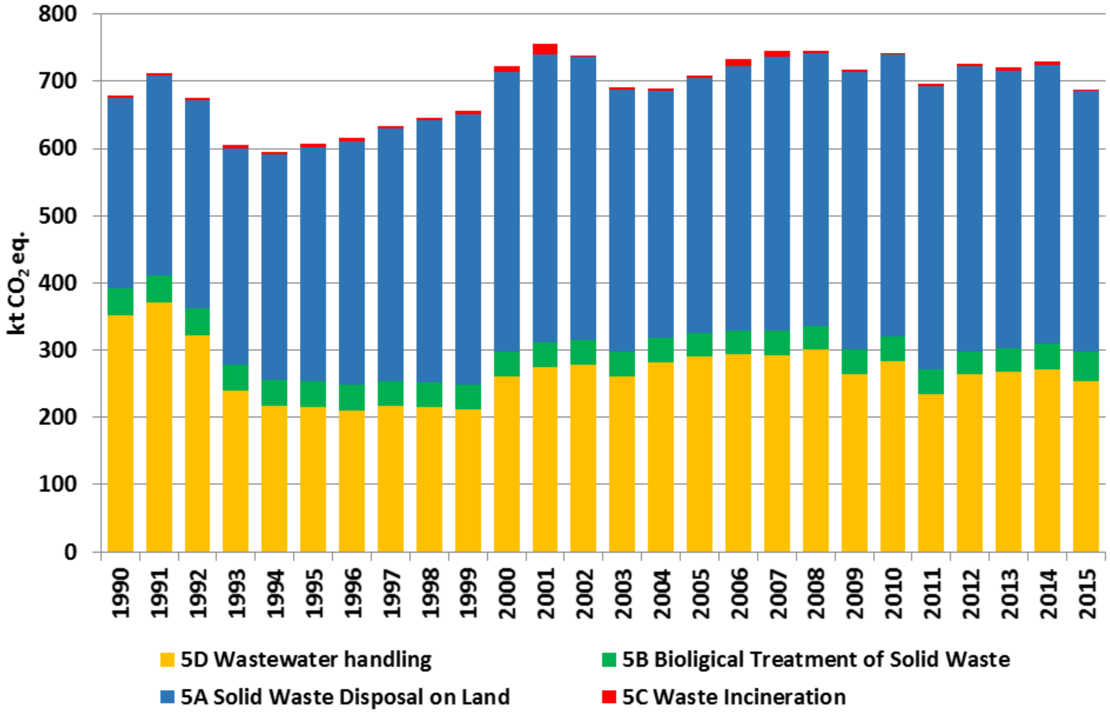

Figure 2.8 Trend in GHG emissions from Waste sector in 1990-2015 (kt CO_2 eq.)

Some industry sectors were almost closed in the middle of 1990s. The main sources of GHG emissions from waste sector are Solid waste disposal (5A) and Wastewater handling (5B). Emissions from Biological treatment of solid waste and Incineration and open burning of waste are small in comparison to main sources.

Fluctuations in Wastewater handling sector are the main reason for GHG emission changes. Solid waste disposal (SWD) emissions are calculated according to First order decay method and disposed waste amount is estimated as equal rise between years 1975 – 2002, that gives equal growth of emissions in times series till year 2002. Starting of methane recovery in Latvia landfills causes SWD emissions decrease in years 2002 – 2004.

In 2015, emissions were approximately 1.2% higher than in 1990. In 2015, emissions from the Waste sector were 687.44 kt CO_2 equivalent; it contributes about 6.1% of total GHG emissions (excluding LULUCF, including indirect CO_2).

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 2.9.

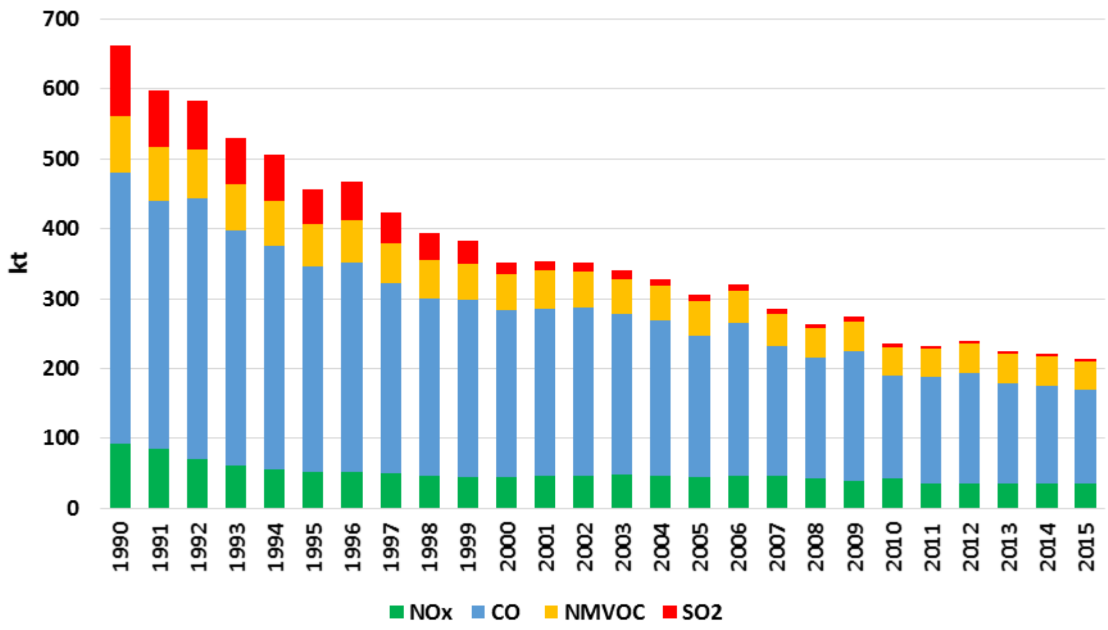

Figure 2.9 Total indirect GHG emissions trend 1990-2015 (kt)

In 2015, the **sulphur dioxide emissions** were 3.76 kt from which 94.9% originated in the Energy sector and 5.1% from IPPU. Since 1990 to 2015 the total SO_2 emissions have decreased by 96%. 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.

Emissions from nitrogen oxides were 36.21 kt in 2015. 83.0% of NOx emissions generated in the Energy sector, 11.5% in Agriculture and 5.2% in IPPU. The Transport sector was responsible for 43.5% of the total NO_x emissions. The total NOx emissions have decreased by 61% from 1990 to 2015. 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.

Carbon monoxide emissions were 133.03 kt, being produced generally in the Energy sector (93.5%). Other sectors (include heating of buildings, other fuel use in agriculture, forestry, fisheries) generate the biggest part of the total CO emissions – 72.7%. The CO emission trend shows a decrease of emissions for period 1990 – 2015 by 66%.

Total emissions of **non-methane volatile organic compounds** were 41.15 kt from which 51.3% are generated in Energy sector (mainly residential stationary plants)) and 28.5% comes from IPPU (mainly from Non-energy products from fuels and solvent use which constitute 25.3% from total NMVOC emissions in 2015).

Emission consistency with the data used to prepare inventories of air pollutants under EU Directive 2001/81/EC and CLRTAP are checked.

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. All mandatory carbon pools and sources are reported.

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	IE		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)

The net emissions due to deforestation increases during the recent years due to active economic growth (building of roads and other infrastructure, recovery of abandoned farmlands) in Latvia. Afforestation rate has decreased during recent years, however, accumulation of carbon in afforested areas continues to grow due to higher increment rates in older previously afforested stands. The net CO_2 removals due to forest management decreased considerably during recent years mostly due to increase of harvesting stock (by about 9 % in 2015 in comparison to 2013-2014), although in 2015 natural mortality decrease by 11 % in comparison to 2013-2014 and increment of living trees increase by 12 % in comparison to 2014. In spite the relative changes between years looks significant, in the most cases they are within the uncertainty range The changes in mortality and increment are mainly associated with ageing of forests. Considering predominance of mature forests declining of increment and increase of the natural mortality is predicted also in the following decades.

3 ENERGY (CRF 1)

3.1 OVERVIEW OF SECTOR

3.1.1 Quantitative overview

Energy sector is the main emission source in Latvia`s GHG inventory in 2015 (Figure 3.1). In total, Energy has created 62.9% of all GHG emissions (excluding LULUCF), and largest part of it contributes to Transport sector (almost half of Energy GHG emissions). As Latvia is located on temperate climate zone, heat production is an essential part of Latvia's economy, thus having an impact on GHG and air pollutant emissions.

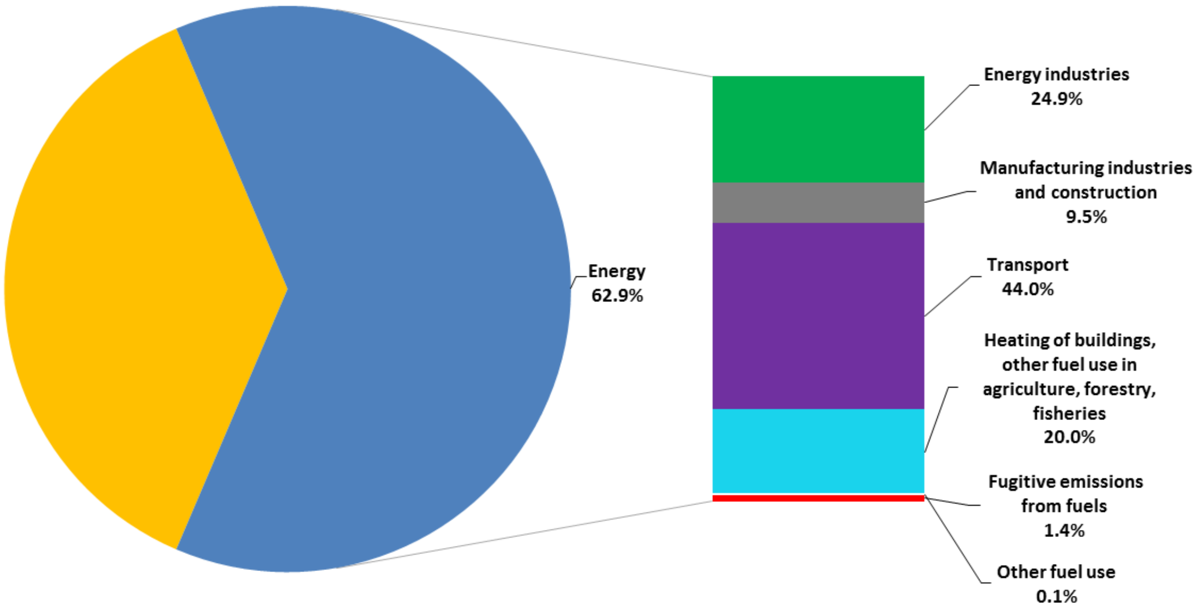

Figure 3.1 Emissions from the Energy sector compared with the total emissions in 2015

Energy consists of two subsectors – fuel combustion (contributing 98.55%) including stationary combustion and transport emissions, and fugitive emissions (1.45%), where emissions from non-combustion processes of fuels are reported, e.g., leakages from natural gas and diffuse emissions from gasoline.

In fuel combustion, the largest part of GHG emissions is generated in Transport sector (CRF 1.A.3; 44.0%). Stationary combustion contributes to 56.0% of all Energy emissions: 24.9% are produced by Energy industries (CRF 1.A.1), 20.0% - by Other sectors (CRF 1.A.4) where heating of buildings (small combustion installations in institutions and households) and other fuel use in agriculture, forestry and fisheries are included, and 9.5% by Manufacturing industries and construction (CRF 1.A.2). Emissions from offroad vehicles in military sector are reported under Other (CRF 1.A.5; in the figure above depicted as Other fuel use). These emissions contribute to 0.1% from all Energy emissions.

In the following sections of Energy chapter both emissions from fuel combustion and fugitive emissions are described.

As it can be seen in Figure 3.2, the share of subsectors in the Energy sector has changed, 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.

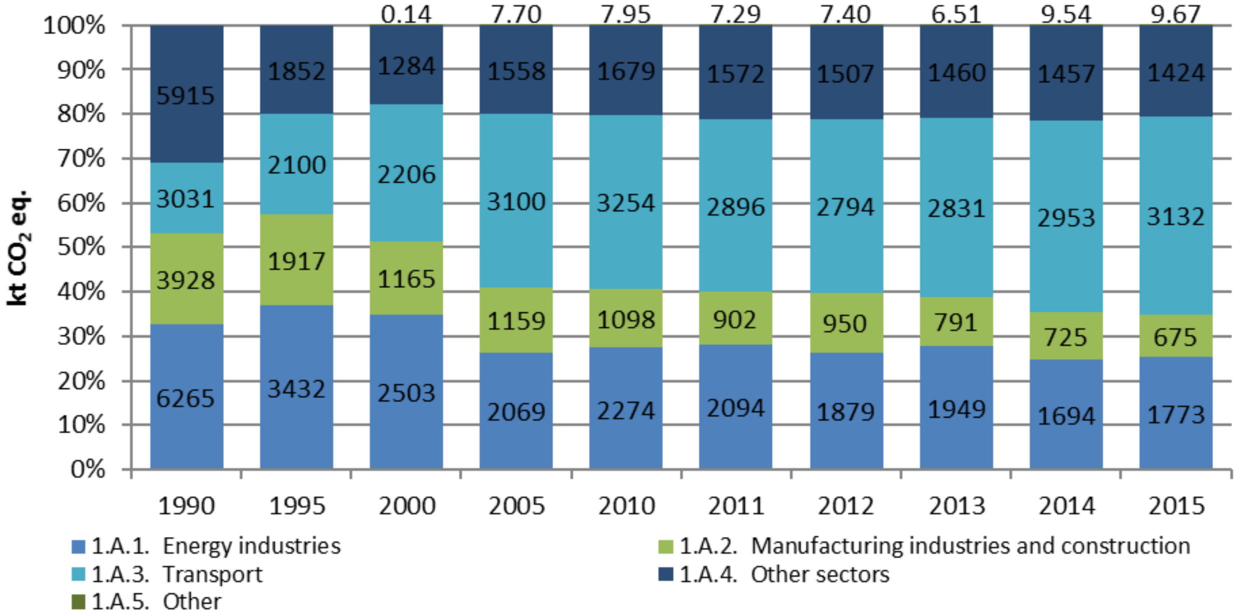

Figure 3.2 Share of emissions in the Energy sector in 1990-2015 (%; kt CO_2 eq.)

In 1990 the biggest share of GHG emissions from combustion was held by Energy industries with 32.7% as well as Other sectors with 30.9% from all emissions produced in Energy sector. 20.5% of emissions occurred in Manufacturing industries and construction sector, and the smallest share of emissions was held by Transport sector with only 15.8%. Emissions in military sector (1.A.5) were not produced until 1996.

However, the share of Transport emissions have grown in comparison with 1990, reaching 39.3% 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 income and growth of economy and also with restrictions related with use of fossil fuels in stationary combustion.

In 2015, the biggest share of GHG emissions in Energy sector is held by Transport sector with 44.7% of total GHG emissions from fuel combustion. The second largest subsector with 25.3% share is Energy Industries, and a quite significant part of emissions 20.3% 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 3.1 GHG emissions from Energy sector in 1990–2015 (kt)

	A Fuel combustion			B Fugitive emissions from fuels		Aggregate GHGs
	CO_2	CH_4	N_2O	CO_2	CH_4	CO_2, CH_4, N_2O
	kt			kt		kt CO_2 equivalent
1990	18713.37	10.05	0.59	0.0115	9.9033	19386.62
1991	17163.68	10.87	0.63	0.0111	9.5390	17862.27
1992	13902.07	9.62	0.51	0.0101	8.6967	14511.48
1993	11816.96	10.15	0.43	0.0097	8.3172	12405.30

	A Fuel combustion			B Fugitive emissions from fuels		Aggregate GHGs
	CO_2	CH_4	N_2O	CO_2	CH_4	CO_2, CH_4, N_2O
	kt			kt		kt CO_2 equivalent
1994	10205.18	9.98	0.38	0.0094	8.1275	10770.85
1995	8940.32	10.12	0.36	0.0092	7.9150	9499.55
1996	9006.73	10.34	0.38	0.0089	7.6267	9567.70
1997	8455.36	9.80	0.38	0.0083	7.1182	8991.97
1998	8070.45	8.95	0.36	0.0079	6.8299	8572.90
1999	7447.93	8.81	0.34	0.0076	6.5111	7932.00
2000	6855.80	8.18	0.33	0.0070	6.0255	7310.01
2001	7251.19	9.06	0.36	0.0073	5.8433	7731.21
2002	7252.99	8.75	0.37	0.0074	6.1026	7734.19
2003	7428.56	8.95	0.40	0.0055	4.7631	7889.44
2004	7443.30	9.19	0.42	0.0055	4.7148	7916.18
2005	7537.93	9.08	0.44	0.0062	5.3272	8027.85
2006	8012.09	8.77	0.44	0.0044	3.8209	8458.55
2007	8328.79	8.75	0.46	0.0046	3.9225	8782.73
2008	7904.91	7.80	0.43	0.0047	4.0278	8327.93
2009	7177.81	8.44	0.42	0.0044	3.8050	7607.63
2010	8008.59	7.16	0.42	0.0043	3.6642	8404.69
2011	7166.57	7.05	0.43	0.0054	2.5212	7534.19
2012	6813.80	7.64	0.45	0.0049	3.1843	7217.40
2013	6722.00	7.14	0.46	0.0080	4.0400	7139.41
2014	6520.78	7.02	0.48	0.0138	5.4127	6974.24
2015	6693.23	6.95	0.49	0.0129	4.1120	7115.05
2015 vs 2014	2.6	-1.0	1.9	-6.0	-24.0	2.0
2015 vs 1990	-64.2	-30.8	-16.7	12.6	-58.5	-63.3

Decrease of emissions depends on economic and social situation in the beginning and ending of the 1990s. The emissions have decreased from 1990 to 2015 with some fluctuations in between. From 2000 to 2010, fuel consumption as well as emissions from fuel combustion increased due to development of national economy, and after 2010 the emissions decreased (Table 3.1). In 2015 total GHG emissions in Energy sector have increased by 2.02% due to emission increase in Energy Industries (4.64%) and Transport (6.05%) sectors compared to 2014.

GHG emissions from the Energy sector in the latest years (since 2000) are fluctuating with a peak point in 2007 that is explained with an increase of national economy (Figure 3.3). GHG emissions in the Energy sector increased by 20.1% in 2000-2007. In the second half of 2008, a recession of the national economy started, caused by the global economic crisis. Decrease in economic output is one of the reasons why all GHG emissions in Energy sector decreased by 13.4% in 2007-2009. Starting with 2010, total GHG emissions increased again by 10.5% compared with 2009 as consumption of fuel increased; also due to the relatively warm winter – in 2009 the number of heating degree days[12] was 4184, while in 2010 – 4671.

[12] *Heating degree day (HDD) is a proxy for the energy demand needed to heat a home or a business; it is derived from measurements of outside air temperature. The heating requirements for a given structure at a specific location are considered to be to some degree proportional to the number of HDD at that location. HDD are defined relative to a base*

However, the emissions decreased again by 10.4% in 2011 compared to 2010 because of warm weather – the number of HDD was 3989. In 2015 emissions are 2.0% higher than in 2014 and HDDs have decreased by 6% from 2014. The increase in emissions can be explained with increased use of fossil fuels.

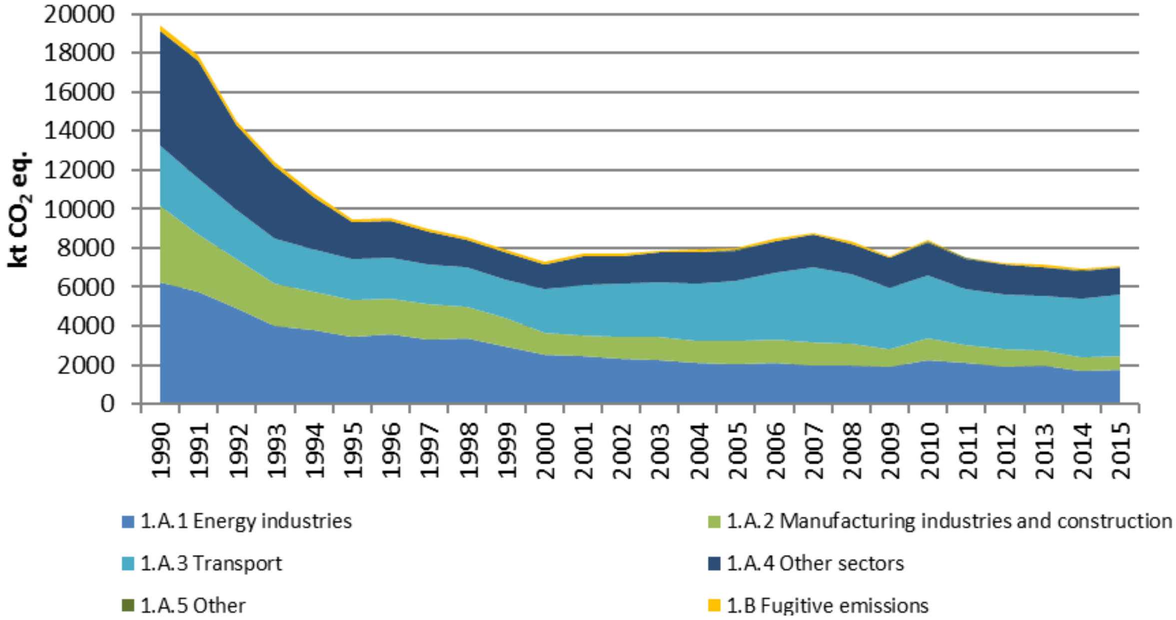

Figure 3.3 GHG emissions from Energy sector 1990–2015 (kt CO_2 eq.)

In CRF 1.A.1 Energy industries sector GHG emission decrease in 2008-2009 can be explained with the recession in national economy caused by global financial crisis, also the winter in 2009 was quite warm, therefore in 2009 GHG emissions in 1.A.1 were 2.6% less than in 2008, but in 2009-2010 an increase of emissions by 20.4% 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 7.9% if compared with year 2010. In 2015 emissions increased by 4.6% compared with 2014 due to increased usage of fossil fuels in Combined heat and power generation (CRF 1.A.1.a.ii).

The decrease of industrial production (CRF 1.A.2) was influenced by economic situation when development of national economy was made in financial and real estate sectors but the import dominated over export. Increase of costs and prices as well as total inflation led to a total decrease of local industry. Therefore GHG emissions from CRF 1.A.2 sector decreased by 19.9% in 2008-2009, but in 2010 emissions increased by 22.5% as fuel consumption increased. In year 2011 emissions decreased by 17.9% which can be explained with great reconstructions in the steel and iron enterprise "Liepājas Metalurgs" under 1.A.2.a sector where the fuel consumption decreased significantly (-76.5%). In 2012 in comparison to 2011 the GHG emissions increased by 5.3% mainly due to intensified steel melting in „Liepājas Metalurgs", emissions in 1.A.2.a sector increased by 44.1%. However, in 2013 decrease in 1.A.2. emissions by 16.7% can be observed, which is related to activities in

temperature (18°C, according to EUROSTAT), the outside temperature below which a building is assumed to need heating (http://www.eea.europa.eu/data-and-maps/indicators/heating-degree-days-1).

"Liepājas Metalurgs", where emissions decreased by 66.2%. "Liepājas Metalurgs" went bankrupt in 2013. Emissions continue to decrease also in 2014 by 8.4%. Also a decrease of 7.0% in 2015 can be explained with overall activity decrease in all 1.A.2 subsectors, with exception of Iron and Steel manufacturing and construction (CRF 1.A.2.a) where slight increase can be seen in comparison with 2014.

For Transport sector (CRF 1.A.3) emissions decreased from 2008 to 2009 by 12.4% that was influenced by sharp increase of fuel price and economy crisis. Decrease can also be explained with improvement of car park in country, where old cars were replaced with new ones. Starting from 2010 growth of emissions from transport sector is observed by 2.1% comparing to 2009. In 2015 5.9% increase can be seen compared with 2014.

Emissions in CRF 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 2015 emissions have decreased by 2.3% in comparison with 2014, it can be explained with relatively warm winter (number of HDDs decreased by 6%) and better housing isolation and higher energy efficiency housing, because largest decrease in this sector can be seen in Residential sector (CRF 1.A.4.b) with decrease of 5.2%.

The emissions in 1.A.5 Other have increased by 1.3% in 2014-2015, and it is not related to financial circumstances nor weather conditions.

Fluctuations of fugitive emissions can be explained with a constant improvement of natural gas supply infrastructure.

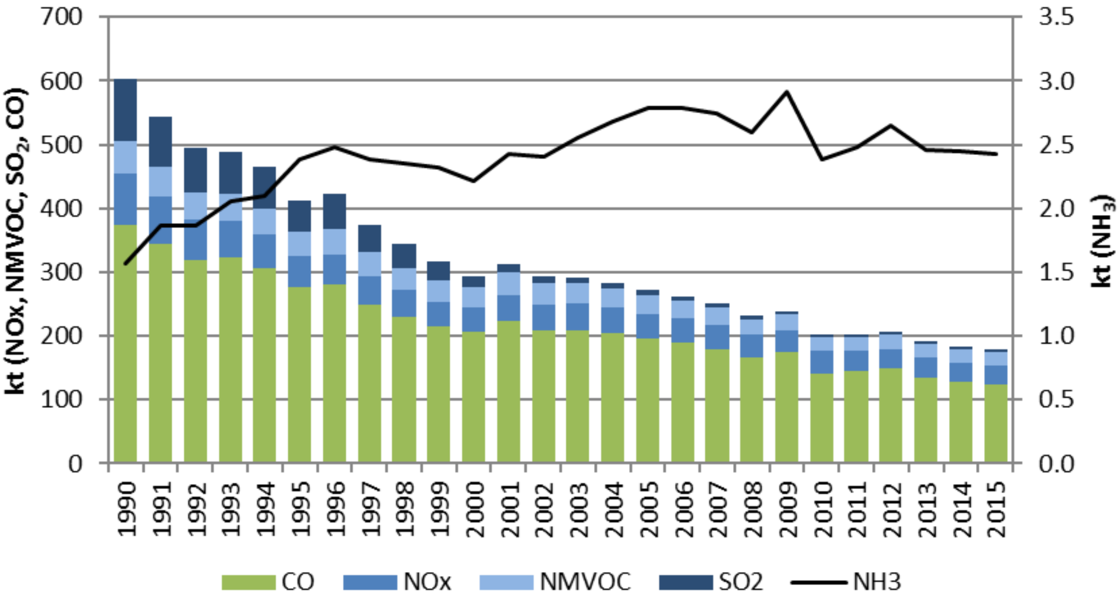

Figure 3.4 Total indirect GHG emissions from Energy sector in 1990–2015 (kt)

In 2015, the largest part of indirect emissions contributes CO, then NMVOC and NOx emissions (Figure 3.4). Most CO and NMVOC emissions come from wood combustion in the Residential sector while the largest share of NOx emissions comes from Transport sector.

The biggest decrease is observed in SO_2 emissions where emissions decreased from 96.9 kt in 1990 to 3.6 kt in 2015. It is explained with changes in type of fuels combusted in Energy sector as well as with implementation of national legislations for sulphur content in liquid fuels used for transport. One of the largest decrease can be seen in Energy Industries and it can be explained with change of used fuel. It was popular to use liquid or solid fuel for heating, but in latest year it was switched to biomass or gaseous fuel with lower sulphur content.

The indirect emissions are generally lower in 2015 if compared to 2014: CO emissions have decreased by 2.9%, NO_x emissions have increased by 0.6%, and SO_2 emissions decreased by 2.3%, NMVOCs have decreased by 2.2%. It can be explained with change of used fuels.

There are also ammonia emissions calculated and reported in Energy sector. According to EMEP/EEA 2016, ammonia emissions arise from biomass combustion and in Transport sector. In 1990-2015, NH_3 emissions have increased by 54.2% that can be explained with increased amounts of biomass burned in Energy Industries, Manufacturing industries, as well as in Other (heat production in institutions, households, agriculture, forestry, fisheries).

3.1.2 Description

Activity data

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 3.2). Mainly the imported fuels (natural gas, coal) are used in heat generation. Smaller boiler houses burn local fuel (wood) and coal as well.

Table 3.2 Consumption of energy resources in Latvia (TJ)[13]

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy consumption	***318571***	***176159***	***143524***	***178707***	***183588***	***186027***	***179327***	***178015***	***185740***	***173188***	***175847***	***176162***	***175156***	***176028***
Liquid fuels, total [14]	*161209*	*81674*	*53518*	*68093*	*71073*	*75890*	*72799*	*70659*	*72127*	*64486*	*64456*	*64721*	*65592*	*68681*
Residual Fuel Oil	76326	41290	9462	10231	7634	6581	7795	10272	8661	6541	6942	6852	6821	5467
Gasoline	26771	18130	14837	15138	16769	18307	16680	13945	12667	11926	10146	9286	9023	8918
Jet Kerosene	3068	1171	1142	2525	2875	3438	4126	4320	4946	4943	5033	5209	4646	4530
Other Kerosene	647	432	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale Oil	NO	78	2440	157	117	118	79	39	39	79	39	NO	NO	NO
Diesel Oil	48021	18274	20906	36791	39208	43862	41066	39141	42013	38520	38958	39433	40769	45594
Liquefied Petroleum Gases	3691	1548	2095	2552	2688	2414	2186	2003	2102	2414	3280	3840	4235	4103
Petroleum Coke	NO	NO	NO	429	627	132	NO	165	627	NO	NO	NO	NO	NO
Other Oil Products	2684	749	2593	269	1155	1038	866	774	1072	64	58	100	98	69
Solid fuels, total	*26249*	*7225*	*2785*	*3199*	*3439*	*4248*	*4225*	*3409*	*4378*	*4509*	*3645*	*2905*	*2473*	*1950*
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	82	27	NO	NO
Oil Shale	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	237	53	26	54	32	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	25984	7172	2759	3145	3407	4248	4225	3409	4378	4509	3563	2878	2473	1950
Peat products, total	*3217*	*3836*	*2392*	*80*	*70*	*90*	*51*	*26*	*46*	*43*	*34*	*64*	*35*	*11*
Peat briquettes	867	401	31	NO	NO	1	1	6	6	3	4	4	5	1
Peat	2350	3435	2361	80	70	89	50	20	40	40	30	60	30	10
Natural gas	*99517*	*41304*	*44962*	*56685*	*58627*	*56588*	*55478*	*50742*	*61044*	*53528*	*50301*	*49994*	*44798*	*45758*
Biomass, total	*27501*	*42120*	*39774*	*49678*	*50032*	*48913*	*46372*	*53017*	*47647*	*49871*	*56535*	*57362*	*60979*	*58380*
Wood	27501	42102	39695	49120	49518	48402	45749	52291	45376	46594	52169	52676	55531	52231
Straws	NO	NO	NO	NO	11	16	14	29	60	43	38	58	99	135
Charcoal	NO	NO	NO	60	30	45	60	60	60	60	59	90	90	60
Biofuel	NO	NO	NO	107	103	73	83	181	1158	1067	938	895	998	1047
Landfill Gas CH_4	NO	NO	NO	251	259	271	290	323	331	349	347	371	369	624
Sludge Gas CH_4	NO	18	41	90	76	80	79	100	114	100	105	97	91	99

[13] *Excluding electricity.*

[14] *Including fuel consumption for international aviation and international navigation.*

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Other Biogas CH_4	NO	NO	NO	NO	NO	NO	NO	NO	37	465	1629	2140	2535	3053
Municipal wastes (biomass fraction)	NO	NO	37	49	34	26	98	33	510	1193	1250	1035	1266	1130
Other fuels, total	*879*	*NO*	*94*	*972*	*348*	*299*	*401*	*162*	*499*	*752*	*877*	*1115*	*1279*	*1248*
Municipal Waste (non-biomass fraction)	NO	NO	NO	NO	NO	NO	80	30	320	332	577	707	915	946
Industrial Waste	NO	NO	94	125	85	65	58	15	84	331	242	379	335	273
Waste Oil	879	NO	NO	847	263	234	263	117	95	88	58	29	29	29

Liquid fossil fuels have an important place in the Latvian energy resource market. Its market share is about 39.0% in 2015. The essential decrease of heavy oil share in CSB Energy Balance is explained with increase of costs due to increasing fuel costs because of implementation of the EU Directive 1999/32/EC prescribing that sulphur content of heavy oil shall not exceed 1%. The biggest part from liquid fuel consumption contributes diesel oil with approximately 66.4% from total liquid fuel consumption in 2015; diesel oil is mostly used in Transport sector. The total consumption of liquid fuels in 2015 has decreased by 57.4% since 1990. Reason for such drastic decrease can be explained by changes in technology, with exception of Transport sector and Other (1.A.5), that technology that uses liquid fuel is replaced with one that uses biomass.

Total share of *solid fuels* in national market is quite low – approximately 1.1% in 2015. The solid fuel consumption in recent years is stable although constantly decreasing 1990-2015 by 92.6%, with 21.1% decrease 2014-2015. A decrease in solid fuel consumption (-19.3%) can be seen in 2008-2009 due to global economic crisis. However, from 2009 to 2011 it increased by 32.3% that can mainly be explained with an increase of coal consumption, but in years 2011-2015 there can be seen a decrease in solid fuel consumption by 56.8% due to reduced use of coal.

Peat and *peat briquettes* are local fuels quite widely used in Latvia in 1990 with 1.1% of total energy consumption. However, nowadays amounts of peat products used have decreased and has 0.01% of total share in 2015. The reason is the same as for solid and liquid fuel - changes in technology. Peat was widely used in heat production, but now for heat and electricity production mostly biomass and gaseous fuels are used.

The largest consumers of *natural gas* are combined heat and power plants, and heat generation enterprises as well as industrial enterprises. Natural gas has a stable place in total fuel consumption where its share was 31.2% in 1990 and 26.0% in 2015. Natural gas consumption has decreased by 54.0% in 1990-2015. Recent years until 2011 the consumption of natural gas had an increasing trend – from 2009 to 2010 it increased by 20.3%, but in 2010-2015 there can be seen a decrease of natural gas consumption by 25.0%.

Biomass fuels are wood and wood products, straw, charcoal, liquid biofuels – bioethanol and biodiesel–, biogas – landfill gas, sludge gas, other biogas. In the total fuel consumption the share of firewood and other wood products is quite substantial with 29.7% of total energy consumption in 2015, comparing with 1990 when whole biomass usage was only 8.6% from total energy consumption. In 2010-2015 wood and wood products' use increased by 15.1%. In latest years liquid and gaseous biofuels are becoming more popular and their share from 0.25% in 2005 has reached 2.7% in 2015 from total fuel consumption. Recently fuels as straws are used more often, and it has an increasing trend with fluctuations, especially in

2010-2011 and 2013-2015, which can mainly be explained with significant temperature differences in winter.

There are also *industrial* and *municipal waste*[15] consumed in the latest years, and the most significant increase can be observed in 2010 – comparing with 2009 the consumption of waste has almost 12-fold increase, and it reached 0.49% from total share. However, in the following years the increase of other fuels consumed was not as rapid as in previous 2009-2010, and the increase in particular fuels' use in 2013-2014 was by 15%. In 2015, however, consumption decreased by 2.4% Also waste oils are reported as other fuels, however, this fuel type has a decreasing trend. Yet in pasts 3 years use of waste oil have been constant.

Hydroelectric power plants (HPP) and combined heat and power plants (CHP) produce part of the electrical power, while part is imported (Table 3.3, Table 3.4). 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 3.3 Heat production and consumption in Latvia (TJ)

	Production	Own use and losses	Final consumption		
			CRF 1.A.2	CRF 1.A.4	TOTAL
1990	99439	15171	32929	51339	84268
1995	46112	7156	1969	36987	38956
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
2013	26249	4551	479	21219	21698
2014	25747	4608	890	20249	21139
2015	25459	4358	1450	19651	21101

Table 3.4 Electricity production and consumption in Latvia (TJ)

	Production	Own use and losses	Import	Export	Final consumption			
					CRF 1.A.2	CRF 1.A.3	CRF 1.A.4	TOTAL
1990	23933	6883	25700	12798	11484	918	17550	29952
1991	20318	6682	15217	7	10807	785	17255	28847
1992	13803	5645	14688	7	8316	745	13777	22838
1993	14126	6102	9619	612	5440	688	10904	17032

[15] *For reporting purposes municipal waste has been divided into fossil and non-fossil fractions, but in the particular paragraph it is described as whole.*

	Production	Own use and losses	Import	Export	Final consumption			
					CRF 1.A.2	CRF 1.A.3	CRF 1.A.4	TOTAL
1994	15984	6681	9533	2988	5076	670	10102	15848
1995	14324	6372	9529	1408	5130	677	10267	16074
1996	11254	7989	12377	760	4975	641	9266	14882
1997	16218	7694	6566	4	5519	634	8935	15088
1998	20869	6559	3290	1382	5296	612	10310	16218
1999	14796	5774	9349	2311	5130	554	10375	16059
2000	14890	5202	7589	1159	5159	547	10411	16117
2001	15408	5688	8424	1645	5562	623	10314	16499
2002	14310	5188	10217	1764	5494	518	11563	17575
2003	14310	5065	9616	137	5778	490	12456	18724
2004	16881	4975	9839	2290	5882	500	13072	19454
2005	17658	4767	10278	2545	6120	533	13972	20625
2006	17607	4522	10116	1087	6332	540	15242	22114
2007	17176	4194	17870	7070	6538	504	16740	23782
2008	18987	4198	16715	7643	6066	497	17298	23861
2009	20048	4032	15333	9378	5421	436	16114	21971
2010	23857	4626	14303	11160	5724	453	16197	22374
2011	21938	4133	14432	9950	6012	446	15829	22287
2012	22202	3636	17766	11678	7175	464	17015	24654
2013	22352	3556	18018	13140	6509	446	16719	23674
2014	18508	3146	19221	10883	6003	421	17276	23700
2015	19921	3215	18888	12330	6130	384	16750	23264

Types of fuels used for combustion in Latvia:

Liquid fuels are mainly imported from Latvia's neighbouring countries – Lithuania, Belarus, Russian Federation, Norway and others and consist of:

- shale oil;
- liquefied petroleum gas (LPG);
- 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 (RFO);
- other liquids;
- petroleum coke.

Solid fuels consist of coal and coke imported from Commonwealth of Independent States (countries of former Union of Soviet Socialist Republics), as well as local fuel – peat briquettes – that are mainly produced inside country but not imported;

Peat is 100% produced inside of the country;

Gaseous fuels (natural gas) are 100% imported from Russian Federation;

Biomass fuels:

- solid biomass – wood and other wood products, charcoal, straw, is mainly produced 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, are mainly imported from Latvia's neighbourhood countries.

Other fuels are municipal waste and industrial waste – used tires, different types of industrial ecofuel collected by and combusted in cement production plant in Latvia, as well as waste oils.

Methodological issues

Table 3.5 Methods and emission factors used in Energy sector

	CO_2		CH_4		N_2O	
CATEGORIES	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**
1. Energy	T1, T2, T3	CS, D, OTH, PS	T1, T2, T3	CR, CS, D, OTH	T1, T2	CR, D, OTH
A. Fuel combustion	T1, T2, T3	CS, D, OTH, PS	T1, T2	CR, CS, D, OTH	T1, T2	CR, D, OTH
1. Energy industries	T1, T2	CS, D	T1	D	T1	D
2. Manufacturing industries and construction	T1, T2, T3	CS, D, PS	T1	D	T1	D
3. Transport	T1, T2	CS, D, OTH	T1, T2	CR, D, OTH	T1, T2	CR, D, OTH
4. Other sectors	T1, T2	CS, D	T1, T2	CS, D	T1	D
5. Other	T1	D	T1	D	T1	D
B. Fugitive emissions from fuels	T3	CS	T3	CS	*NA*	*NA*
1. Solid fuels	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2. Oil and natural gas	T3	CS	T3	CS	*NA*	*NA*
C. CO_2 transport and storage	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

The main methods and emission factors can be seen on Table 3.5. It can be seen that in fuel combustion for CO_2 emission calculations there are methods from Tier 1 to Tier 3 used, generally Tier 2, while for CH_4 and N_2O Tier 1 and Tier 2 are used, generally Tier 1. In stationary combustion, CO_2 emission factors are country-specific (CS), but for CH_4 and N_2O – default values (D) from 2006 IPCC Guidelines, while in Transport country-specific, default, Corinair (CR) and other (OTH) values are used. For fugitive emissions, Tier 3 method and country-specific emission factors are used. As there are no GHG emissions from solid fuels, but there are particulate matter emissions reported, there can be seen a notation key "NA" and for CO_2 transport and storage there are no operations, therefore "NA" is used.

Key categories

Key categories of Energy sector are presented in Table 3.6. Key categories are estimated using Approach 1 and Approach 2 both by level and trend with and without taking LULUCF sector into account.

Table 3.6 Key categories in Energy sector in 2017 submission

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	T1,T2	X	X
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	T2		X
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	L1		X
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	T1		X
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	T1	X	X
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	T1	X	X
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	T1		X
1.A.2.c Chemicals - Liquid Fuels	CO_2	T1,T2	X	X
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	T1	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	L1	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	T1,T2	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	T1,T2	X	X
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	L1	X	X
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	L1,T1,T1	X	X
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	T1,T2	X	X
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.3.b Road Transportation - Diesel Oil	CO_2	L1,L2,T1,T2	X	X
1.A.3.b Road Transportation - Diesel Oil	N_2O	L2,T1,T2		X
1.A.3.b Road Transportation - Gasoline	CO_2	L1,L2,T1	X	X
1.A.3.b Road Transportation - LPG	CO_2	L1,T1,T2	X	X
1.A.3.c Railways - Liquid Fuels	CO_2	L1,T1	X	X
1.A.3.c Railways - Liquid Fuels	N_2O	L1,L2		X
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	L1,L2,T1	X	X
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	L1,T1,T2	X	X
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	L1,L2,T2		X
1.A.4.a Commercial/Institutional - Peat	CO_2	T1		X

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
1.A.4.b Residential - Biomass Fuels	CH_4	L1,L2,T1,T2	X	X
1.A.4.b Residential - Gaseous Fuels	CO_2	L1,L2,T1	X	X
1.A.4.b Residential - Liquid Fuels	CO_2	L1,L2,T1	X	X
1.A.4.b Residential - Solid Fuels	CO_2	L1,T1,T2	X	X
1.A.4.b Residential - Solid Fuels	CH_4	T2		X
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	L1,L2,T1,T2	X	X
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	T1,T2	X	X
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	L1,L2,T2		X
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	L1,L2,T1	X	X
1.B.2.b Natural Gas	CH_4	L1,L2	X	X
1.A.2.g Other - Gaseous Fuels	CO_2	L1,T1,T2	X	X
1.A.2.g Other - Liquid Fuels	CO_2	L1,T1,T2	X	X
1.A.2.g Other - Biomass Fuels	N_2O	T2		X

3.2 FUEL COMBUSTION (CRF 1.A)

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) – military transport.

Reported greenhouse gas emissions are listed in Table 3.7.

Table 3.7 Reported emissions from fuel combustion in Latvia in 2015

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	√	√	√	√	√	√	√
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Petroleum Refining								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Peat	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
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	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	NO	NO	NO	NO	NO	NO	NO
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	NO	NO	NO	NO	NO	NO	NO
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Non-Ferrous Metals								
	Liquid Fuels	NO	NO	NO	NO	NO	NO	NO
	Solid Fuels	√	√	√	√	√	√	√
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	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
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
d. Pulp, Paper and Print								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	NO	NO	NO	NO	NO	NO	NO
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
e. Food Processing, Beverages and Tobacco								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	√	√	√	√	√	√	√
f. Non-metallic minerals								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	√	√	√	NO	NO	NO	NO
g. Other								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Peat	√	√	√	√	√	√	√
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
1.A.3 Transport								
a. Civil Aviation								
	Aviation Gasoline	√	√	√	√	√	√	√
	Jet Kerosene	√	√	√	√	√	√	√
	Biomass	NO	NO	NO	NO	NO	NO	NO
b. Road Transportation								
	Gasoline	√	√	√	√	√	√	√
	Diesel Oil	√	√	√	√	√	√	√
	LPG	√	√	√	√	√	√	√
	Other Liquid Fuels	√	√	√	√	√	√	√
	Gaseous Fuels	NA	NA	NA	NA	NA	NA	NA
	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
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NA	NA	NA	NA	NA	NA	NA
d. Navigation								
	Residual Oil (Residual Fuel Oil)	NO	NO	NO	NO	NO	NO	NO
	Gas/Diesel Oil	√	√	√	√	√	√	√
	Gasoline	√	√	√	√	√	√	√
	Other Liquid Fuels	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
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	√	√	√	√	√	√	√
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√

Source	Fuel Type	Emissions						
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
b. Residential								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	Other Fuels	NO	NO	NO	NO	NO	NO	NO
c. Agriculture/Forestry/Fisheries								
	Liquid Fuels	√	√	√	√	√	√	√
	Solid Fuels	√	√	√	√	√	√	√
	Peat	NO	NO	NO	NO	NO	NO	NO
	Gaseous Fuels	√	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√	√
	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
	Peat	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
	Peat	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 6693.23 kt (including Transport sector) in 2015 and accounted for 92.2% of the total CO_2 emissions. Biggest contributor to CO_2 emissions was Road transportation with 3072.28 kt CO_2.

CH_4 emissions from fuel combustion were 6.95 kt (including Transport sector) in 2015 and accounted for 7.70% of total CH_4 emissions. The biggest part of CH_4 emissions contributes to Other sectors (CRF 1.A.4) – 5.79 kt.

N_2O emissions from fuel combustion were 0.49 kt (including Transport sector) and accounted 5.48% of the total N_2O emissions in 2015.

3.2.1 Comparison of the sectoral approach with the reference approach

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 CSB Energy Balance.

Difference between fuel consumption estimated with RA and SA for liquid fuels is quite high – from 3.59% in 1995 to -18.65% in 2010 (Table 3.8). Difference for solid fuels is smaller from

0.60% in 1992 to -1.65% in 2005. Difference for gaseous fuels fluctuates from 3.10% in 1993 to 0.14% in 1990. For other fuels the fluctuations are from 1.18% in 2014 to -1.97% in 2015. For peat the fluctuations are more remarkable – from 130.43% in 2010 to 0% in 2002, 2011, 2012, 2014 and 2015.

Table 3.8 Difference (%) between Sectoral and Reference approach data (PJ) and CO_2 emissions (kt)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fuel consumption - Liquid fuels											
SA	138.39	123.94	103.92	96.87	91.09	74.33	80.21	68.90	67.76	63.13	52.05
RA	139.74	123.06	104.10	96.51	93.07	77.00	78.56	67.35	66.37	55.13	44.98
Diff., %	0.97	-0.71	0.17	-0.37	2.17	3.59	-2.06	-2.24	-2.04	-12.69	-13.59
CO_2 emissions - Liquid fuels											
SA	10342.66	9246.59	7753.00	7227.39	6825.40	5556.47	6015.18	5141.29	5048.33	4694.52	3828.26
RA	10538.59	9230	7807.94	7253.34	7021.51	5803.69	5941.74	5071.06	5004.62	4189.65	3373.18
Diff., %	1.89	-0.18	0.71	0.36	2.87	4.45	-1.22	-1.37	-0.87	-10.75	-11.89
Fuel consumption - Solid fuels											
SA	26.249	22.512	18.756	17.092	12.173	7.225	6.853	5.630	4.178	3.636	2.785
RA	26.126	22.626	18.869	17.048	12.095	7.171	6.802	5.578	4.155	3.586	2.761
Diff., %	-0.47	0.51	0.60	-0.26	-0.64	-0.74	-0.74	-0.92	-0.54	-1.38	-0.87
CO_2 emissions - Solid fuels											
SA	2486.39	2129.65	1774.29	1618.24	1152.55	684.11	648.95	533.22	395.54	344.65	263.81
RA	2502.91	2151.66	1799.14	1635.33	1172.45	700.97	666.06	561.51	424.11	373.07	292.24
Diff., %	0.66	1.03	1.40	1.06	1.73	2.46	2.64	5.31	7.22	8.25	10.78
Fuel consumption - Gaseous fuels											
SA	99.52	98.84	70.75	46.15	33.62	41.30	35.22	43.12	42.22	40.44	44.96
RA	99.65	100.47	72.23	47.58	34.62	42.28	36.22	44.15	43.25	41.44	45.74
Diff., %	0.14	1.64	2.09	3.10	2.98	2.36	2.84	2.39	2.44	2.47	1.72
CO_2 emissions - Gaseous fuels											
SA	5486.30	5448.82	3972.62	2591.86	1872.77	2296.54	1975.82	2416.44	2368.97	2263.43	2503.05
RA	5496.73	5541.69	4058.32	2674.04	1929.74	2352.32	2033.25	2475.85	2428.49	2320.86	2547.78
Diff., %	0.19	1.70	2.16	3.17	3.04	2.43	2.91	2.46	2.51	2.54	1.79
Fuel consumption - Peat											
SA	3.22	3.24	3.85	3.62	3.37	3.84	3.50	3.47	2.45	1.36	2.39
RA	4.15	3.93	4.62	4.12	3.68	4.24	3.93	3.81	2.63	1.46	2.48
Diff., %	29.13	21.21	19.95	13.69	9.22	10.57	12.46	9.92	7.40	7.57	3.82
CO_2 emissions - Peat											
SA	333.59	338.61	402.16	379.48	354.45	403.20	366.79	364.41	257.61	143.24	253.22
RA	433.18	411.77	483.97	432.34	387.63	446.47	413.22	401.07	276.78	153.54	263.09
Diff., %	29.85	21.61	20.34	13.93	9.36	10.73	12.66	10.06	7.44	7.19	3.90
Fuel consumption - Other fuels											
SA	0.88	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0.03	0.09
RA	0.88	NO	NO	NO	NO	NO	NO	NO	NO	0.03	0.09
Diff., %	0.00	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0.00	0.00
CO_2 emissions - Other fuels											
SA	64.43	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	2.09	7.46
RA	64.50	NO	NO	NO	NO	NO	NO	NO	NO	2.18	7.78
Diff., %	0.11	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	4.25	4.25

Continuation of Table 3.8

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fuel consumption - Liquid fuels										
SA	52.28	52.07	53.97	55.31	54.74	60.06	65.06	60.14	54.94	56.70
RA	48.00	44.05	48.83	50.87	49.74	54.22	59.54	55.77	47.08	46.12
Diff., %	-8.18	-15.41	-9.52	-8.02	-9.14	-9.74	-8.48	-7.26	-14.30	-18.65
CO_2 emissions - Liquid fuels										
SA	3829.32	3816.93	3966.96	4064.11	4005.17	4394.17	4749.64	4386.97	4017.55	4159.85
RA	3585.3	3290	3654.9	3783	3678.2	4045.2	4424.7	4144.3	3490.4	3446.5

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Diff., %	-6.37	-13.81	-7.87	-6.92	-8.16	-7.94	-6.84	-5.53	-13.12	-17.15
Fuel consumption - Solid fuels										
SA	3.638	2.928	2.674	2.596	3.199	3.439	4.248	4.225	3.409	4.378
RA	3.614	2.903	2.648	2.570	3.146	3.408	4.248	4.248	3.409	4.378
Diff., %	-0.66	-0.87	-0.97	-1.00	-1.65	-0.90	0.00	0.54	0.00	0.00
CO_2 emissions - Solid fuels										
SA	344.46	277.36	253.28	245.91	303.26	325.71	401.85	399.71	322.48	414.17
RA	372.93	303.32	267.74	263.25	317.73	339.63	413.32	416.21	336.84	422.72
Diff., %	8.27	9.36	5.71	7.05	4.77	4.27	2.85	4.13	4.45	2.07
Fuel consumption - Gaseous fuels										
SA	52.25	53.50	55.67	55.25	56.69	58.63	56.59	55.48	50.74	61.04
RA	53.16	54.07	56.41	55.79	56.85	58.89	56.92	55.81	51.38	61.31
Diff., %	1.74	1.07	1.33	0.97	0.29	0.45	0.59	0.61	1.26	0.44
CO_2 emissions - Gaseous fuels										
SA	2903.96	2974.93	3090.50	3070.51	3149.00	3258.70	3145.44	3081.78	2822.66	3388.97
RA	2956.23	3008.60	3133.69	3102.37	3160.29	3275.62	3166.04	3102.51	2860.18	3406.26
Diff., %	1.80	1.13	1.40	1.04	0.36	0.52	0.65	0.67	1.33	0.51
Fuel consumption - Peat										
SA	1.25	1.01	0.67	0.08	0.08	0.07	0.09	0.05	0.03	0.05
RA	1.26	1.01	0.91	0.09	0.08	0.07	0.09	0.09	0.04	0.11
Diff., %	1.26	0.00	35.80	13.75	1.12	1.14	0.83	78.08	38.46	130.43
CO2 emissions - Peat										
SA	131.85	106.52	71.33	8.48	8.49	7.44	9.56	5.41	2.70	4.82
RA	133.62	106.59	96.94	9.65	8.59	7.53	9.65	9.63	3.80	11.21
Diff., %	1.34	0.07	35.89	13.83	1.19	1.21	0.96	78.16	40.66	132.37
Fuel consumption - Other fuels										
SA	0.55	1.03	0.62	0.72	0.97	0.35	0.30	0.40	0.16	0.50
RA	0.55	1.03	0.62	0.72	0.97	0.35	0.30	0.40	0.16	0.50
Diff., %	0.00	0.00	0.00	-0.14	0.10	0.00	0.00	0.00	-0.01	0.00
CO_2 emissions - Other fuels										
SA	41.60	77.25	46.48	54.30	72.00	26.07	22.30	31.05	12.41	40.77
RA	42.22	78.11	47.21	55.02	72.15	26.09	22.32	31.07	12.41	40.80
Diff., %	1.50	1.12	1.58	1.33	0.20	0.10	0.10	0.09	0.00	0.07

Continuation of Table 3.8

	2011	2012	2013	2014	2015
Fuel consumption - Liquid fuels					
SA	50.59	49.40	49.77	51.30	53.57
RA	43.83	47.43	47.15	51.14	49.08
Diff., %	-13.37	-3.99	-5.28	-0.32	-8.37
CO_2 emissions - Liquid fuels					
SA	3691.76	3598.71	3621.10	3729.83	3899.57
RA	3265.246	3538.236	3518.73	3788.39	3668.858
Diff., %	-11.55	-1.68	-2.83	1.57	-5.92
Fuel consumption - Solid fuels					
SA	4.509	3.645	2.905	2.473	1.950
RA	4.509	3.645	2.906	2.473	1.950
Diff., %	0.00	0.00	0.03	0.00	0.00
CO_2 emissions - Solid fuels					
SA	426.54	345.12	274.91	233.95	184.47
RA	435.12	362.36	280.58	233.95	184.47
Diff., %	2.01	4.99	2.06	0.00	0.00
Fuel consumption - Gaseous fuels					
SA	53.53	50.30	49.99	44.80	45.76
RA	54.03	50.81	50.54	45.39	46.10
Diff., %	0.95	1.00	1.10	1.31	0.74
CO_2 emissions - Gaseous fuels					

	2011	2012	2013	2014	2015
SA	2971.03	2786.68	2724.61	2443.64	2499.75
RA	3001.20	2816.61	2756.50	2477.43	2519.96
Diff., %	1.02	1.07	1.17	1.38	0.81
Fuel consumption - Peat					
SA	0.04	0.03	0.06	0.04	0.01
RA	0.04	0.03	0.08	0.04	0.01
Diff., %	0.00	0.00	31.25	0.00	0.00
CO2 emissions - Peat					
SA	4.53	3.57	6.75	3.67	1.16
RA	4.55	3.60	8.89	3.67	1.14
Diff., %	0.46	0.91	31.75	0.06	-1.90
Fuel consumption - Other fuels					
SA	0.75	0.88	1.12	1.28	1.25
RA	0.75	0.88	1.12	1.29	1.22
Diff., %	0.00	0.00	0.00	1.18	-1.97
CO_2 emissions - Other fuels					
SA	72.70	79.71	94.63	109.70	108.28
RA	72.75	79.77	94.70	111.05	106.37
Diff., %	0.07	0.07	0.07	1.23	-1.77

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 as well as municipal waste combusted in the same cement production plant. According to 2006 IPCC Guidelines, used oils are also reported under Other fuels.

3.2.1.1 Explanation of the difference

Energy Balance

In the Annual questionnaires, as well as in CSB online database statistical differences, distribution losses and interproduct transfer are reported for certain fuels, whereas in the Reference Approach (RA) table only stock changes are possible to insert. These data are not taken into account and are not put in stock changes' cells of the CRF Reporter RA tables. Therefore the difference in liquid fuels and peat have been quite significant for many years. For example, distribution losses for peat are quite visible, in comparison with total consumption, especially in 2010. To improve the transparency of reporting, the statistical differences, distribution losses, as well as interproduct transfers for the whole time series are presented in Annex A.3.1 of this report.

CSB estimates total consumption data by taking production, import, export, international bunkering and stock changes data into account. Final consumption data is estimated by taking into account sectoral consumption data reported by fuel consumers excluding reported distribution losses data. Transformation and Energy sectors are not included in final consumption 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 peat 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 interproduct transfer but this amount is not reported in RA tables therefore the consumption of fuel in RA tables is reported although the fuel was not consumed in Latvia, for example, for other kerosene in 2004-2008.

The changes larger than 5% between fuel consumption in RA and Sectorial Approach (SA) are explained below for each fuel type.

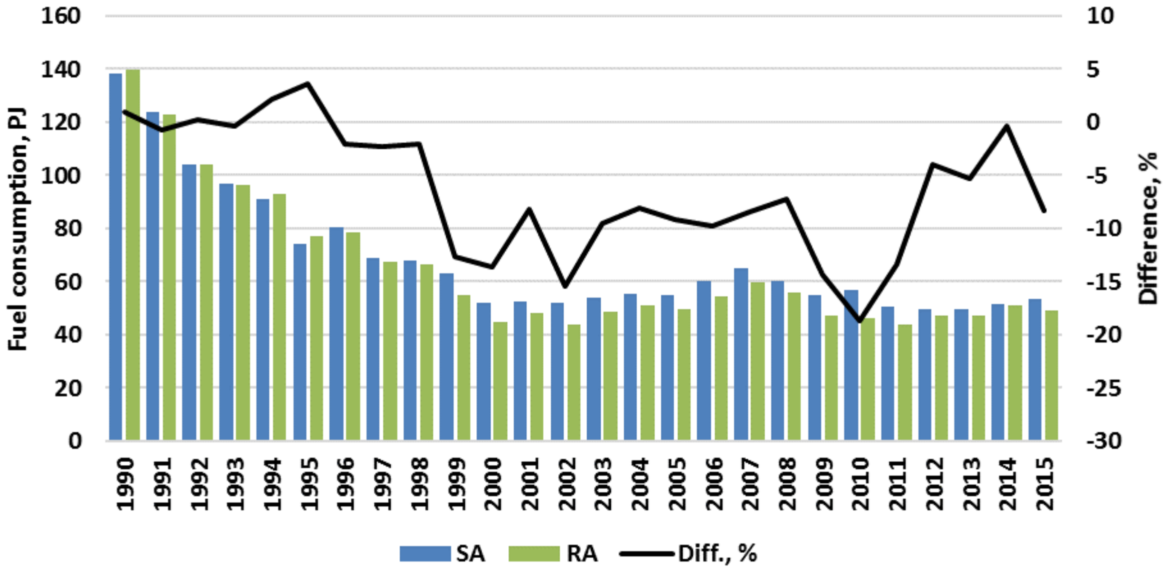

Figure 3.5 Difference in fuel consumption of Liquid fuels between Reference and Sectoral Approach

The difference between fuels varies from -2% to 4% until 1998, and with up to -18.65% difference in 2010 (Figure 3.5). The differences after 1998 can be generally explained with statistical differences in diesel oil energy balance which are not taken into account when calculating RA, and also with interproduct transfers of RFO, shale oil, jet fuel and kerosene. In 1999, there are also large statistical differences in gasoline consumption (-6.38 PJ).

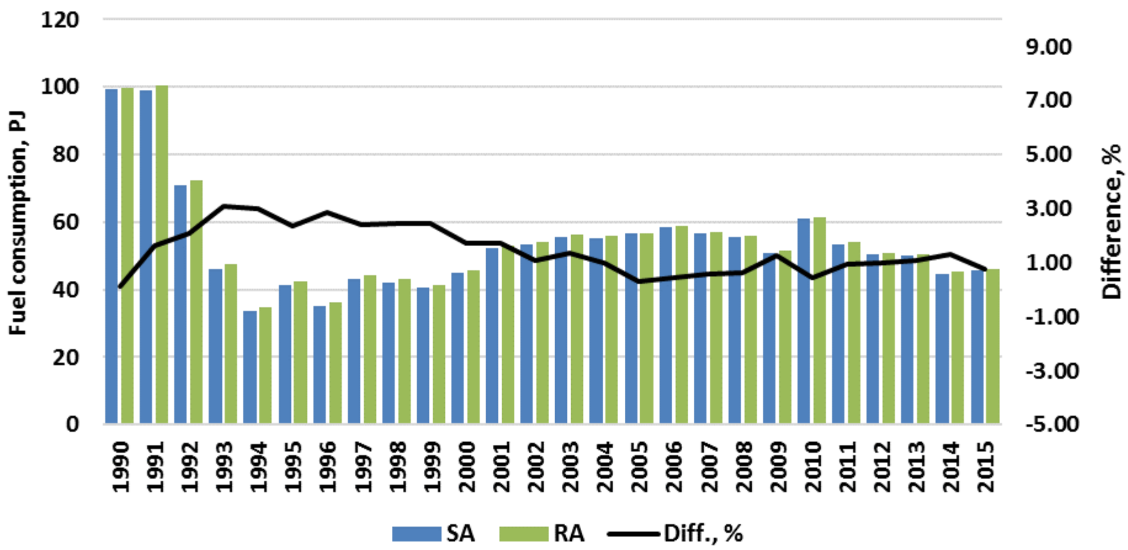

Figure 3.6 Difference in fuel consumption of Gaseous fuels between Reference and Sectoral Approach

The differences in Natural gas consumption between Sectoral and Reference approaches are mainly due to distribution losses that occur every year (Figure 3.6).

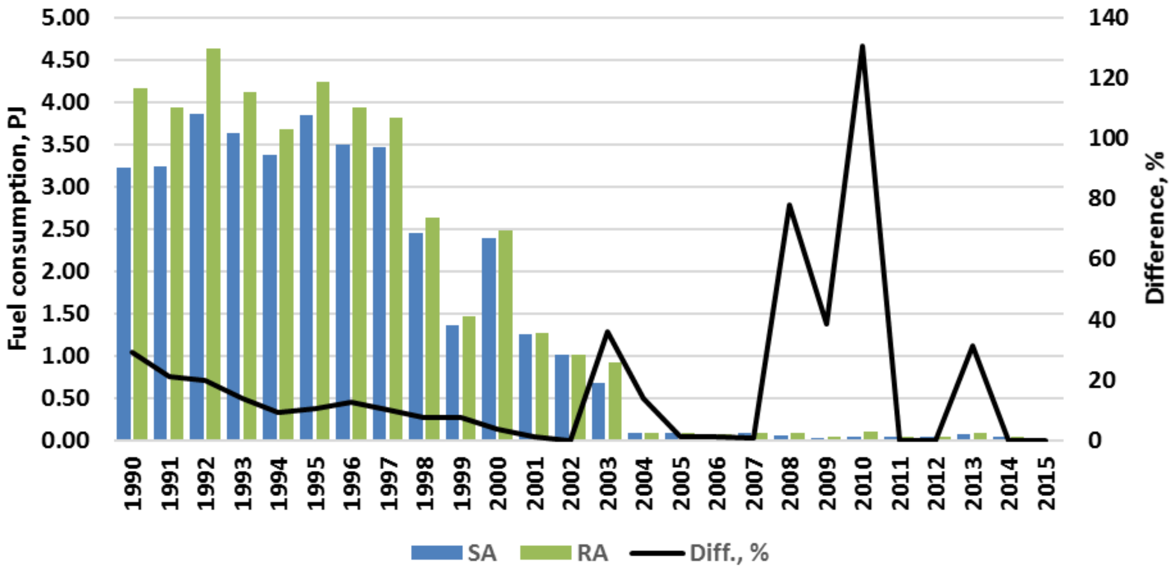

Figure 3.7 Difference in fuel consumption of Peat (including Peat briquettes) between Reference and Sectoral Approach

Among all fuel types, for peat and peat briquettes the differences are the most remarkable (Figure 3.7). It is because in the recent years there are significant losses of peat reported by CSB, for example, in 2003, there are 241 TJ reported by CSB as peat losses, and it can be clearly seen in difference of RA and SA - while the total consumption according to RA is 914 TJ, within SA only 673 TJ are reported. The same applies to years 2008-2011 and 2013, where losses of peat are around 10-60 TJ. With small total peat consumption these losses affect difference quite drastically.

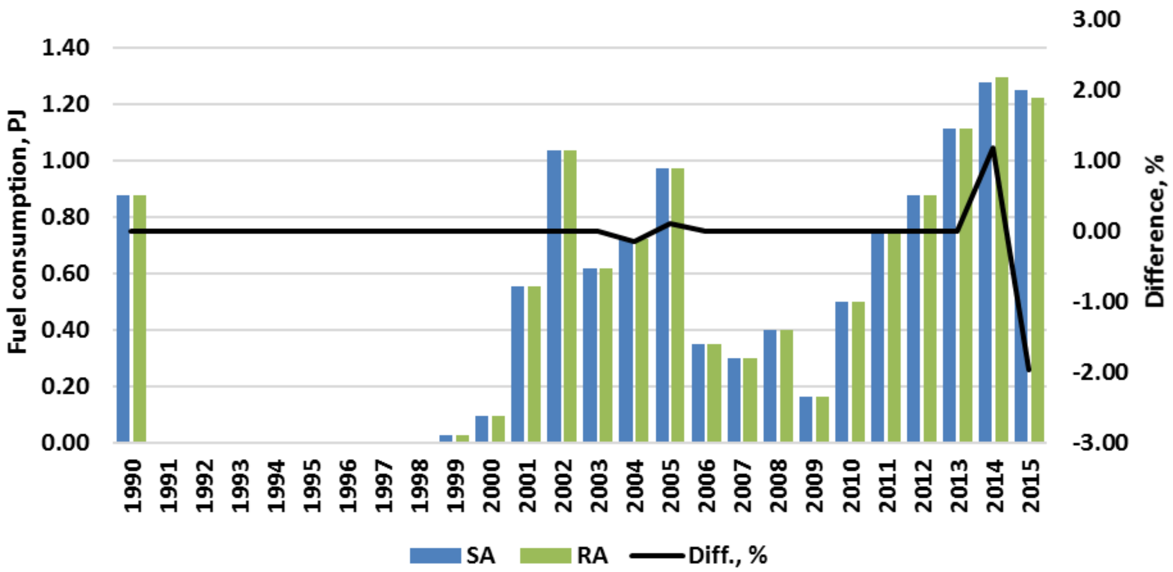

Figure 3.8 Difference in consumption of Other fuels between Reference and Sectoral Approach

The differences for Other fuels are not larger than ±5% (Figure 3.8), therefore they are not analysed.

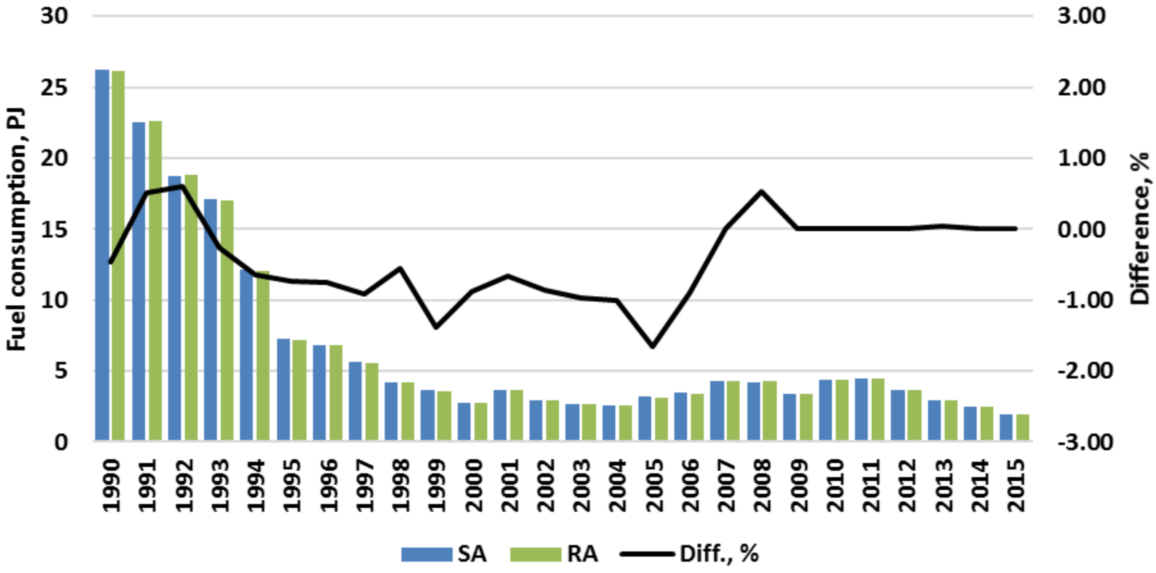

Figure 3.9 Difference in consumption of Solid fuels between Reference and Sectoral Approach

The differences for solid fuels are not larger than ±5% (Figure 3.9), therefore they are not analysed.

3.2.1.2 Explanation of the fluctuations

Fluctuations of emissions estimated with SA and RA 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 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 2010-2014 with a decreasing trend of emissions. In 2015 overall fuel usage have increased and it can be explained with economic growth and increased household purchasing power (increase in average salary), because largest fuel consumption can be seen in Road transportation (1.A.3.b).

3.2.1.3 Methodological issues

2006 IPCC Guidelines Reference approach for the CO_2 emission estimations and comparison of CO_2 emissions were used. CRF Reporter software was used to report emission data. Annual import, export, production, international bunkers and stock changes data divided by fuel types are put in the RA tables of CRF Reporter as well as carbon emission factor (EF) 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 (NCV) of the fuels are taken from CSB Energy Balance. 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. The consumption of fuels is taken from CSB on-line database due to more precise data as in Annual Questionnaires, therefore, in order to improve transparency of the reporting, it was decided to use data from CSB Energy Balance instead of Annual Questionnaires.

For peat, gasoline, diesel oil, RFO, shale oil, jet fuel, kerosene, wood, used oils and natural gas carbon emission factor is assumed as country specific. For several fuels NCV changes once in whole time series in 2003-2004 or 2002-2003 but for natural gas and municipal waste NCV and also carbon emission factor changes for every year in whole time series. NCV and carbon emission factor (C_{EF}) of other liquid fuels changes in every year in time series are explained with the fluctuation of other oil fuel structure (biogasoline, biodiesel, other liquid biofuels – bioethanol). Municipal waste structure also influenced carbon emission factor change in 2008-2015.

Table 3.9 Carbon emission factors (t/TJ)

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Peat	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93	28.93
Gasoline	18.89	18.89	18.89	18.91	18.91	18.91	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	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	21.11	21.11	21.11
Shale oil	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05	21.05
LPG	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13	17.13
Jet fuel	19.72	19.72	19.72	19.71	19.71	19.71	19.71	19.71	19.71	19.71	19.71	19.71	19.71	19.71
Kerosene	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72
Wood	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01	30.01
Used oils	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01	20.01
Natural gas	15.04	15.17	15.19	15.16	15.17	15.17	15.16	15.18	15.15	15.15	15.12	14.87	14.89	14.91
Landfill gas. sludge gas. other biogas	NO	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95
Municipal waste (biomass)	NO	NO	21.68	21.68	21.68	21.68	23.24	23.26	23.48	30.01	25.71	23.37	23.55	24.10
Industrial waste	NO	NO	21.68	21.68	21.68	21.68	23.20	23.20	23.97	23.58	23.12	22.82	23.20	22.09
Municipal waste (non-biomass)	NO	NO	NO	NO	NO	NO	23.25	23.47	22.57	30.90	25.99	23.46	23.60	24.25
Petroleum coke	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60
Anthracite	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80	26.80
Peat briquettes	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60	26.60
Waste oils	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Straws	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30	27.30
Charcoal	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50
Oil shale	29.10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80
Coke	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Other oil	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Biogasoline. biodiesels	NO	NO	NO	19.30	19.30	19.30	19.30	19.30	19.30	19.30	19.30	19.30	19.30	19.30

Carbon emission factors for petroleum coke, anthracite, peat briquettes, waste oils, straws, charcoal, oil shale, coal, coke, other oil, biogasoline, biodiesels and other liquid biofuels taken from 2006 IPCC Guidelines were used (Table 3.9). Carbon emission factor for industrial and municipal waste 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 series. Emissions from all sectors are estimated or reported as not occurring / not applicable therefore there are no "not estimated" sectors.

3.2.1.5 Category-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 CSB Energy Balance, and it 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 Quality assurance process and in case of inconsistency of data reported in NIR and in CRF with the data in CSB Energy Balance 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 5%) 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.

3.2.2 International bunker fuels

International bunkers cover international aviation and navigation according to the 2006 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. In 2015, total GHG emissions of International Bunkering (see Figure 3.10), compared to 2014 level has increased by 7.2%. In different subsectors various changes have taken place in 2015. In international aviation GHG emissions have decreased by 1.8%, whereas in the international navigation it has increased by 11.1 %.

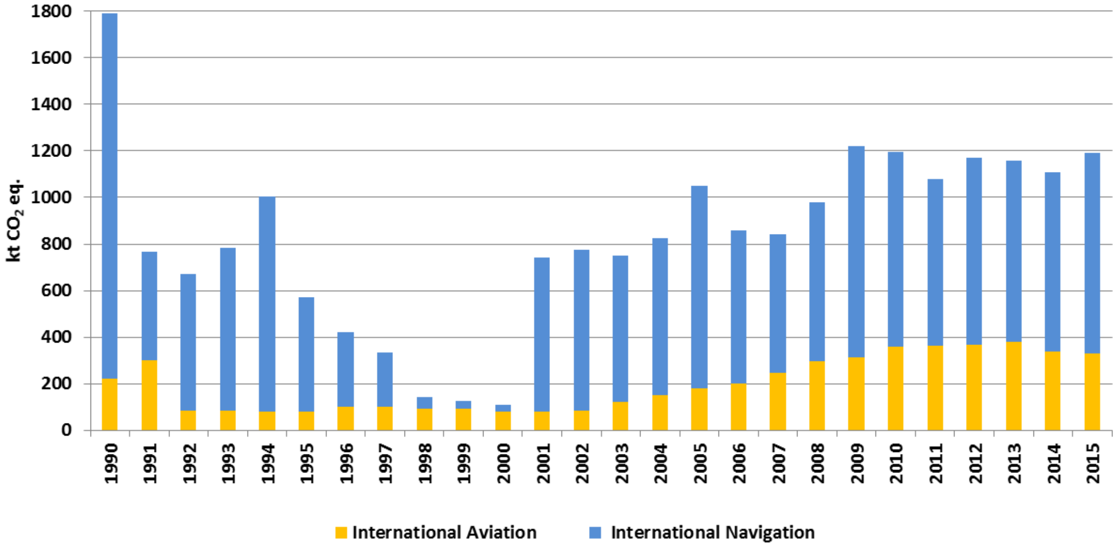

Figure 3.10 Emissions from International Bunkers (kt CO_2 eq.)

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 GPG 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 then 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 consistent allocation of fuel consumption between domestic and international mode in the navigation and aviation, CSB each month collects and summarizes the information which is submitted by every enterprise which performs 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)[16]

	Aviation	Navigation	
	Jet Kerosene	Diesel Oil	Residual Fuel oil
1990	3067	5014	14738
1995	1080	1105	5156
2000	1123	340	NO
2001	1123	4249	3938
2002	1166	3612	4994
2003	1685	3102	4750
2004	2031	3187	5278
2005	2463	3824	7064
2006	2765	2762	5481
2007	3371	2507	4953
2008	4051	1912	6699
2009	4278	2592	8851
2010	4907	2932	7592
2011	4921	3187	5800
2012	4984	3697	6374
2013	5142	3148	6658
2014	4580	2932	6780
2015	4494	5226	5440

The new sulphur regulations entered into force in 1 January 2015 for marine fuels used on board ships operating in the Emission Control Areas comprising the Baltic Sea and the North Sea., That resulted in the change of fuel type used on board ships. The maximum sulphur content in marine fuels was reduced from 1.00 per cent to 0.10 per cent by mass. To fulfil this requirement, the consumption of diesel oil increased in 2015 (Table 3.10).
In 2015, CO_2 emissions from international aviation, compared to 2014 level, have decreased by 1.8% (Figure 3.10) due to decreasing fuel consumption. These changes in fuel consumption are mainly due to using more efficient airliners.
CO_2 emissions from the international navigation are affected by fuel consumption, which depends on several factors:

- On the one hand it is affected by the port activity indicators (loaded, unloaded cargo). As shown in Figure 3.11, the total loaded and unloaded cargo volume in 2015 has increased by nearly 22% compared to 2001. At the same time the structure of the cargo handled has changed (see Figure 3.13). The main changes have affected the oil transshipment, whose share in handeled cargo volume has decreased from 18.7% to 0.2%. At the same time, the coal share in the total handled cargo volume has increased from 9.7% to 32.4 %.
- On the other hand, fuel consumption is affected by the number of vessels serviced in ports. As shown in Figure 3.11, in spite of the rapid increase in the volume of cargo at

[16] *CSB. Annual Eurostat Energy Questionnaire, 2013*

the port of Riga, the number of serviced ships has remained almost unchanged or even has decreased. The main reason for this trend is the increase in the gross tonnage of vessels. The most significant increase was registered in the average tanker gross tonnage, but also in other cargo carrier groups (container, dry bulk carriers). All this confirms the fact that the cargo owners continue to optimize transport costs including fuel costs and try to use larger vessels where possible.

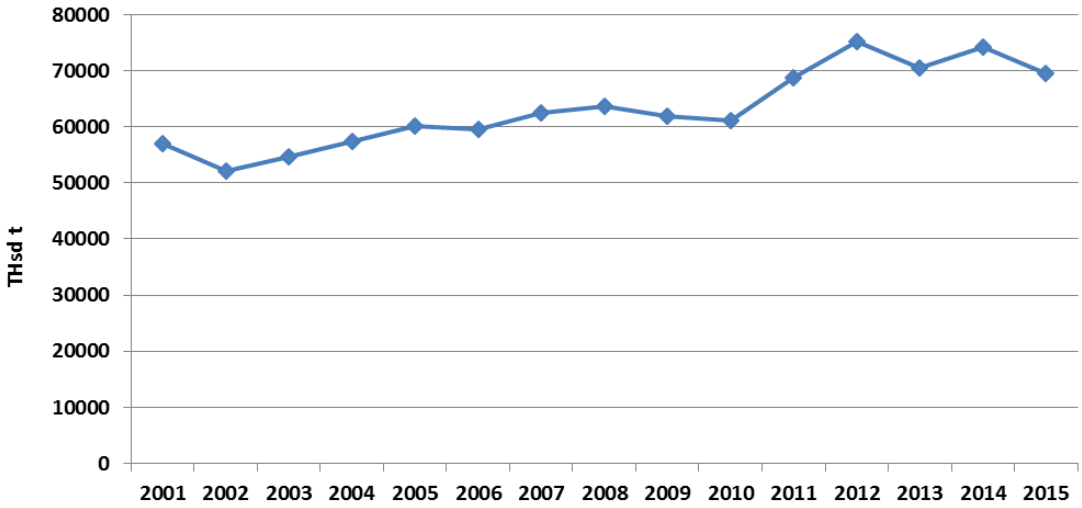

Figure 3.11 Loaded, unloaded cargo at ports in Latvia, thsd t

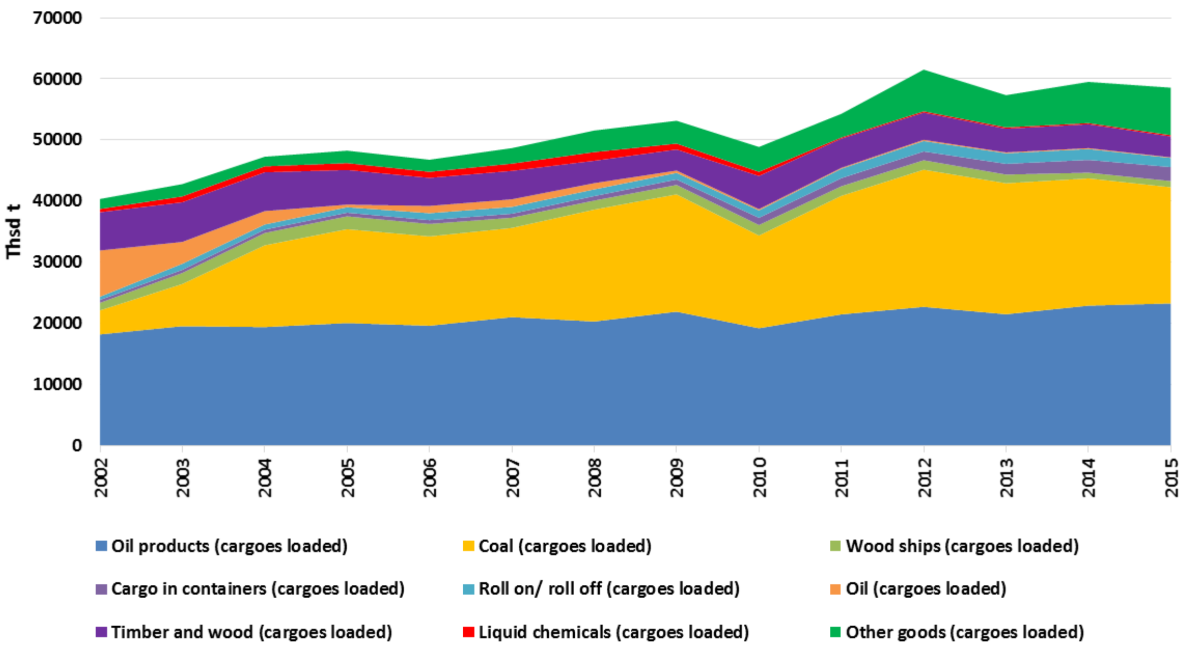

Figure 3.12 Structure of loaded goods at ports in Latvia, thsd t.

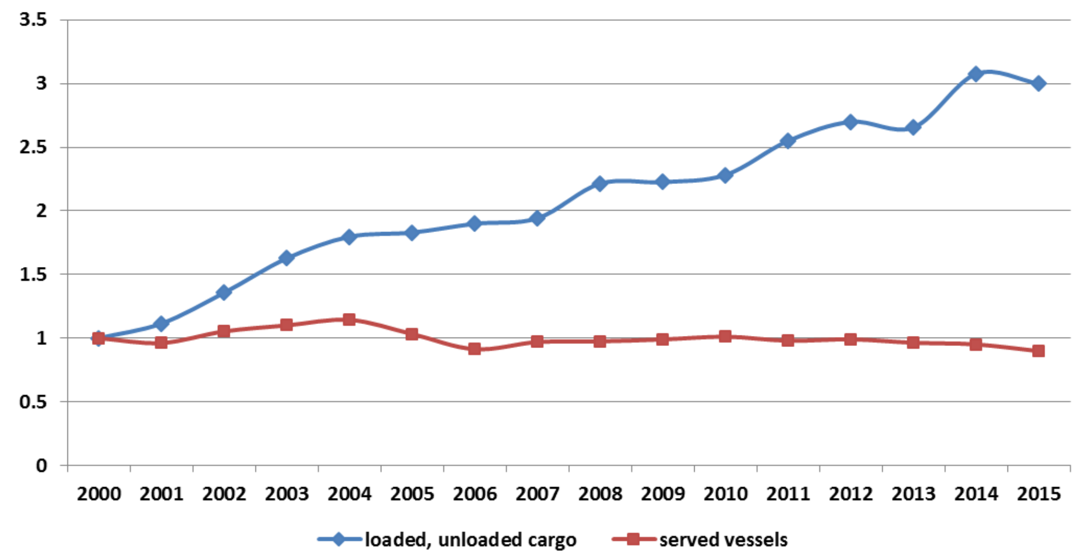

Figure 3.13 Loaded, unloaded cargo and served vessels at Riga port (2000 = 1)

The implemented emission factors for emission calculation from international navigation 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
	kt/PJ	kt /PJ	kt /PJ	kt /PJ	kt /PJ	kt /PJ
Diesel oil	74.0	0.004	0.03	1.8475	0.1742	0.0659
RFO	77.4	0.005	0.002	1.9532	0.1822	0.0665

The methodology used for calculation of emissions from international aviation corresponds to the 2006 IPCC Guidelines Tier 2 where the amount of LTO/cruises (landing and take-off) is crucial. Emissions from international navigation are calculated in pursuance with 2006 IPCC Guidelines 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 2006 IPCC Guidelines, while the remaining factors – from EMEP/EEA 2013 (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
2008-2015	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)
1990-1999	3.5	40.6	1.689
2000-2009	1.5	40.6	0.724
2010 - 2014	1.0	40.6	0.483
2015 - now	0.1	40.6	0.048

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

3.2.3.1 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, Coke, White spirits and Paraffin wax is reported in 1.D tables for all years in time series 1990–2015.

3.2.3.2 Methodological issues

Carbon emission factors used in 2006 IPCC Guidelines were taken for all fuel types – Bitumen (22 t/TJ), Lubricants (20 t/TJ), Coke (29.2 t/TJ), White spirits (20 t/TJ) and Paraffin waxes (20 t/TJ).

Activity data prepared by CSB and available on CSB on-line database were used (Table 3.14).

Table 3.14 Activity data for Feedstocks and Non-energy use of fuels in 1990–2015 (TJ)

	Bitumen	Lubricants	Coke	White spirits	Paraffin waxes
1990	1633	1586	290	84	NO
1991	544	1003	105	84	NO
1992	84	880	132	84	NO
1993	167	1047	211	84	NO
1994	544	965	264	84	NO
1995	712	926	211	84	NO
1996	879	927	211	84	NO
1997	1633	843	316	84	NO
1998	2051	969	290	126	NO
1999	2344	843	316	84	126
2000	2009	839	290	126	126
2001	1507	788	290	126	167
2002	2093	786	268	84	167
2003	2177	867	161	84	167
2004	2009	948	188	126	251
2005	2512	1029	188	126	335
2006	3098	1022	161	126	251
2007	3349	1013	107	84	251
2008	3600	976	134	84	209
2009	2218	565	134	42	293

	Bitumen	Lubricants	Coke	White spirits	Paraffin waxes
2010	1967	519	80	40	461
2011	2930	731	80	42	293
2012	2888	864	161	42	251
2013	3181	821	52	42	377
2014	2930	570	NO	42	335
2015	3349	953	NO	42	335

Constant increase of bitumen use since 2004 until 2008 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 2010 increase of bitumen use can be seen, it can be explained with increased financial resource to road paving. Lubricants are mainly used in transport sector and IPPU.

Coke is used as ingredient in metallurgy to produce higher quality steel. Evident decrease in coke use can be explained with changes in metallurgy. Financial crisis in 2010 and bankruptcy of "Liepājas metalurgs" is the reason of reduced metal production and use of coke. Therefore in last two years there has been no usage of coke.

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

3.2.4 Energy Industries (CRF 1.A.1)

3.2.4.1 Category description

CRF 1.A.1 Energy Industries sector includes emissions from fuel combustion in point sources in energy and heat production. According to 2006 IPCC Guidelines, emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) are assigned to the sector where they were generated and not under CRF 1.A.1.

Emissions from combustion installations with NACE 2 codes 35.11 and 35.30 are reported in CRF 1.A.1.a sector. There are no petroleum refineries in Latvia therefore in CRF 1.A.1.b notation key „NO" is used. CRF 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.

The GHG emissions were reported under following ones:

- 1. A.1. Energy industries:
- 1.A.1.a. Public electricity and heat production:
    - 1.A.1.a.i Electricity generation;
    - 1.A.1.a.ii Combined heat and power generation;
    - 1.A.1.a.iii Heat plants;
- 1.A.1.c. Manufacture of solid fuels and other energy industries:
    - 1.A.1.c.i Manufacture of solid fuels.

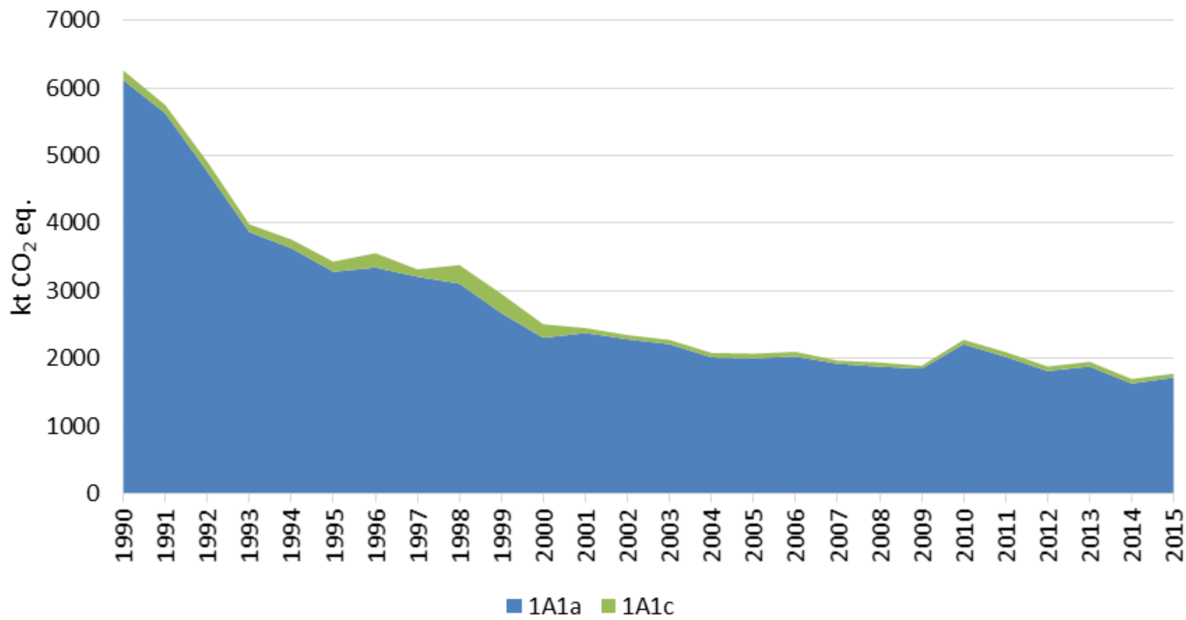

Figure 3.14 GHG emissions in CRF 1.A.1. Energy industries by subsectors (kt CO_2 eq.)

In Figure 3.14 there can be seen distribution of GHG emissions in CRF 1.A.1. sector. The largest part of emissions consists of CRF 1.A.1.a Public electricity and heat production (96.8% in 2015), while CRF 1.A.1.c Manufacture of solid fuels and Other energy industries contribute only 3.2% of Energy industry emissions. As mentioned above, there are no emissions in CRF 1.A.1.b Petroleum refining, therefore NO is used.

Table 3.15 Emissions from Energy industries (CRF 1.A.1) in 1990–2015 (kt)

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
1990	6248.76	0.19	0.038	6264.70	10.54	2.61	0.22	36.39
1991	5735.69	0.17	0.033	5749.94	9.65	2.56	0.21	29.52
1992	4899.56	0.15	0.031	4912.49	8.34	2.09	0.17	26.86
1993	3972.68	0.14	0.030	3984.94	7.07	1.48	0.13	28.30
1994	3747.40	0.15	0.032	3760.63	6.92	1.28	0.13	32.20
1995	3421.28	0.12	0.026	3432.12	6.25	1.39	0.12	22.83
1996	3544.23	0.15	0.030	3557.04	6.54	1.32	0.13	28.61
1997	3303.43	0.19	0.032	3317.69	6.10	1.70	0.14	19.66
1998	3364.73	0.21	0.035	3380.63	6.11	1.75	0.15	20.84
1999	2941.47	0.19	0.030	2955.21	5.24	1.61	0.13	16.02
2000	2492.11	0.15	0.024	2503.18	4.40	1.56	0.12	7.64
2001	2437.06	0.17	0.025	2448.63	4.37	1.75	0.13	5.51
2002	2332.07	0.18	0.026	2344.24	4.23	1.75	0.13	5.22
2003	2259.86	0.20	0.028	2273.20	4.15	1.86	0.14	3.89
2004	2068.41	0.20	0.026	2081.23	3.78	1.78	0.13	2.28
2005	2058.22	0.17	0.023	2069.32	3.70	1.73	0.12	1.61
2006	2084.74	0.19	0.025	2096.85	3.77	1.85	0.13	0.92
2007	1954.92	0.19	0.024	1966.85	3.57	1.74	0.12	1.06
2008	1927.30	0.18	0.024	1938.92	3.51	1.73	0.12	0.67
2009	1877.32	0.18	0.024	1889.04	3.44	1.68	0.12	0.78
2010	2261.12	0.20	0.027	2274.14	4.10	2.02	0.14	0.69
2011	2082.02	0.19	0.025	2094.08	3.81	1.87	0.13	0.63

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
2012	1864.68	0.22	0.029	1878.61	3.62	1.85	0.13	0.63
2013	1928.36	0.32	0.043	1949.08	4.07	2.25	0.16	0.65
2014	1669.76	0.38	0.050	1694.15	3.82	2.29	0.17	0.60
2015	1746.21	0.41	0.054	1772.76	4.06	2.46	0.18	0.63
Share of Energy total, 2015	26.1%	3.7%	11.1%	24.9%	13.5%	2.0%	0.9%	17.8%
2015 vs 2014	4.6	9.0	8.8	4.6	6.3	7.4	7.6	5.0
2015 vs 1990	-72.1	119.4	44.4	-71.7	-61.5	-6.0	-17.1	-98.3

CO_2 emissions from CRF 1.A.1 sector have a decreasing trend with a few fluctuations from which the most recent were in 2010 (Table 3.15). Since 1990, CO_2 emissions have decreased by 72.1%. In the beginning of the 90's the decrease of CO_2 emissions is explained with economic crisis caused by changes of political and social situation in the country when national economy was completely reorganized. Decrease of emissions can be explained with higher standards of physical specification of fuels and switching to fuels with lower costs and emissions – natural gas and biomass. In recent years, an increase of CO_2 emissions in 2010 can be explained with extremely cold winter, and the decrease in 2011 – with much warmer one, which influenced the amounts of fuel used for heating. Since 2010 up to year 2015, the emissions of CO_2 have decreased by 22.8%. 4.6% increase in 2015 in comparison with 2014 can be explained with changes in used fuel.

In CH_4 and N_2O emissions there can be seen an increase in recent years, starting from 2011, due to increased use of liquid, solid and biomass fuel consumption. Since 2011 up to year 2015 the increase in CH_4 and N_2O emissions was 120.1% and 120.3%, respectively. If compared with small increase of CO_2 emissions, the increase in CH_4 and N_2O emissions is larger because of biomass use – as it is considered as CO_2 neutral, it does not take place in CO_2 balance, however, biomass combustion is accounted for CH_4 and N_2O emissions.

Indirect GHG emissions from CRF 1.A.1 Energy Industries were estimated as well. SO_2 had the biggest decrease by 98.3% in 1990–2015. It can be explained with fuel switching from coal, peat and heavy fuel oils to natural gas and biomass from what sulphur dioxide emissions are emitted in considerably smaller amounts. Also a strict national legislation was approved to improve the quality of used liquid fuels in country. NO_x emissions have also decreased by 61.5% in 1990-2015, NMVOC emissions – by 17.1%, and CO emissions – by 6.0%. The decrease can also be explained with fuel switch from solid to natural gas and biomass, which have lower emission factors.

3.2.4.2 Methodological issues

2006 IPCC Guidelines' 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, for some fuels country-specific emission factors is not available, therefore 2006 IPCC Tier 1 method using default emission factors was used. 2006 IPCC Guidelines' Tier 1 method was used to calculate CH_4 and N_2O emissions from the CRF 1.A.1 sector.

As sludge gas consists approximately 35-44% of non-combustible components such as CO_2 sulphur and others and 56-65% of sludge gas is combustible, methane emissions from biogas were 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 methane is obtained from sludge it is considered as biomass combustion, hence CO_2 neutral. Therefore Tier 2 method from 2006 IPCC Guidelines 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. The general method for emission data preparation was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (kt)
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 2005-2015 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, therefore these data are plant specific. Other indirect GHGs (CO, NMVOC) are calculated using Tier 1 method.

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;
- 2006 IPCC Guidelines;
- EMEP/EEA 2016.

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. 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 A.3.2). 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 (Annex A.3.2) was used:

$$EF_{CO_2} = \frac{C^d \times M_{CO_2} \times 1000}{Q_d^z \times M_C \times 100}$$

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

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, GJ/t	Emission factor (EF CO_2), t/TJ
Peat W_d=40%	29.07	10.05	105.986
Motor gasoline (for off-roads)	83.13	44 (1990-2002)	69.227
		43.97 (2003-2015)	69.274
Diesel oil	86.68	42.49	74.748
RFO	85.72	40,6	77.362
Shale oil	82.82	39.35	77.119
LPG	77.99	45.54	62.750
Jet fuel	85.18	43.2 (1990-2002)	72.248
		43.21 (2003-2015)	72.231
Other kerosene	85.17	43.2 (1990-2000)	72.239
		43.21 (2004)	72.223
		43.2 (2005-2015)	72.239
Other Oil Products	83.77	41.86	73.326
Wood Wd = 55%	20.11	6.7	109.978

For some fuels default CO_2 emission factors from 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.2, were taken due to unavailability of country specific data:

- coal – 94.6ktg/PJ;
- coke – 107 kt/PJ;
- peat briquettes – 97.5 kt/PJ;
- biodiesel – 70.8 kt/PJ;
- straws – 100 kt/PJ;
- waste oils – 73.3 kt/PJ.

<u>Natural gas</u>

For calculating CO_2 emission factor for natural gas following equation (Annex A.3.2) was used:

$$EF_{CO_2} = \frac{C^d \times M_{CO_2}}{M_C \times 100} \times \rho$$

where:
EF_{CO2} – emission factor for CO_2 (t/1000m^3)
C^d – carbon content in fuel (%)
M_{CO2} – molecule weight for CO_2 – 44.0098 (g/mcl)
Mc – molecule weight for C – 12.011 (g/mcl)
ρ – natural gas density – for transition from density to mass units (t/1000m^3)

Data of carbon content and natural gas density for 1990-2015 were obtained from only natural gas supplier JSC "Latvijas Gāze" that collects/measures these data by themselves (Table 3.17). NCV values to calculate data further in energy units were taken from CSB.

Table 3.17 Characteristics of natural gas and estimated CO_2 emission factors

	Carbon content in working mass of fuel, (C_d)	Natural gas density, (ρ)	Emission factor, (EF CO_2)	Net calorific value, (NCV)
	%	$t/1000m^3$	$t/1000m^3$	$GJ/1000\ m^3$
1990	74.33	0.687	1.8703	33.93
1991	74.33	0.687	1.8703	33.93
1992	74.36	0.692	1.8863	33.60
1993	74.15	0.697	1.8924	33.70
1994	74.04	0.691	1.8757	33.68
1995	74.26	0.689	1.8745	33.71
1996	74.30	0.686	1.8673	33.29
1997	74.39	0.685	1.8658	33.29
1998	74.35	0.686	1.8680	33.29
1999	74.31	0.684	1.8627	33.28
2000	74.32	0.688	1.8733	33.65
2001	74.36	0.688	1.8735	33.71
2002	74.36	0.686	1.8686	33.61
2003	74.38	0.685	1.8672	33.63
2004	74.39	0.684	1.8641	33.54
2005	74.40	0.684	1.8633	33.54
2006	74.39	0.684	1.8639	33.53
2007	74.38	0.683	1.8609	33.48
2008	74.38	0.683	1.8622	33.53
2009	74.41	0.686	1.8704	33.62
2010	74.42	0.686	1.8693	33.67
2011	74.43	0.686	1.8698	33.69
2012	74.31	0.686	1.8665	33.69
2013	74.34	0.688	1.8751	34.41
2014	74.36	0.692	1.8857	34.57
2015	74.41	0.697	1.9009	34.80

Landfill gas

There were five landfills in Latvia that collect biogas from landfills – first data about biogas combustion in landfill is collected in 2002. Second landfill started to combust biogas from 2003 third from 2004. Fourth landfill started to combust biogas with energy recovery only in 2008, but fifth – in 2013. Also one landfill have stopped producing landfill gas since 2014.

As landfills were not able to provide information of carbon content percentage in working mass of fuel constant methane value was used instead and was estimated basing on molar mass of components. Following equation (Annex A.3.2) 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, an equation basically the same as for natural gas was used, although methane carbon content, density and NCV from scientific literature was used[17] (Table 3.18). The same assumption refers to other biogas.

$$EF_{CO_2} = \frac{C^d \times M_{CO_2} \times 1000}{Q_d^z \times M_C \times 100} \times \rho$$

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

Table 3.18 Characteristics of methane obtained from landfill gas and estimated CO_2 emission factors

Amount of methane in landfill gas (%)	Default carbon content in working mass of methane (C^d) %	NCV of methane (Q_z^d) TJ/1000m^3	Density (ρ) t/1000m^3	Emission factor (EF CO_2) kg/GJ
50%	74.867543%	35.88	0.6687	51.1261

Sludge gas

The CO_2 emission factor estimated below is estimated for pure methane that is obtained from collected sludge gas. Since 2008 there is only one enterprise that is burning Sludge gas.

As wastewater treatment plant was not able to provide the information of carbon content percentage in working mass of fuel constant carbon content in methane was used estimated on moll mass of components. Following equation was used for calculations:

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

where:
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 the same equation as for natural gas was used. NCV numbers of methane obtained from sludge gas

[17] http://dolgikh.com/index/0-31

that is combusted with energy recovery for all years are obtained from wastewater treatment plant (Table 3.19).

Table 3.19 Characteristics of methane obtained from sludge gas and estimated CO_2 emission factors

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	Density (ρ) t/1000m^3	Emission factor (EF CO_2) kg/GJ
56-65%	74.867543%	35.88	0.6687	51.1261

SO_2 emission factors

SO_2 emissions factors were calculated by equation taken from EMEP/EEA 2016 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 A.3.1).

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 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.2.

Emission factors for NO_x, NMVOC and CO were taken from EMEP/EEA 2016, 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 2015 Submission are listed in Table 3.20 below.

Table 3.20 CH_4, N_2O, NOx, CO, NMVOC emission factors used in CRF 1.A.1. Energy Industries (kt/PJ)

	CH_4	N_2O	NO_x	NMVOC	CO
Diesel oil	0.003	0.0006	0.065	0.0008	0.0162
RFO	0.003	0.0006	0.142	0.0023	0.0151
LPG	0.001	0.0001	0.089	0.0026	0.039
Jet fuel	0.003	0.0006	0.065	0.0008	0.0162
Other kerosene	0.003	0.0006	0.065	0.0008	0.0162
Other liquid	0.003	0.0006	0.065	0.0008	0.0162
Shale oil	0.003	0.0006	0.065	0.0008	0.0162

	CH_4	N_2O	NO_x	NMVOC	CO
Coal	0.001	0.0015	0.209	0.001	0.0087
Coke	0.001	0.0015	0.209	0.001	0.0087
Peat briquettes	0.001	0.0015	0.247	0.0014	0.0087
Peat	0.001	0.0015	0.247	0.0014	0.0087
Natural gas	0.001	0.0001	0.089	0.0026	0.039
Wood	0.030	0.0040	0.081	0.00731	0.09
CH_4 from sludge gas	0.001	0.0001	0.089	0.0026	0.039
Landfill gas	0.001	0.0001	0.089	0.0026	0.039
Other biogas	0.001	0.0001	0.089	0.0026	0.039
Biodiesel	0.003	0.0006	0.065	0.0008	0.0162
Straws	0.030	0.0040	0.081	0.00731	0.09
Waste oils	0.030	0.0040	0.065	0.0008	0.0162

Activity data

Mainly emissions from fuel combustion are calculated using fuel consumption data from the CSB Energy Balance, prepared by CSB. In previous submissions the Annual Questionnaires sent to EUROSTAT were used, but after an internal third party review in 2014 an expert's conclusion was to use CSB Energy Balance, if possible, to ensure more precise data. As in the EUROSTAT tables fuel consumption mainly is in natural units (kt, millions m^3) therefore net calorific values provided by CSB were used to calculate fuel consumption into terajoules. However, there were differences between Annual Questionnaires' and CSB Energy Balance data due to rounding and conversion of units therefore it was decided to use CSB Energy Balance data with accuracy up to 1 TJ (instead of Annual Questionnaire accuracy 1 kt). Data on fuel consumption in CRF 1.A.1 sector are presented in Annex A.3.1 , Table 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 6000 enterprises and organizations (with all kind of economic activity) that are included in the lists of suppliers of statistical information.

Approximately 6000 respondents were surveyed - all enterprises of the local and public administration employing 10 or more persons, other enterprises employing 80 and more persons, as well as enterprises with turnovers equal or more than 4 mln euro, and other enterprises that CSB considers to be significant enough to include in the CSB Energy Balance, for example, with large imports of briquettes, coal and oil products. Enterprises and organizations that are not included in the above mentioned selection 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.

The amounts of methane from landfill gas combusted are taken from Waste sector expert, therefore are consistent with numbers of recovered amounts of landfill gas in Waste sector. The amounts of methane from sludge gas combusted are given by only Sludge gas combustion enterprise and they are consistent with numbers of gas, recovered from Wastewater handling sector.

In Figure 3.15 there can be seen fuel consumption by fuel types in 1990-2015 in Energy Industries sector. The largest amounts of fuel types consumed are gaseous fuels in the whole time series and liquid fuels in the beginning of 1990s. The amounts of biomass consumed are slightly increasing, while the consumption of solid fuels and peat has sharply decreased.

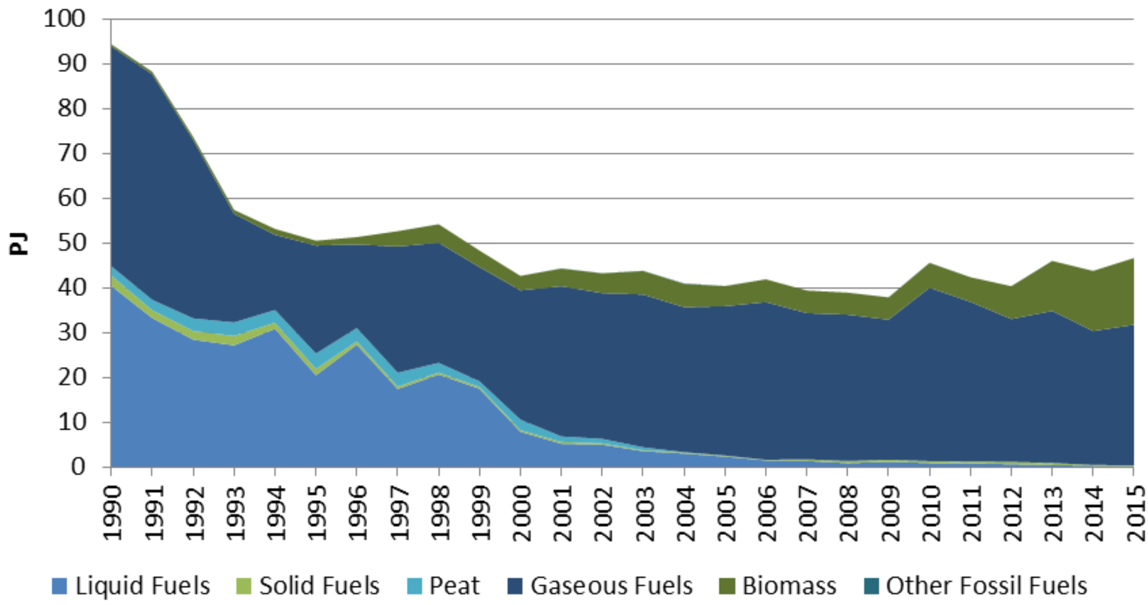

Figure 3.15 Fuel consumption in Energy Industries (CRF 1.A.1) for 1990-2015 (PJ)

The biggest decrease in time period 1990–2015 for the two sub-sectors of 1.A.1 Energy industries sector was for liquid fuel by 99.3% due to changes in technology. It is explained with fuel switching processes when liquid fuels were switched to cheaper fuels. Also a 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 2007-2013 the consumption of solid fuels increased that is explained with the increase of coal consumption in CRF 1.A.1.a subsector. 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, diesel oil and natural gas. In 2014-2015 decrease of solid fuels continues (-40.0%) as well as decrease in liquid fuel usage (-11.3%).

Consumption of biomass fuel has significantly increased in 1990–2015 almost 33 times. Solid biomass is a local fuel and has lower costs therefore liquid and solid fuels were replaced with biomass and natural gas. And due to its CO_2 neutrality, enterprises switched from fossil fuels to biomass.

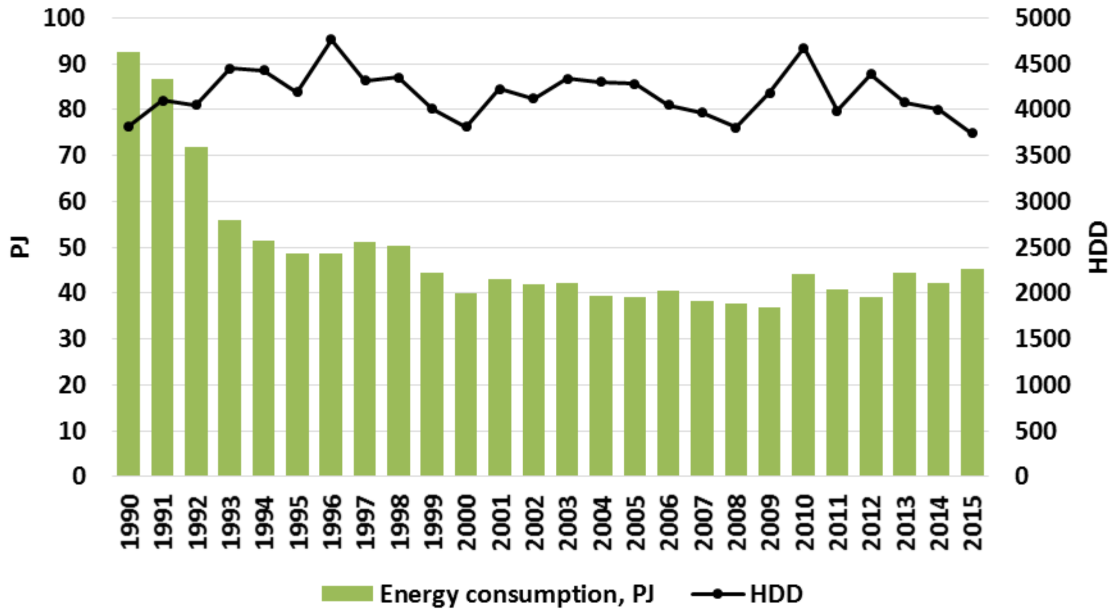

Figure 3.16 Fuel consumption in Main activity electricity and heat production (CRF 1.A.1.a) and heating degree days in Latvia

As it can be seen in Figure 3.16 the fuel consumption in 1.A.1.a sector can be related with the heating degree days with an exception of 1990s when Soviet Union collapsed and reorganizations took place in Latvia. However, for time period from 1997 to 2002 there can be seen that in years where energy consumption reduced, the HDD were also reduced. Years 2006-2008 had quite high average temperature therefore the fuel consumption of combined heat plants and heat plants for heat production decreased as there was limited need for heat production. 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 (hence the decrease in HDDs), which could be explained with better heat insulation in houses therefore less heat needed to be produced. In 2013 the fuel consumption increased, however, HDD were less than in 2012, while in 2014 it decreased, although the number of HDDs decreased. In 2015 HDDs decreased by 6.6% but fuel consumption increased, it could be explained with changes in technologies, when enterprises switches from heat plants to combined heat and power plants.

3.2.4.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty in activity data of fuel combustion in 1.A.1 sector is ±2% in 2015. 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 and peat combustion was assigned as 5% because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass. Also, according to 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19, biomass data are generally more uncertain than other data in national energy statistics, because a large fraction of the biomass may be part of the informal economy, and the trade in these types of fuels is frequently not registered in the national energy statistics and balances. That was a reason for higher uncertainty for biomass than for other fuel types. Uncertainty of sludge gas 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, therefore final uncertainty of combusted sludge gas is assumed as 5%. The same applies to landfill gas.

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, hence the uncertainty for liquid fuels was assigned as quite low – about 10%. As emission factors for solid fuels were taken from 2006 IPCC Guidelines, the uncertainty was assumed 20%. Emission factor uncertainty for peat and peat briquettes was assumed 10% because peat emission factor is country specific. CO_2 emission factor for natural gas was assumed rather low – as 5% because annual plant specific fuel data is used to estimate emission factor.

CH_4 and N_2O emission factors used in estimation of emissions were taken according to 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.12., which provides the range of default values for uncertainties. The uncertainty both for CH_4 and N_2O EFs of 50% was assigned similarly as in previous submissions – 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. Emissions from all sectors are estimated or reported as not occurring / not applicable, therefore there are no "not estimated" sectors.

3.2.4.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the Energy sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

All documentation and information received for inventory purposes are archived in FTP folder. All findings are documented by using check-lists, available on Regulations of the Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units".

Activity data verification

All sources of energy data are presented in the corresponding NIR chapter (3.2.4.2 Methodological issues) as well as disaggregated data at the finest level possible are presented in the corresponding Annex A.3.1. Data completeness has been explained in the previous subchapter.

Activity data have been checked at the data provider – Central Statistical Bureau, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data have been received, the sectoral expert responsible for the emission estimation and reporting are comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

All activity data used in Sectoral Approach are also compared with activity data used in Reference Approach estimations. All significant differences (±5%) are explained in the corresponding subchapter.

Emission factor verification

For country-specific CO_2 emission factors, the sources of the calorific values, carbon content and oxidation factors, as well as these values are provided in 3.2.4.2 Methodological issues.

Country specific CO_2 values for year are compared with default ones available on 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.2. Whether country specific CO_2 emission factor is or is not in the confidence interval can be seen in Table 3.21.

Table 3.21 Comparison of country specific and 2006 IPCC default CO_2 emission factor values (kt/PJ)

	Lower	CS	Upper
Gasoline	67.50	71.18	73.00
Diesel oil	72.60	74.74	74.80
RFO	75.50	77.36	78.80
LPG	61.60	62.75	65.60
Jet fuel	69.70	72.23	74.40
Other kerosene	70.80	72.24	73.70
Other liquid	72.20	72.59	74.40
Shale oil	67.80	77.12	79.20
Peat	100.00	105.99	108.00
Natural gas	54.30	54.63	58.30
Wood	95.00	109.98	132.00
Sludge gas	46.20	51.13	66.00
Landfill gas	46.20	51.13	66.00
Other biogas	46.20	51.13	66.00

All country specific values incorporate in 2006 IPCC default CO_2 lower and upper emission factor values.

Emission verification:

To verify the CO_2 emissions, logical mistakes are checked 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. The emissions for indirect GHGs in the database are cross-checked with emissions reported within Convention on Long-range Transboundary Air Pollution (CLRTAP) for verification purposes.

CO_2 emissions are compared with emissions in Reference Approach estimations, and all significant differences (±5%) are explained in the corresponding subchapter.

3.2.4.5 Category-specific recalculations

Recalculations have been done in CRF 1.A.1 sector due to activity data corrections:

- 1.A.1.a.iii Peat in 1990;
- 1.A.1.a.ii Landfill gas in 2013;
- 1.A.1.a.ii Landfill gas in 2014.

For SO_2 EFs have been revised in every stationary combustion sector.

3.2.4.6 Category-specific planned improvements

It is planned to update CO_2 EFs for most widely used fuels in Latvia.

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

3.2.5.1 Category description

CRF 1.A.2 Manufacturing industries and construction sector includes 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 pr oduction facilities (autoproducers) – these emissions are reported under particular sub-sectors of CRF 1.A.2 according to 2006 IPCC Guidelines.

According to 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.1., emissions arising from off-road and other mobile machinery in industry should be broken out as a separate subcategory. These emissions are calculated together from all gasoline use in particular subsectors (Chemicals, Wood and wood products, Construction) within CRF 1.A.2. It also ensures the consistency between CLRTAP and UNFCCC data.

CRF 1.A.2 Manufacturing industries are split into subsectors which are in line with 2006 IPCC Guidelines/CRF Reporter structure:

- 1.A.2.a Iron and steel;
- 1.A.2.b Non-ferrous metals;
- 1.A.2.c Chemicals;
- 1.A.2.d Pulp, paper and print;
- 1.A.2.e Food processing, beverages and tobacco;
- 1.A.2.f Non-metallic minerals;
- 1.A.2.g Other:
  - 1.A.2.g.i Manufacturing of machinery;
  - 1.A.2.g.ii Manufacturing of transport equipment;
  - 1.A.2.g.iii Mining (excluding fuels) and quarrying;
  - 1.A.2.g.iv Wood and wood products;
  - 1.A.2.g.v Construction;
  - 1.A.2.g.vi Textile and leather;
  - 1.A.2.g.vii Off-road vehicles and other machinery;
  - 1.A.2.g.viii Other.

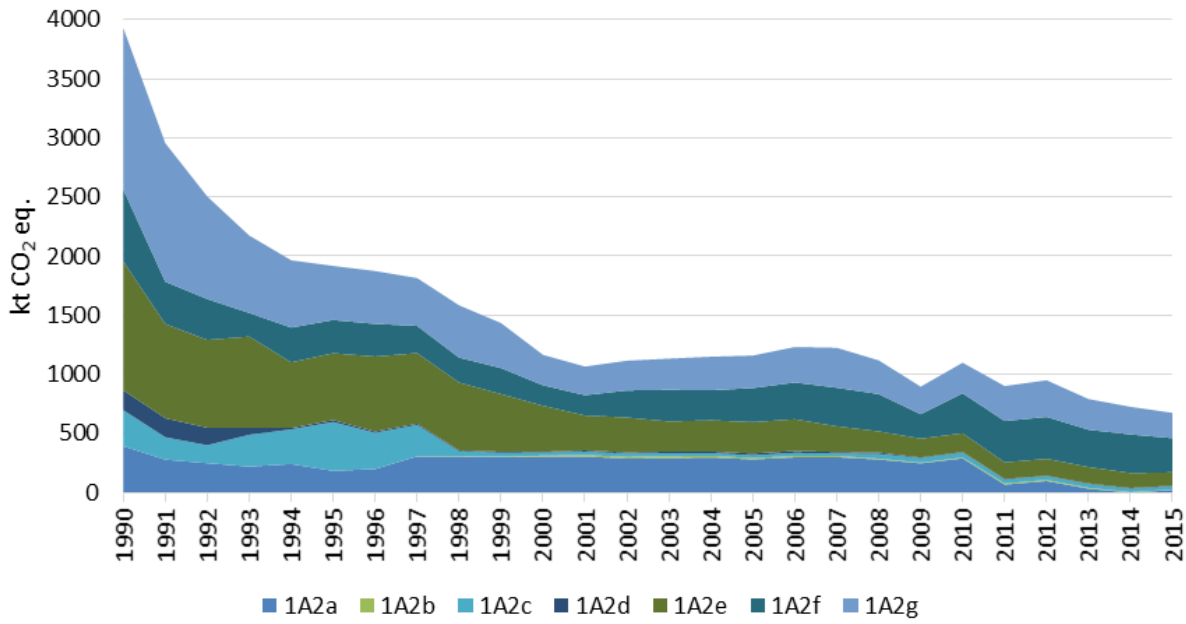

Figure 3.17 GHG emissions in CRF 1.A.2. Manufacturing industries and Construction by subsectors (kt CO_2 eq.)

In Figure 3.17, there can be seen the distribution of GHG emissions in CRF 1.A.2 sector. The largest part of emissions contributes to CRF 1.A.2.f Non-metallic minerals (42.8% in 2015) and CRF 1.A.2.g Other (31.8% in 2015), where emissions from Machinery, Transport equipment, Mining and quarrying, Wood processing, Construction, Textiles, Offroads and Other products are produced. In CRF 1.A.2.e Food processing, beverages and tobacco 16.6% of 1.A.2 GHG emissions are produced in 2015. Such sectors as CRF 1.A.2.a Iron and Steel, 1.A.2.b Non-ferrous metals, 1.A.2.c Chemicals. 1.A.2.d Pulp, Paper and Print contributes to 3.3%, 0.5%, 4.1% and 0.8% from total 1.A.2 GHG emissions in 2015, accordingly.

Table 3.22 Emissions from Manufacturing industries and construction (CRF 1.A.2) in 1990–2015 (kt)

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
1990	3913.61	0.23	0.029	3928.21	17.58	19.16	3.08	24.33
1991	2946.73	0.13	0.019	2955.41	12.29	6.86	1.66	15.12
1992	2496.76	0.11	0.016	2504.53	10.47	6.61	1.50	13.96
1993	2164.25	0.15	0.021	2174.30	10.03	7.68	1.74	14.44
1994	1955.31	0.15	0.022	1965.39	9.59	6.12	1.61	15.67
1995	1907.37	0.14	0.022	1917.39	9.61	4.12	1.50	15.08
1996	1863.83	0.15	0.022	1874.34	9.35	5.63	1.70	14.68
1997	1804.04	0.15	0.022	1814.42	9.15	4.79	1.62	14.25
1998	1573.19	0.15	0.022	1583.64	7.65	4.80	1.68	11.02
1999	1423.72	0.15	0.021	1433.72	6.83	3.96	1.57	9.10
2000	1157.22	0.12	0.017	1165.43	4.87	3.29	1.35	4.70
2001	1055.88	0.16	0.022	1066.49	3.77	3.83	1.71	2.55
2002	1105.24	0.16	0.022	1115.71	3.62	3.99	1.65	2.07
2003	1123.83	0.15	0.020	1133.52	3.69	3.54	1.58	1.86
2004	1137.28	0.19	0.026	1149.72	3.73	5.05	2.08	1.42
2005	1144.07	0.23	0.031	1159.00	3.49	6.16	2.34	1.56
2006	1215.46	0.25	0.033	1231.45	3.92	7.09	2.64	1.79

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
2007	1210.78	0.22	0.029	1225.02	3.77	7.00	2.35	1.72
2008	1103.76	0.23	0.031	1118.91	3.38	7.18	2.43	1.37
2009	877.11	0.30	0.040	896.48	3.04	6.86	3.02	1.05
2010	1074.68	0.37	0.049	1098.45	3.20	7.12	3.35	0.99
2011	873.66	0.43	0.058	901.75	2.74	7.81	3.69	0.81
2012	918.14	0.49	0.066	949.99	3.06	8.89	4.24	0.94
2013	758.95	0.50	0.067	791.40	2.88	9.00	4.36	0.83
2014	688.69	0.57	0.075	725.29	2.82	10.03	4.88	0.90
2015	638.36	0.56	0.07	674.73	2.69	10.06	4.93	0.84
Share of Energy total, 2015	9.5%	5.1%	15.4%	9.5%	8.9%	8.1%	23.4%	23.4%
2015 vs 2014	-7.3%	-0.5%	-0.7%	-7.0%	-4.6%	0.3%	0.9%	-6.9%
2015 vs 1990	-83.7%	141.1%	154.4%	-82.8%	-84.7%	-47.5%	60.0%	-96.6%

Emissions from CRF 1.A.2 significantly decreased in 1990 to 2001, which can be explained with recession of Soviet Union and following reformations and reorganizations within Latvia after that. Since 2001, the emissions started to increase until 2006, because of development in national economy and industry, as well as growing demand of industrial production and increasing welfare of inhabitants (Table 3.22). Growth in GHG emissions in the given time period were caused by increased amounts of coal and natural gas consumed. Decrease of emissions in 2006-2008 were influenced by the features of national economy development when in-country industrial production already started to diminish due to increasing costs of the production and dominance of imported products. Crisis in national economy in the second part of 2008 also caused a significant decrease in total emissions. The increasing amounts of solid biomass consumption also caused a drop in CO_2 emissions. The crisis in national economy caused by global financial crisis in 2008-2009 influenced quite significant decrease of GHG emissions by 21%. The crisis and development of EU ETS influenced biomass consumption for 2008-2009 in 1.A.2 sector – its amounts were growing, while amounts of almost all other fuels decreased. In 2010-2015 the emissions are fluctuating mainly due to reconstructions in 2011-2012 in the largest steel producer "Liepājas Metalurgs". As it replaced its furnace to electric one, the emissions decreased, however, in 2013 due to several reasons it initiated bankruptcy, therefore the amounts of production decreased significantly afterwards. From 2012-2015 CO2 emissions have constantly decreased due to the changes in industry. Now 1.A.2 produces 9.5% of total GHG emissions in Energy sector, and emissions in this sector have decreased by 82.8% in comparison with 1990.

Due to the essential increase of biomass consumption non-CO_2 emissions increased in 2009-2015: CH_4 emissions increased by 88.3%, while N_2O emissions increased by 87.5%.

Also indirect GHG emissions from CRF 1.A.2 sector were estimated. In this sector almost all indirect emissions have decreased: NO_x emissions have decreased by 84.7%, CO emissions – by 47.5%, and SO_2 emissions have a decrease by 96.6% in 1990–2015. The decrease in emissions is explained with fuel switching to natural gas and biomass from what sulphur dioxide emissions are not emitted, and there are less NOx and CO emissions from these fuels comparing with solid and liquid fuels. However, NMVOC emissions have an increasing trend and have increased by 60.0% since 1990 due to very high emission factors for biomass compared to other fuels.

3.2.5.2 Methodological issues

Methods

2006 IPCC Guidelines' 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, for some fuels there are no country-specific emission factors, therefore 2006 IPCC Tier 1 method using default emission factors was used. To calculate CO_2 emissions from Industrial and Municipal wastes plant specific values was used. 2006 IPCC Guidelines' Tier 1 method was used to calculate CH_4 and N_2O emissions from the CRF 1.A.2 sector.

Calculation of all emissions from fuel combustion is done with Excel databases developed by the experts from LEGMC.

The general method for emission data preparation was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (kt)
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;
- EU ETS reports (for used tires and municipal waste);
- IPCC 2006 Guidelines;
- EMEP/EEA 2016.

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 CRF 1.A.2 Manufacturing Industries and Construction sector are estimated with the same equations and using the same method as for CRF 1.A.1 Energy industries sector with the exception for industrial waste and municipal waste that are not combusted in CRF 1.A.1 sector.

For some fuels default CO_2 emission factors from 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.3, were taken due to unavailability of country specific data:

- other liquid fuels – 73.3 kt/PJ;
- coal – 94.6 kt/PJ;
- coke – 107 kt/PJ;
- anthracite – 98.3 kt/PJ;
- oil shale – 107 kt/PJ;
- petroleum coke – 97.5 kt/PJ
- peat briquettes – 97.5 kt/PJ;
- biodiesel – 70.8 kt/PJ;

- straws – 100 kt/PJ;
- waste oils – 73.3 kt/PJ.

Municipal waste

CO_2 emission factors of municipal waste combusted in cement production plants are taken from plant's annual GHG report within EU ETS for 2008-2015. This CO_2 emission factors are 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. 2006 IPCC Guidelines state to separate non-biomass and biomass parts of the municipal waste. It has been done in Submission 2017 as follows: CO_2 emissions to be reported to EU ETS have been taken from 2008-2015 for non-biomass part, because for EU ETS only non-biomass CO_2 emissions have to be reported. The emission factors given in the reports are for whole emissions and it is possible to calculate the emission factor for non-biomass fraction. The emission factors for total CO_2 emissions and for non-biomass fraction are provided in Table 3.23.

Table 3.23 CO_2 emission factors, carbon content and NCV for municipal waste by waste types (kt/PJ)

	2008	2009	2010	2011	2012	2013	2014	2015
	Total CO_2 EF, kt/PJ							
Ecofuel 1	85.19	82.81					86.41	88.85
Ecofuel 2		120.95	82.69	113.22	95.24	85.98	88.52	88.22
	Fossil CO_2 EF, kt/PJ							
Ecofuel 1	44.16	43.03					38.52	42.32
Ecofuel 2		71.01	35.11	27.99	32.42	38.69	44.97	45.23
	C content, %							
Ecofuel 1	23.25	22.60					24.16	24.08
Ecofuel 2		33.01	22.57	30.90	25.99	23.46	23.58	24.25
	NCV, TJ/kt							
Ecofuel 1	22.78	23.51					19.35	20.21
Ecofuel 2		17.42	19.59	18.23	16.85	17.61	31.46	31.34
	Biomass content, %							
Ecofuel 1	48.16%	48.04%					55.42%	52.36%
Ecofuel 2		41.29%	57.54%	75.28%	65.96%	55.00%	49.20%	48.73%

For estimating biomass emissions the following equation was used:

$$E_{biomass} = E_{total} - E_{non-biomass}$$

where:

$E_{biomass}$ – CO_2 emissions from biomass fraction (kt)

E_{total} – total CO_2 emissions (kt)

$E_{non-biomass}$ - CO_2 emissions from biomass fraction (kt)

The calculated results for total CO_2 emissions from municipal waste, as well as from biomass and non-biomass fraction can be found in Table 3.24.

Table 3.24 CO_2 emissions from municipal waste non-biomass and biomass fractions by waste types in 2008-2015

	2008	2009	2010	2011	2012	2013	2014	2015
	Fossil CO_2 emissions, Mg							
Ecofuel 1	6856.00	2284.54					77068.70	83051.40
Ecofuel 2		304.63	26440.00	37606.00	54948.00	60808.06	2033.80	1007.60
	Biomass CO_2 emissions, Mg							
Ecofuel 1	6369.75	2112.17					95800.85	91295.39
Ecofuel 2		214.25	35835.33	114499.41	106457.61	74320.97	1969.83	957.55
	Total CO_2 emissions, Mg							
Ecofuel 1	13225.75	4396.71					172869.50	174346.80
Ecofuel 2		518.88	62275.33	152105.41	161405.61	135129.03	4003.63	1965.15

<u>Industrial waste</u>

Emission factors for CO_2 emission estimation for industrial waste – used tires, neutralised polluted soil, waste wood, fluffy tyre, wood processing residues and shredded rubber – combusted in CRF 1.A.2.f Non-metallic minerals (cement production) for years 1999–2015 are taken from GHG emission reports that plant submitted under ETS (Table 3.25). These CO_2 emission factors are 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. Also for this fuel type biomass and non-biomass emissions have been calculated, as this fuel contains biomass.

Table 3.25 CO_2 emission factors, carbon content and NCV for industrial waste

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Total CO_2 EF, kt/PJ																
Used tyres	79.44	79.44	79.44	79.44	79.44	79.44	79.44	79.44	79.44	85.00	85.00	85.00	85.00	85.00	85.00	85.00	85.00
NPS														79.43	80.60	85.03	72.90
Waste wood												117.6					
Fluffy tyres													81.13	81.13	87.01		
Wood processing residues													135.3	130.4			
Shredded rubber															81.13		
	Fossil CO_2 EF, kt/PJ																
Used tyres	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90	60.90
NPS														66.31	56.42	60.03	59.71
Waste wood												15.88					
Fluffy tyres													27.01	17.93	30.45		
Wood processing residues													37.58	41.47			
Shredded rubber															41.22		
	C content, %																
Used tyres	23.05	23.05	23.05	23.05	23.05	23.05	21.68	21.68	21.68	23.20	23.20	23.20	23.20	23.20	23.20	23.20	23.20
NPS														21.68	22.00	23.21	19.90
Waste wood												32.10					
Fluffy tyres													22.14	22.14	23.75		
Wood processing residues													36.93	35.58			
Shredded															22.14		

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Total CO_2 EF, kt/PJ																
rubber																	
	NCV (TJ/kt)																
Used tyres	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21	26.21
NPS														14.30	15.00	16.23	17.46
Waste wood												13.18					
Fluffy tyres													28.50	42.98	28.96		
Wood processing residues													12.57	12.11			
Shredded rubber															31.32		
	Biomass content, %																
Used tyres	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%
NPS														16%	30%	29%	18%
Waste wood												87%					
Fluffy tyres													67%	78%	65%		
Wood processing residues													72%	68%			
Shredded rubber															49%		

For estimating biomass emissions, the above mentioned equation for municipal waste was used.

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

SO_2 emission factors

SO_2 emission factors for all fuels, except industrial and municipal waste, in CRF 1.A.2 Manufacturing Industries and Construction sector are estimated with the same equations and using the same method as for CRF 1.A.1 Energy industries sector.

For industrial and municipal waste SO_2 emission factors are taken from EMEP/EEA 2016, Chapter 5.C.1.b, Table 3-1 (0.047 kg/Mg) and Chapter 5.C.1.a, Table 3-1 (0.087 kg/Mg).

Other emission factors

List of other emission factors can be seen in Table 3.26.

The default CH_4 and N_2O emission factors are taken from 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.3. Gasoline emission factors are used for CH_4 and N_2O emission estimation from off-roads (2006 IPCC Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Table 3.3.1.). As there is no information about distribution between 2-stroke and 4-stroke engines, it was assumed that 25% of consumed gasoline is combusted in 2-stroke engines, while 75% - in 4-stroke engines. Such assumption has been made, based on Danish data which are presented in EMEP/EEA 2016 for air pollutants' calculations.

$NO_{x,}$ CO and NMVOC emission factors used in estimation of emission were taken from EMEP/EEA 2016, Chapter 1.A.2, Tables 3-2 to 3-5, with an exception of oil shale which has been taken from Estonian NIR 2015 as country specific. For industrial waste and municipal waste NO_x, CO and NMVOC emission factors are taken from EMEP/EEA 2016, Chapter 5.C.1.b, Table 3-1 and Chapter 5.C.1.a, Table 3-1 (Table 3.26).

Table 3.26 CH_4, N_2O, NOx, NMVOC, CO emission factors (kt/PJ[18])

		CH_4	N_2O	NO_x	NMVOC	CO
Gasoline	2-stroke	0.130	0.0004	2.765	227.289	620.793
	4-stroke	0.050	0.002	7.117	18.893	770.368
Diesel oil		0.003	0.0006	0.513	0.025	0.07
RFO		0.003	0.0006	0.513	0.025	0.07
LPG		0.001	0.0001	0.074	0.023	0.029
Jet fuel		0.003	0.0006	0.513	0.025	0.07
Other kerosene		0.003	0.0006	0.513	0.025	0.07
Other liquid		0.003	0.0006	0.513	0.025	0.07
Petroleum coke		0.003	0.0006	0.513	0.025	0.07
Other oil products		0.003	0.0006	0.513	0.025	0.07
Shale oil		0.003	0.0006	0.513	0.025	0.07
Coal		0.01	0.0015	0.173	0.089	0.931
Coke		0.01	0.0015	0.173	0.089	0.931
Anthracite		0.01	0.0015	0.173	0.089	0.931
Oil shale		0.01	0.0015	0.173	0.05	0.931
Peat briquettes		0.01	0.0015	0.173	0.089	0.931
Peat		0.002	0.0015	0.173	0.089	0.931
Natural gas		0.001	0.0001	0.074	0.023	0.029
Wood		0.03	0.004	0.091	0.3	0.57
Other biogas		0.001	0.0001	0.074	0.023	0.029
Biodiesel		0.003	0.0006	0.513	0.03	0.07
Industrial waste (used tires)		0.03	0.004	0.87	7.4	0.07
Municipal waste		0.03	0.004	1.071	0.0059	0.041
Waste oils		0.03	0.004	0.513	0.03	0.07

There is a different approach regarding CRF 1.A.2.f *Non-metallic minerals* subsector and corresponding subsector under IPPU (CRF 2.A.1 *Cement production*). Until 2010 indirect GHG emissions under CRF 2.A.1 sector were calculated using EMEP/CORINAIR 2007 and EMEP/EEA 2006 methodology, but afterwards these emissions were automatically detected at plant site, and measurements are taken in the main chimney. However, as these values are measured directly in the chimney, there is no way to allocate emissions under Energy and IPPU sectors separately (there are both emissions from fuel combustion and technological processes). Regarding calculation of indirect GHGs, to avoid double counting, the following fuel types (used tyres, ecofuel, coal, natural gas consumed in "Cemex") are subtracted from Energy part (from CRF 1.A.2.f subsector) and their emissions can be considered as included elsewhere (CRF 2.A.1 sector under IPPU) in case of "Cemex". However, as "Cemex" is not the only company under CRF 1.A.2.f subsector, fuel consumption and emissions appear from other enterprises. As for GHGs, these emissions are taken from EU ETS reports (CO_2) reported by "Cemex" or calculated (CH_4, N_2O), therefore can be allocated under appropriate sectors.

[18] *For indirect GHGs for gasoline, industrial and municipal waste – kg/Mg*

Activity data

Mainly emissions from fuel combustion are calculated using fuel consumption data from the CSB Energy Balance. The data collection system for CRF 1.A.2 sector is the same as for CRF 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 2006 IPCC Guidelines.

Only gasoline combustion is reported as off-roads in CRF 1.A.4 sector, except for 1.A.4.c where approximate amounts of diesel are consumed in off-road installations.

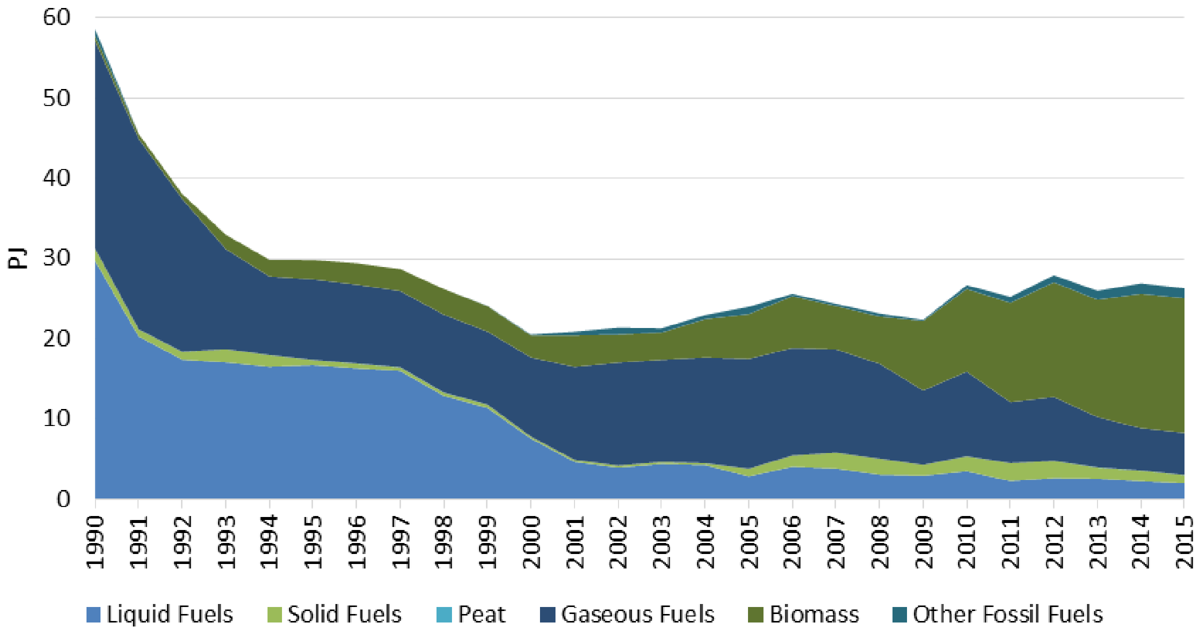

Figure 3.18 Fuel consumption in Manufacturing industries and construction (CRF 1.A.2) for 1990-2015 (PJ)

The most of fuel types with an exception of biomass and other fossil fuels have decreased in 1990-2015 (Figure 3.18). Liquid fuels have the biggest decrease in time period by 93.2%. It is explained with fuel switching processes when liquid fuels were replaced with other cheaper fuels. Also stronger legislation contributed fuel replacement 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.

The consumption of solid fuels (mainly coal) decreased in 1990-2004 with an exception of 1992-1993, mainly due to increased use of coal in Construction and Textiles and Leather sectors. Solid fuels consumption was growing rapidly by 7.5 times since 2004 until 2008 because of the growth in national economy, and decreased in 2009 by 31.7% due to global crisis. However, from 2010, the consumption of solid fuels grew 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 is consumed. In 2012-2015 there can be seen a steady drop in solid fuel consumption – in Non-metallic minerals sector the consumption decreased.

After the crisis in the beginning of 1990s natural gas consumption steadily increased with some small exceptions due to fuel replacement processes and development of national economy or due to the changes in demand. However in latest years natural gas consumption had increased only by 0.1% 2014-2015.

Consumption of biomass fuel has increased very significantly – by 2.6 times in 1990–2015 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 reasons for liquid and solid fuels' replacement with biomass and natural gas.

Consumption of used tires and municipal waste in Mineral production (information taken from „CEMEX", the only company which combusts used tires and municipal waste for energy purposes) reported as other fossil fuels had a 46-fold increase in 1999-2015, and continue to increase year by year. Comparing with 2010, the consumption of industrial and municipal (biomass and non-biomass) waste has increased more than 2.5 times in 2015. The increase was influenced by intensified cement production that was caused by increased demand of construction materials and sharp development of construction sector. In other fossil fuels also used oils are reported, and the amounts of this fuel are fluctuating over years with a decreasing trend in recent years. However, small decrease can be seen in 2014-2015 by 2.4%, it can be explained with changes in demand of cement.

3.2.5.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty in activity data of fuel combustion in 1.A.2 sector is ±2% in 2015. 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 and peat combustion was assigned as 5% because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass. Also, according to 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19, biomass data are generally more uncertain than other data in national energy statistics, because a large fraction of the biomass may be part of the informal economy, and the trade in these type of fuels is frequently not registered in the national energy statistics and balances.

Uncertainty of other fuels consumption – municipal and industrial waste 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 peat. However, for combustion of solid fuels and other fossil fuels (waste oils) the uncertainty of CO_2 emission factor was assigned higher to 20% because CO_2 emission factor of anthracite, coal and coke was taken from 2006 IPCC Guidelines. 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 industrial and municipal waste are assumed as 2% as were determined in accredited laboratory of cement production company.

CH_4 and N_2O emission factor used in estimation of emissions was taken according to 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.12., which provides the range of default values for uncertainties. The uncertainty both for CH_4 and N_2O EFs was assigned as uncertainties used in previous submissions – 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. Emissions from all sectors are estimated or reported as not occurring/not applicable therefore there are no "not estimated" sectors.

3.2.5.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the Energy sector in order to achieve these quality objectives. Quality meetings are held annually bet ween experts.

All documentation and information received for inventory purposes are archived in FTP folder. All findings are documented by using check-lists, available on Regulations of the Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units".

Activity data verification

All sources of energy data are presented in the corresponding NIR chapter Methodological issues.

As well as disaggregated data at the finest level possible are presented in the corresponding Annex A.3.1. Data completeness has been explained in the previous subchapter.

Activity data have been checked at the data provider – Central Statistical Bureau, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data have been received, the sectoral expert responsible for the emission estimation and reporting are comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

All activity data used in Sectoral Approach are also compared with activity data used in Reference Approach estimations. All significant differences (±5%) are explained in the corresponding subchapter.

Emission factor verification

For country-specific CO_2 emission factors, the sources of the calorific values, carbon content and oxidation factors, as well as these values are provided in corresponding NIR chapter Methodological issues.

Country specific CO_2 values for year are compared with default ones available on 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.2. Whether country specific CO_2 emission factor is or is not in the confidence interval can be seen in Table 3.27.

Table 3.27 Comparison of country specific and 2006 IPCC default CO_2 emission factor values (kt/PJ)

	Lower	CS	Upper
Gasoline	67.50	71.18	73.00
Diesel oil	72.60	74.74	74.80
RFO	75.50	77.36	78.80
LPG	61.60	62.75	65.60
Jet fuel	69.70	72.23	74.40
Other kerosene	70.80	72.24	73.70
Other liquid	72.20	72.59	74.40
Shale oil	67.80	77.12	79.20
Peat	100.00	105.99	108.00
Natural gas	54.30	54.63	58.30
Wood	95.00	109.98	132.00
Sludge gas	46.20	51.13	66.00
Landfill gas	46.20	51.13	66.00
Other biogas	46.20	51.13	66.00

All country specific values incorporate in 2006 IPCC default CO_2 lower and upper emission factor values.

Emission verification:

To verify the CO_2 emissions, logical mistakes are checked 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. The emissions for indirect GHGs in the database are cross-checked with emissions reported within CLRTAP for verification purposes.

CO_2 emissions are compared with emissions in Reference Approach estimations, and all significant differences (±5%) are explained in the corresponding subchapter.

3.2.5.5 Category-specific recalculations

Recalculations have been done in CRF 1.A.2. due to activity data corrections:

- 1.A.2.e Biodiesel in 2013;
- 1.A.2.c Landfill gas in 2014.

Regarding SO_2, EFs have been revised in every stationary combustion sector. Corrected CH_4 emission factors for all time serie.

Emission factor changed due to switching from EMEP/EEA 2013 to EMEP/EEA 2016 guidelines.

3.2.5.6 Category-specific planned improvements

It is planned to update CO_2 EFs for most widely used fuels in Latvia.

3.2.6 Transport (CRF 1.A.3)

3.2.6.1 Category description

This section describes GHG emissions resulting from transport fuel combustion. In 2015, this source category was responsible for around 27.3% of total GHG emissions in Latvia, reaching 3132 kt CO_2 eq (see Figure 3.19).

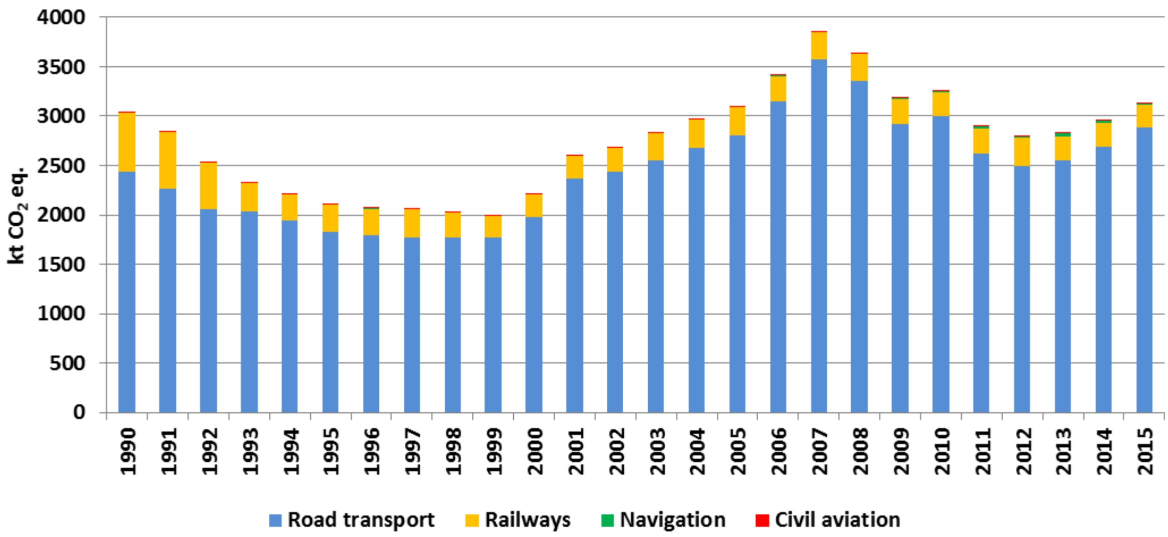

Figure 3.19 GHG emissions development in transport 1990 – 2015 (kt CO_2 eq.)

Emissions from Transport (CRF 1.A 3) include all domestic transport sectors: civil aviation, road transport, railways, domestic navigation and other mobile sources (which are not included in other sectors).

In 2015, total GHG emissions in the transport sector, compared to 1990 level, have increased by 3.3%. The GHG emissions in 2015, compared to 2014, were by 6.1% higher.

Peak of GHG emissions in transport sectors have been recognized in 2007 when emissions exceeded 1990 level by 27%.

The road transport constitutes a convincing majority of the total GHG emissions in the transport sector. In 2015, it gave around 92.3 % of total emissions but the next largest emission source is railway – 7.3 % (see Figure 3.20).

CO_2 emissions constitute nearly 97% of the total GHG emissions in the transport sector and they are key categories in road transport and railway as well (see Figure 3.21).

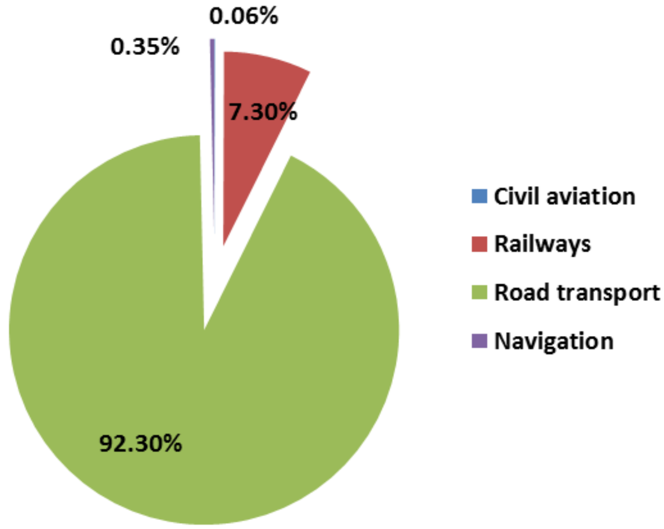

Figure 3.20 GHG emissions in transport by sub-sectors in 2015

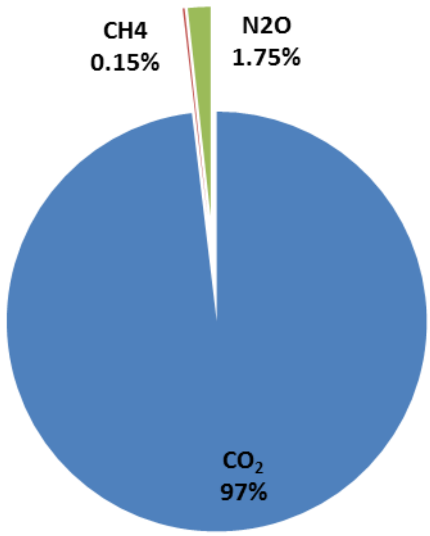

Figure 3.21 GHG emissions in transport sector by gases in 2015

One of the critical factors influencing CO_2 emission is the amount and type of the consumed fuel. In 2015, total fuel consumption in the transport sector, compared to 2014 level, has increased by 6 %. In different subsectors various changes have taken place in 2015. The main impact to changes in total fuel consumption related to road transport where the fuel consumption has increased by around 7 %.

In total, road transport consumes around 93%, railway – about 6.5% 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 71.6 %, and is followed by gasoline – 19.9 %, but LPG constitutes 6.2% and biofuels (biodiesel and bioethanol) 2.2 % of the total fuel consumption in the transport sector (see Figure 3.22). The share of biofuels has decreased from 2.3 % in 2014 up to 2.2% in 2015. Biofuel includes biodiesel and bioethanol and it mainly is used in road transport but small portion is consumed in railway as well. In 2015 it was not in place a rapid growth of LPG consumption compared to the last 5 years trend and LPG consumption has increased only by 1.5% in 2015 compared to 2014.

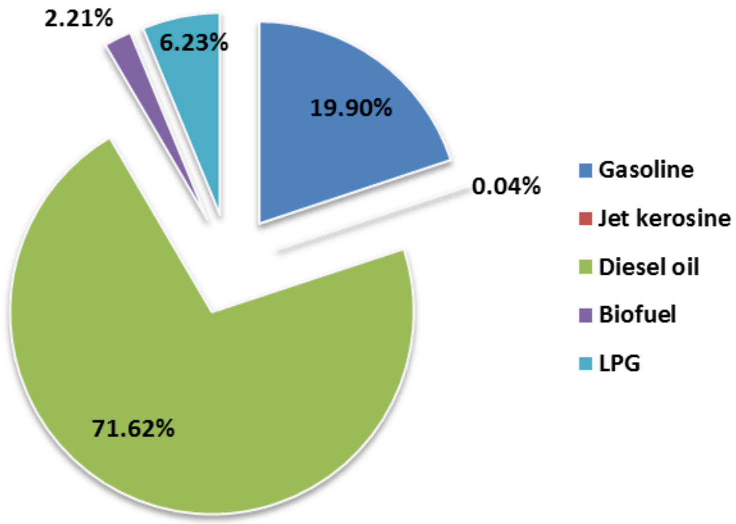

Figure 3.22 Fuel consumption in transport by fuel type (2015)

3.2.6.1.1 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 0.06% of GHG emissions from transport sector in year 2015 (see Figure 3.20). 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 turbofan and turbo props engines.

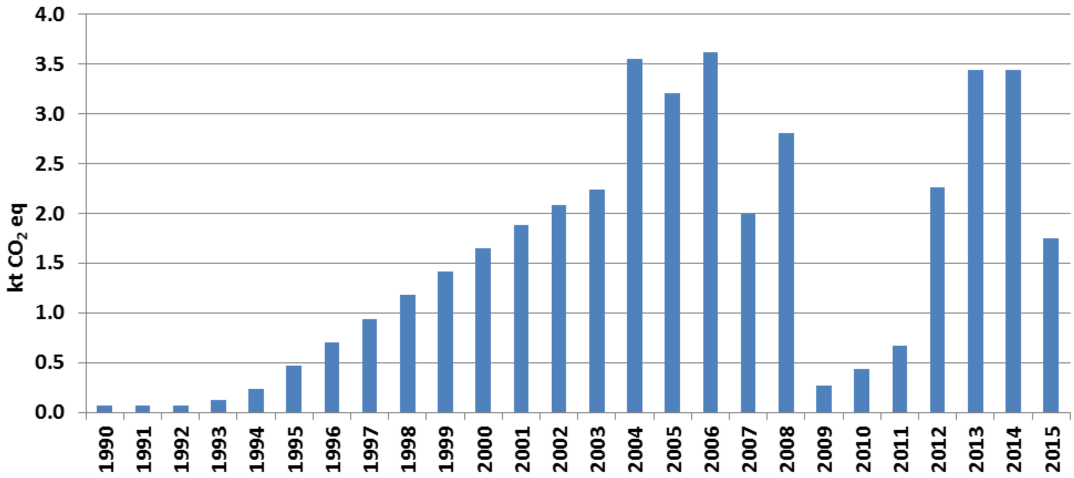

Figure 3.23 GHG emissions in civil aviation (kt CO_2 eq.)

In Latvia, there are four airports for commercial aviation, of which the largest is the Riga International Airport. 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 (80.05% of shares) local airline company had aborted domestic commercial flights in year 2009, fuel consumption had decreased dramatically in 2009. Today there are not domestic commercial flights in Latvia; the main activities in civil aviation relates with private flights. Economic recovery starting in Latvia in 2011 has fostered activity and fuel consumption in civil aviation. The results from the carried out additional analyses indicate no evidence of any certain trend in gasoline and jet fuel consumption.

Methods

When calculating emissions from civil aviation, two approaches have been applied. 2006 IPCC Guidelines Tier 1 method has been applied when estimating emissions from aviation gasoline for all gases. When calculating emissions from jet kerosene Latvia uses Tier 1 to estimate emissions of CO_2 and SO_2, and Tier 2 to estimate CH_4, N_2O and all other gases. 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 — 2013).

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*

The summary of the latest key category assessment, methods and EF used is presented in Table 3.28.

Table 3.28 Summary of source category description, CRF 1.A.3.a

CRF	Gas	Method	EF	All sources estimated
1.A.3.a	CO_2	T1	D	Yes
	CH_4	T1,T2	D	Yes
	N_2O	T1, T2	D	Yes

T1 Tier 1; T2 Tier 2; D Default.

Activity data

The data about fuel consumption (see Table 3.29) in aviation is derived from the CSB. CSB has started to separate fuel consumption for domestic flights from total fuel consumption data in aviation 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.

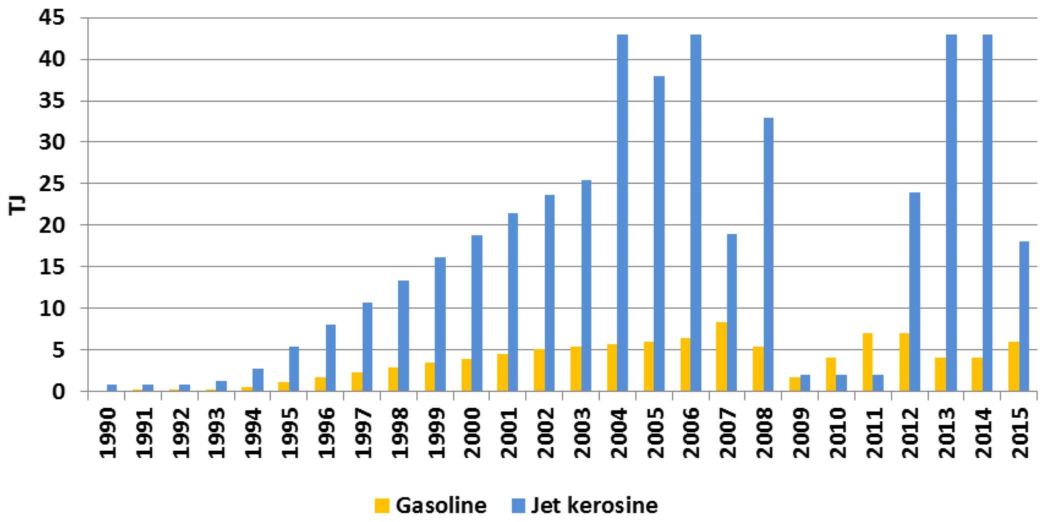

Figure 3.24 Fuel consumption in domestic civil aviation (TJ)

Table 3.29 Fuel consumption in domestic civil aviation (TJ)

	Jet kerosene	Gasoline
1990	0.8	0.2
1995	5.4	1.1
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	43.0	6.4
2007	19.0	8.4

	Jet kerosene	Gasoline
2008	33.0	5.4
2009	2.0	1.7
2010	2.0	4.0
2011	2.0	7.0
2012	24.0	7.0
2013	43.0	4.0
2014	43.0	4.0
2015	18.0	6.0

Emission factors

Default EFs of LTO and cruise (jet kerosene) for civil aviation is used (2006 IPCC Guidelines and EMEP/EEA emission inventory guidebook – 2013).

Table 3.30 Emission factors used in the calculation of emissions from civil aviation

	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ
Aviation gasoline	70.0	0.0005	0.002	0.25	0.1	0.05	0.023

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

The road transport constituted around 91.3% of GHG emissions in the transport sector in 2015. After the rapid growth in the period 2000 – 2007 (see Figure 3.25), 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 43.7% (2015) of the total freight in the country (traffic of goods in ton-km). The share has increased by around 2.4 % point, compared with year 2014. 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 increased by around 8.4% in year 2015 compare with 2014. In different fuels various changes have taken place in 2015 compare with 2014. Gasoline consumption has decreased by 0.5%, whereas biofuel consumption has increased by 4.8 %, diesel fuel consumption has increased by 10.2% and LPG consumption by 1.5 % (see Figure 3.29).

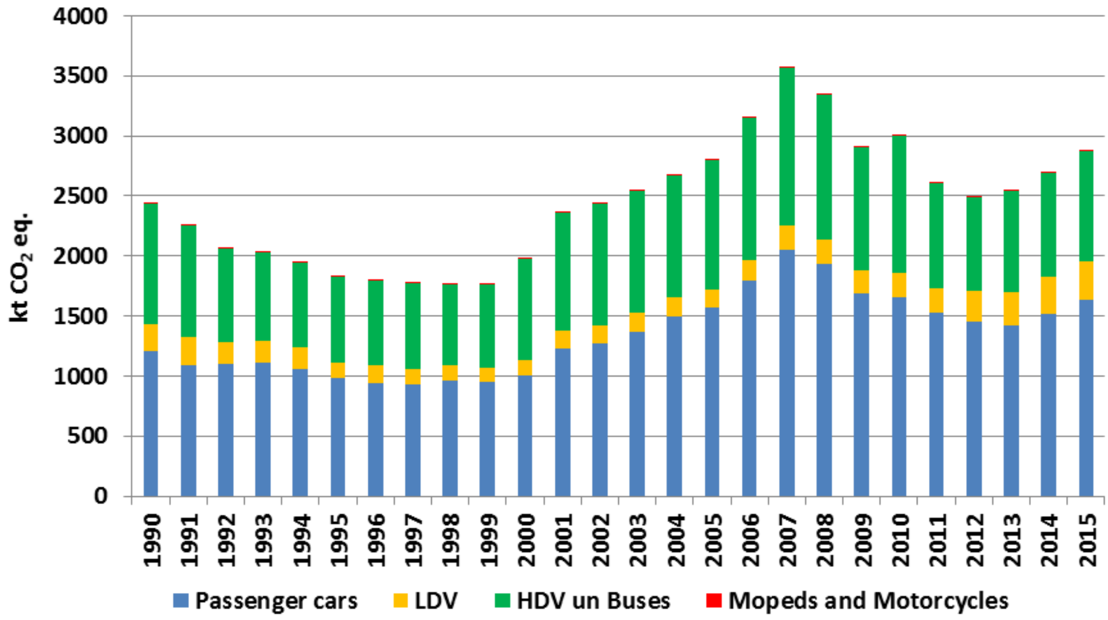

Figure 3.25 GHG emissions in road transport (kt CO_2 eq.)

Road transport includes five vehicle categories: Passenger cars, Buses, Heavy duty-vehicles (HDV), Light duty-vehicles (LDV) and Mopeds & Motorcycles. In time period 1990 – 2015, essential changes have taken place in the structure of GHG emissions created by the road transport (see Table 3.31). Gasoline has been the most common fuel used for road transports up to year 2000, but in 2015 the amount of diesel used for road traffic is 3.2 times more as gasoline and the emissions of CO_2 from diesel surpassed the emissions of CO_2 from gasoline as from 2001.

In 2015, emissions from gasoline consumption created by passenger cars were less than that of 1990 level, while emissions created by diesel oil consumption in 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 at this time span.

Table 3.31 GHG emissions in road transport by vehicle types (kt CO_2 eq.)

	Passenger Cars		LDV		HDV	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
1990	1132	43	161	55	424	525
1995	926	36	91	39	261	440
2000	864	119	48	78	145	660
2001	953	253	44	101	115	835
2002	958	285	37	117	95	879
2003	974	359	32	122	83	908
2004	1001	448	28	130	66	930
2005	993	521	24	130	55	1007
2006	1111	621	23	147	49	1116

	Passenger Cars		LDV		HDV	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
2007	1252	767	22	180	43	1254
2008	1118	767	20	180	35	1162
2009	942	706	16	169	20	1003
2010	867	755	15	184	17	1118
2011	802	673	15	191	16	855
2012	677	685	17	237	13	763
2013	614	681	16	255	13	829
2014	601	777	15	284	12	846
2015	585	891	15	303	12	901
Trend 2015/1990(%)	**-49**	**1970**	**-91**	**454**	**-97**	**72**

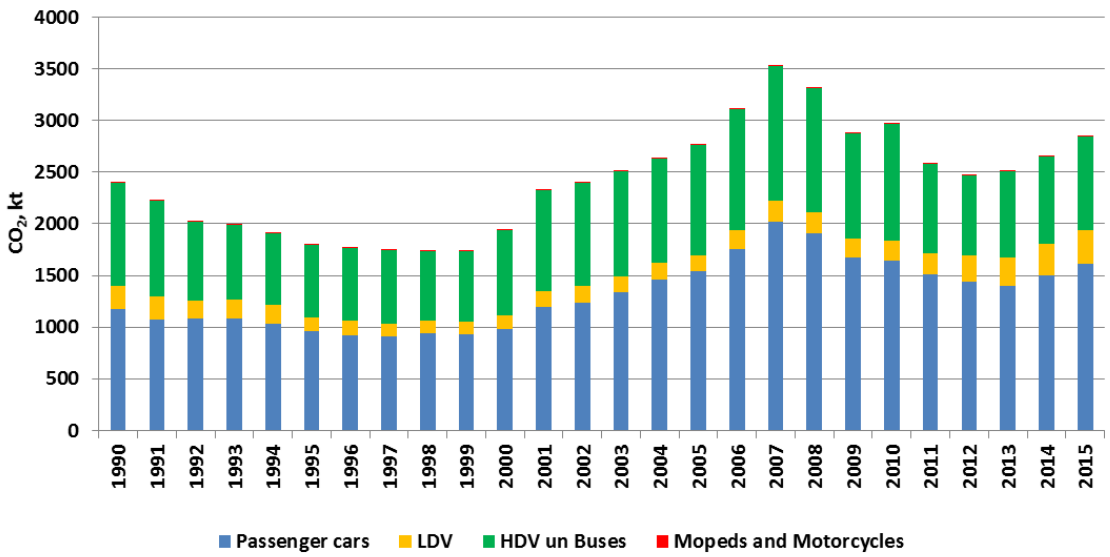

Figure 3.26 CO_2 emissions in road transport by vehicle types

CO_2 emissions are directly fuel-use dependent and, in this way, the development in the emissions reflects a trend in the fuel consumption. As shown in Figure 3.26, 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 56.5%, HDV and buses 31.9 % and LDV 11.4 % in year 2015. In 2015, CO_2 emissions in road transport, compared to 2014 level have increased by 7.2 %.

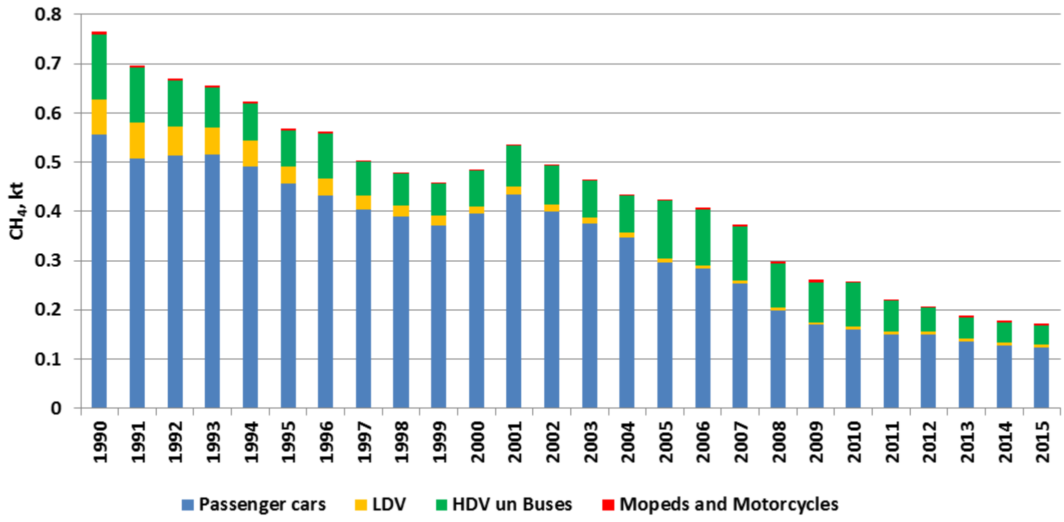

Figure 3.27 CH_4 emissions in road transport by vehicle types

CH_4 emissions present consistent decrease trend within the whole period (see Figure 3.27). In 2015, CH_4 emissions in road transport, compared to 2014 level have decreased by 7.1 %. The majority of CH_4 emissions from the road transport come from passenger cars (72.3%). The substantial emission drop from 2001 onwards is explained by the sharp penetration of EURO3, EURO4 and EURO5 passenger cars into the Latvia fleet and additionally in years 2009 - 2014 with decreasing of gasoline consumption by passenger cars.

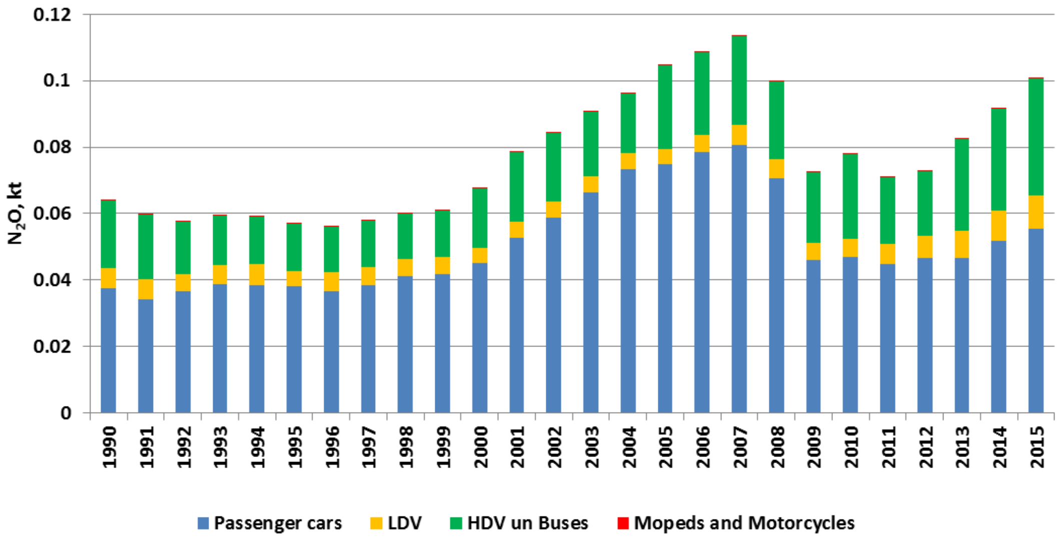

Figure 3.28 N_2O emissions in road transport by vehicle types

In 2015, N_2O emissions in road transport, compared to 2014 level have increased by 9.8 %. 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 (Figure 3.28) contribute 54.9%, LDV 9.8%

and HDV and busses 35% of total N_2O emission in Latvia's road transport. Thus the N_2O emission trend is mainly determined by the change in the technologies and fuel used by passenger cars.

Regarding total N_2O emission created by the fleet of Latvia passenger cars, gasoline fuelled passenger cars contribute slightly above 33%, 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 EURO3 and EURO4 cars and EURO5 and EURO6 cars. The N_2O emission factor (g/km) of gasoline fuelled passenger cars of the EURO1 and EURO2 classes is more than twice higher compared to the factor of gasoline fuelled passenger cars of the EURO3 and EURO4 classes. The mileage shares in 2015, calculated by summing the shares of EURO3 and EURO4 and EURO5 and EURO6 gasoline passenger cars, has increased almost twice – from 29.5% to 59.3% 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 and EURO5 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, EURO4 and EURO5 cars – from 24% (year 2005) up to 70.8% (year 2015) of the total diesel passenger cars mileage, the average N2O 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 2006 IPCC Guidelines and EMEP/EEA emission inventory guidebook – 2013. The actual calculation is made with a COPERT IV model[19]. 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's 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 standards 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's fleet are grouped into vehicle classes, subclasses and layers. The layer classification is a further

[19] *www.emisia.com*

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. The summary of the methods and EF used is presented in Table 3.32.

Table 3.32 Summary of source category description, CRF 1.A.3.b

CRF	Gas	Method	EF	All sources estimated
1.A.3.b	CO_2	T2	CS	Yes
	CH_4	T2	D (COPERT model)	Yes
	N_2O	T2	D (COPERT model)	Yes

T2 Tier 2; CS Country Specific; D Default.

Reported CO_2 emissions from lubricant consumption in road transport have been calculated based on kilometres travelled. Lubricant consumption have been calculated for an each of road transport groups (cars, HDV, LDV and other) including 2-stroke motorcycles whom petrol engine should be lubricated by a mixture of lubricating oil and petrol.

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 2013). Based on this calculated lubricant oil consumption and using default EF (2006 IPCC Guidelines) CO_2 emissions for lubricant oil burning for engine operation has been calculated.

For estimating CO_2 emissions from use of urea-based additives in catalytic converters (non-combustive emissions), it is used equation from 2006 IPCC Guidelines:

$$Emission = Activity \times \frac{12}{60} \times Purity \times \frac{44}{12}$$

where:
Emissions - CO_2 Emissions from urea-based additive in catalytic converters (Gg CO_2);
Activity - amount of urea-based additive consumed for use in catalytic converters (Gg);
Purity - the mass fraction (= percentage divided by 100) of urea in the urea-based additive;
12/60 - conversion from urea to carbon;
44/12 - conversion from carbon to CO_2.

In calculations, it is assumed that 75% of the HDV (starting with Euro IV class and later) the urea-based additives are used in catalytic converters. The activity level is 3 percent of diesel consumption by the HDV. Thirty-two and half percent is taken as default purity. Estimated CO_2 emissions are reported in the IPPU sector (CRF 2).

Activity data

As a basis for model input information CSB and LR Road Traffic Safety Directorate (RTSD) data is used. CSB data have been used considering the fuel consumption, 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 1996-2015. The summary of the data sources used in emission calculation for road transport are presented in Table 3.33.

Table 3.33 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 0,05%
Number of cars	Road Traffic Safety Directorate	For calculation it is used number of cars with permission to participate in traffic
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 are based on carbon content in fuel. 1990 – 1999 EF for unleaded gasoline is 68.6; 2000 - onwards EF gasoline is 71.18 1990 – onwards EF diesel oil 74.0

General information about activity data is presented in Figure 3.30- Figure 3.36 (number of cars and their split by sub-classes and layers). Before emission calculation COPERT IV model was calibrated to be consistent with actual fuel consumption (energy statistics see Table 3.34). 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 3.34 Fuel consumption in road transport (TJ)

	Gasoline, TJ	Diesel oil, TJ	LPG, TJ	Natural gas, TJ	Biofuel (biodiesel and bioethanol), TJ
1990	24200	8328	592	335	-
1995	17996	6883	501	33	-
2000	14520	11472	865	68	-
2001	15268	15934	865	101	-
2002	14960	17166	865	68	-
2003	14950	18611	956	68	-
2004	15038	20225	1047	68	-
2005	14730	22180	1093	68	107
2006	16313	25235	1184	68	100
2007	17852	29488	1093	67	71
2008	16269	28256	956	33	82
2009	13586	25154	865	4	173
2010	12308	27449	989	1	1102
2011	11432	22945	1184	-	844
2012	9697	22465	1858	-	742

	Gasoline, TJ	Diesel oil, TJ	LPG, TJ	Natural gas, TJ	Biofuel (biodiesel and bioethanol), TJ
2013	8794	23539	2368	-	737
2014	8617	25409	2646	-	840
2015	8576	28001	2687	-	880

As it can be seen in Figure 3.29 the fuel consumption has essentially changed in the time period 1990 – 2015. The gasoline consumption from the highest consumption in 1990 has decreased till 1999, reaching the lowest consumption and after six year stabilization the increase was seen in 2006 and 2007. Consumption of gasoline had decreased in 2015 by 0.5% compared to 2014. Whereas diesel fuel consumption starting from 1997 has increased gradually till 2007. While it decreased in 2008 and 2009 mainly due to economic recession. Diesel fuel consumption has increased in 2015 by 10.2% compared to 2014. Substantial LPG consumption increasing in road transport was observed starting from 2011.

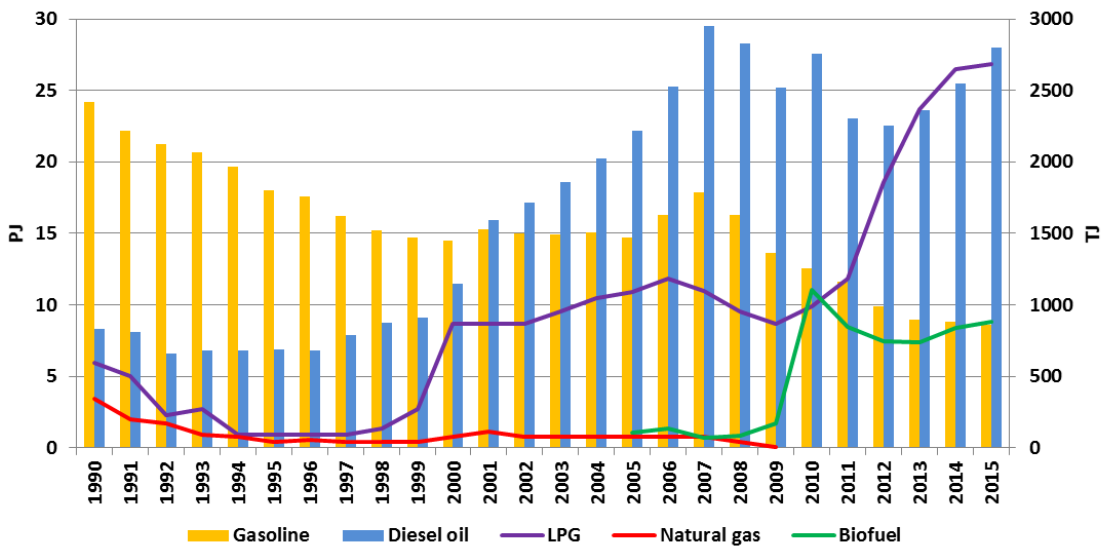

Figure 3.29 Development of Fuel consumption in road transport (TJ)[20]

The vehicle numbers per passenger cars sub-class and layers are shown in Figure 3.30.

[20] *LPG, natural gas and biofuel on secondary axes*

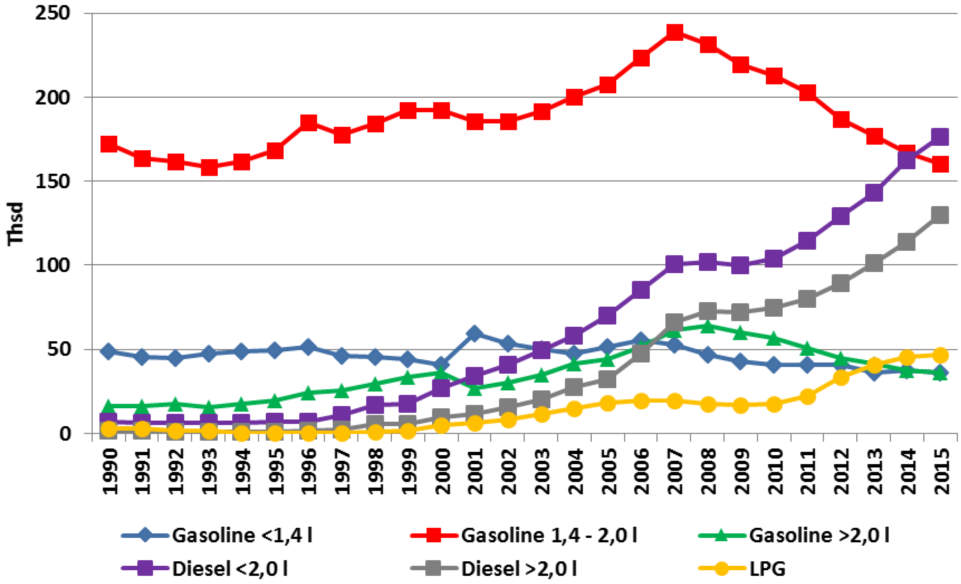

Figure 3.30 Distribution of passenger cars fleet by sub-classes

Analyzing the development of the passenger car fleet in the time period 1990 – 2015 (Figure 3.31, Figure 3.32), following features can be noted:

- Cars with a diesel engine of a capacity < 2.0l constitute the major part but the second leading group is cars with a gasoline engine of a capacity 1.4l - 2.0l;
- Cars with a gasoline engine of a capacity < 1.4l during the whole period have small changes and it`s constitute approximately 6.2% in year 2015 from total passenger cars;
- Cars with a gasoline engine of a capacity >2.0l starting from year 2010 have a small decreasing in their share of total passenger cars;
- As of 2000, the number of cars with diesel engines, both, < 2.0l and > 2.0l, grow rapidly and its share is 52.2% from the total number of passenger cars in 2015;
- As of 2005, in the car fleet with a gasoline engine, the number of EURO 3 and EURO 4 cars grows rapidly. In 2015 a share of EURO4 and EURO5 and EURO6 cars constitutes 30.1%;
- As of 2005, in the car fleet with a diesel engine, the number of EURO 4 and EURO 5 cars grows rapidly. In 2015 a share of EURO4, EURO5 and EURO6 cars constitute 32.7%.

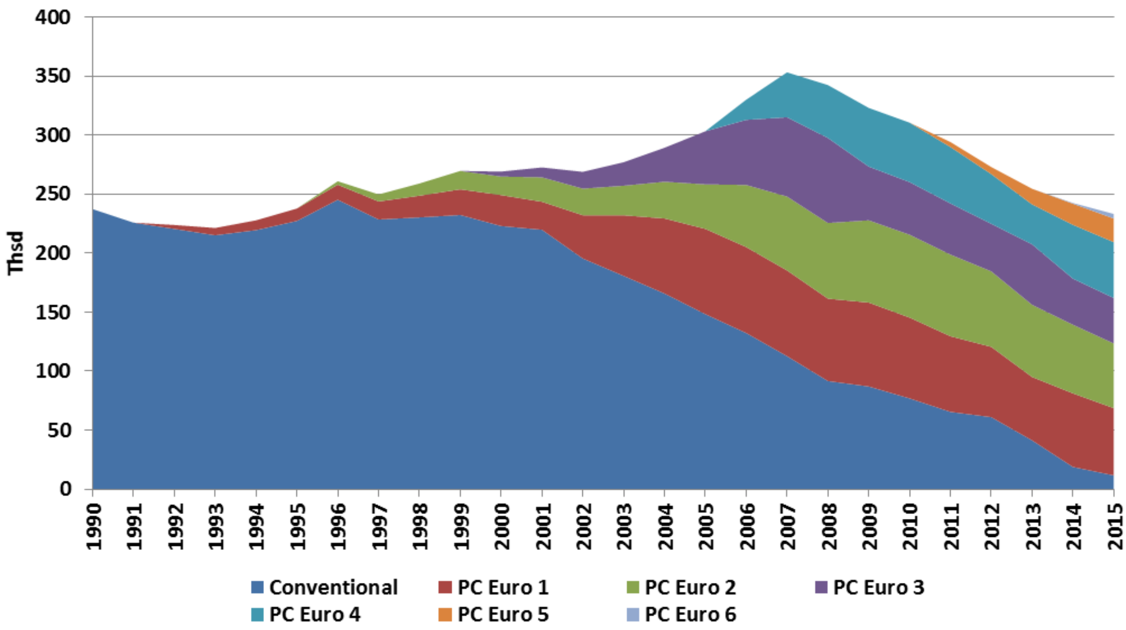

Figure 3.31 Distribution of gasoline passenger cars fleet by layers

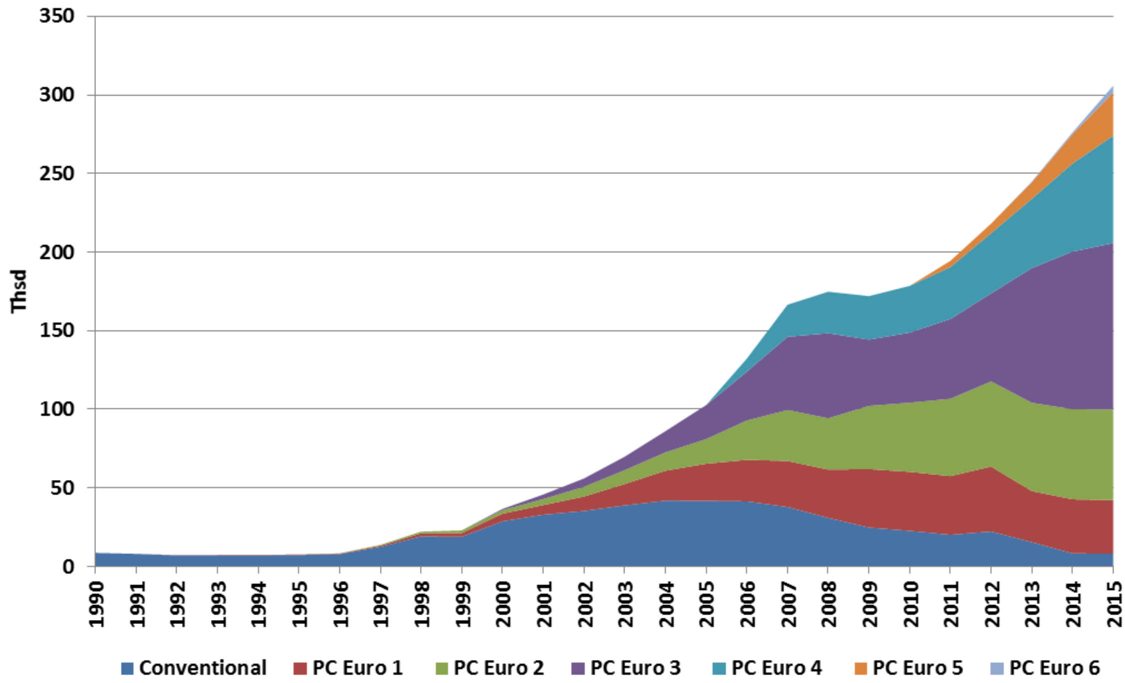

Figure 3.32 Distribution of diesel oil passenger cars fleet by layers

Analyzing the development of LDV fleet (Figure 3.33, Figure 3.34) in the time period 1990-2015, major features can be noted as follows:

- As of 1996, the number of cars with a gasoline engines have decreased;
- As of 2000, the number of cars with a diesel engine rapidly increases. In 2015 the share of diesel cars is 93.2%;

- As of 2005, the number of EURO4 and EURO5 and EURO6 cars have increased. In 2015 the share of EURO4, EURO5 and EURO6 cars constitute 50.0%;

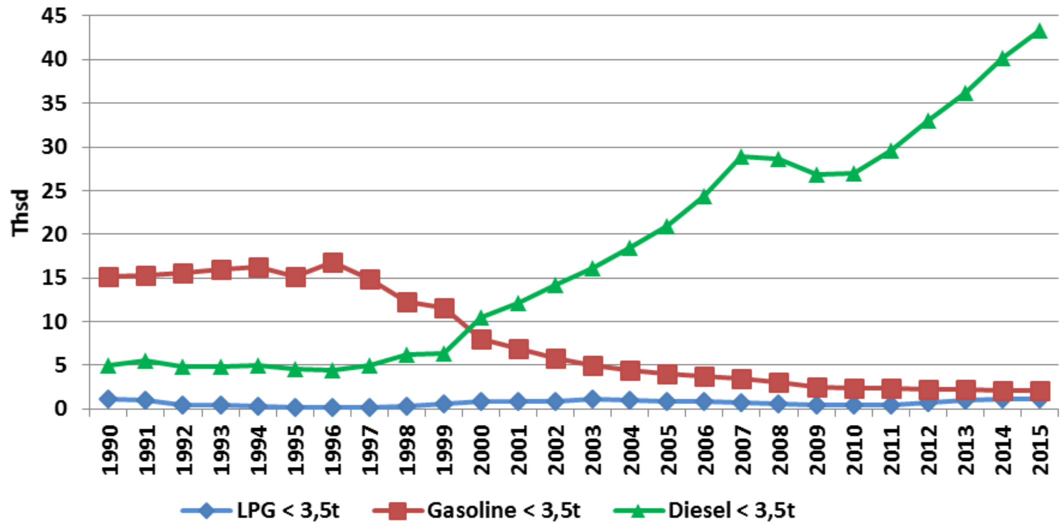

Figure 3.33 Distribution of light duty vehicles fleet by sub-classes

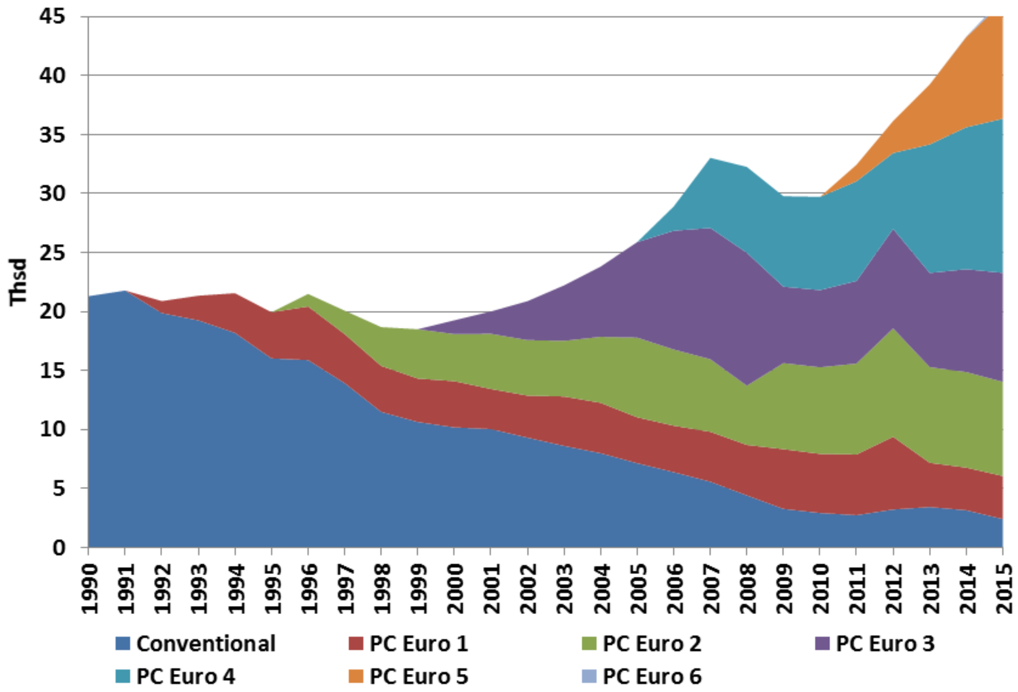

Figure 3.34 Distribution of light duty vehicles fleet by layers

The vehicle numbers per HDV sub-classes and layers are presented in Figure 3.35 and Figure 3.36. Analyzing the development of HDV fleet in the following time period, major features can be noted as follows:

- Since 2000, the number of cars with a gasoline engines have rapidly decreased. The share of gasoline cars has decreased from 33% to 3.8 % corresponding years 2000 and 2015;

- Since 2000, 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 2015 the share of EURO IV, EURO V and EURO VI cars constituted 44.7%.

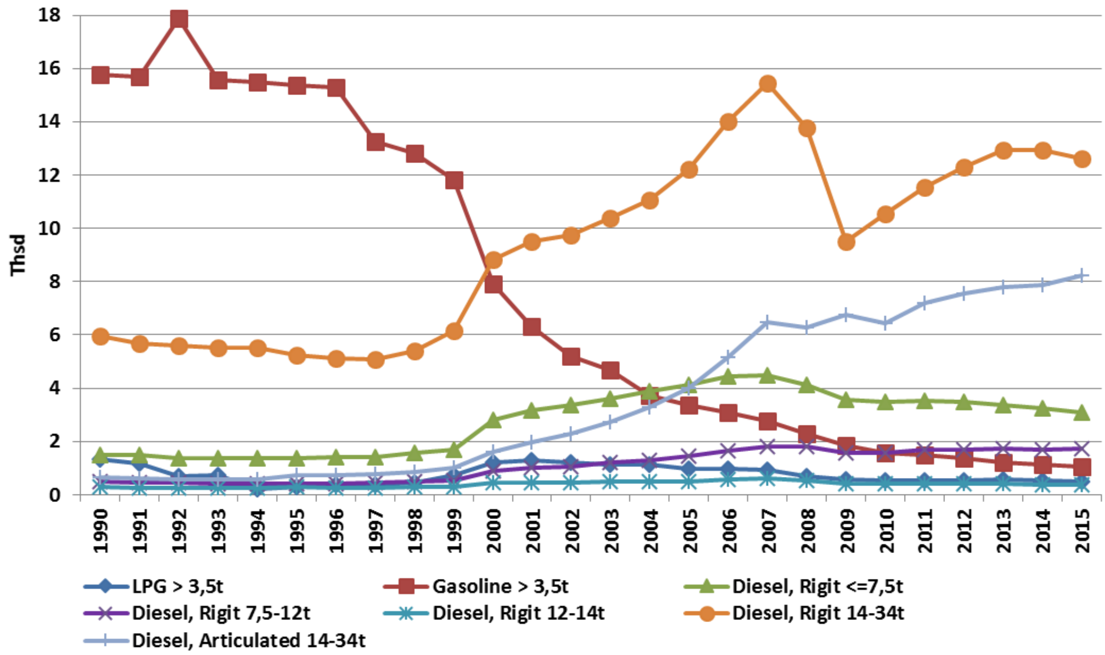

Figure 3.35 Distribution of heavy duty vehicles fleet by sub-classes

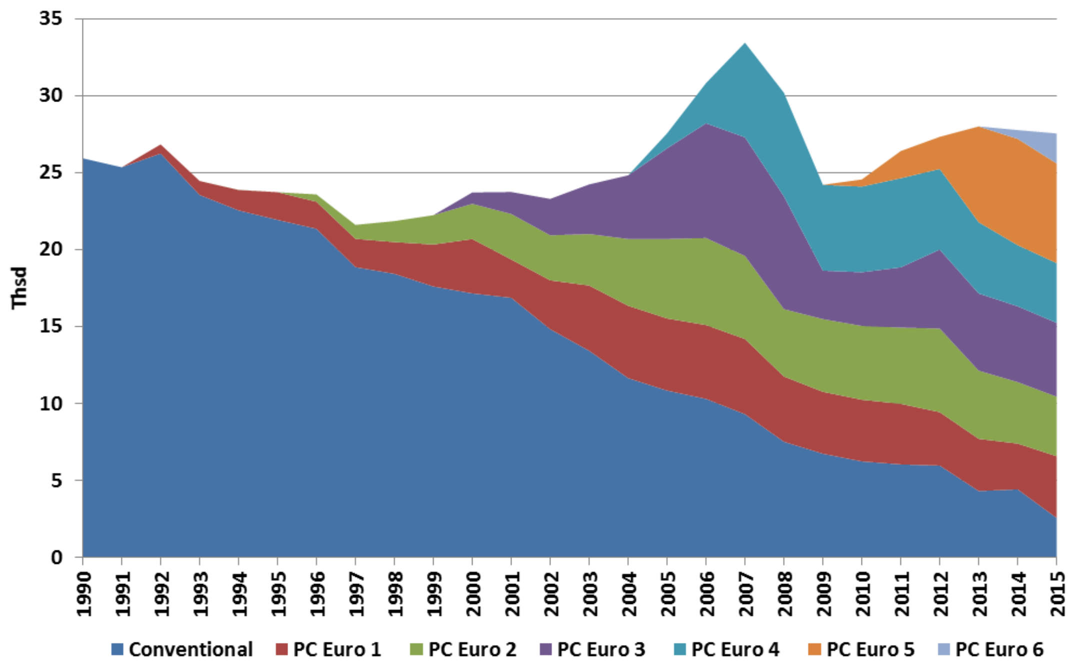

Figure 3.36 Distribution of heavy duty vehicles fleet by layers

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 is used:

- 1990 – 2015 EF diesel oil 74.0 kg/GJ;
- 1990 – 2015 EF for unleaded gasoline is 71.18 kg/GJ.

Taking into account recommendations from ERT about the necessity to investigate EF for gasoline (due to big difference in comparison with other countries'), Ministry of Environmental Protection and Regional development funded research "Research on carbon content in transport fuels" in 2012. The research on C content in fuels carried out in 2012 quantified C and H content in gasoline and diesel oil. For gasoline the C content is 84.7%, further it is calculated NCV for gasoline (43.97 MJ/kg) and estimated CO_2 emission factor in accordance Requirements from the 2006 IPCC Guidelines. For diesel oil the C content is 86.7%, further it is calculated NCV for diesel oil (42.49 MJ/kg) and estimated CO_2 emission factor in accordance Requirements from the 2006 IPCC Guidelines. Based on the results of this research, CO_2 EF of gasoline has been calculated - 71.18 kg/GJ and diesel oil 74.0 kg/GJ (oxidation factor is 1). Although quantification of C and H content in gasoline and diesel oil has been performed for fuel with a requirement for gasoline quality which is in force since January 1, 2009, the updated CO_2 EF is implemented for emissions calculation 1990-2008 as well to ensure consistent time series. Rest of emission factors (CH_4 and N_20) comes from the COPERT IV model.

3.2.6.1.3 Railways (CRF 1.A.3.c)

In 2015, the fuel consumption in railway constituted 7.3% of GHG emissions from the total GHG emissions in transport. Freight transport has a dominant role in railway. The railway transport accomplishes around 56.3% (2015) of the total freight transport in Latvia (traffic of goods in ton-km) 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. Due to dependence on transit transport of goods from Russia and other neighboring countries fuel consumption has decreased by approximately 4.5% in 2015 compared to 2014. It results in decreased GHG emissions by 4.3% in 2015 compared to 2014 level. Emission calculation in railway transport includes railway transport operated by diesel locomotives.

Railway related fuel consumption is key categories for CO_2 emissions. In 2015, total GHG emissions in railway, compared to 1990 level have decreased by 61.5% (see Figure 3.37).

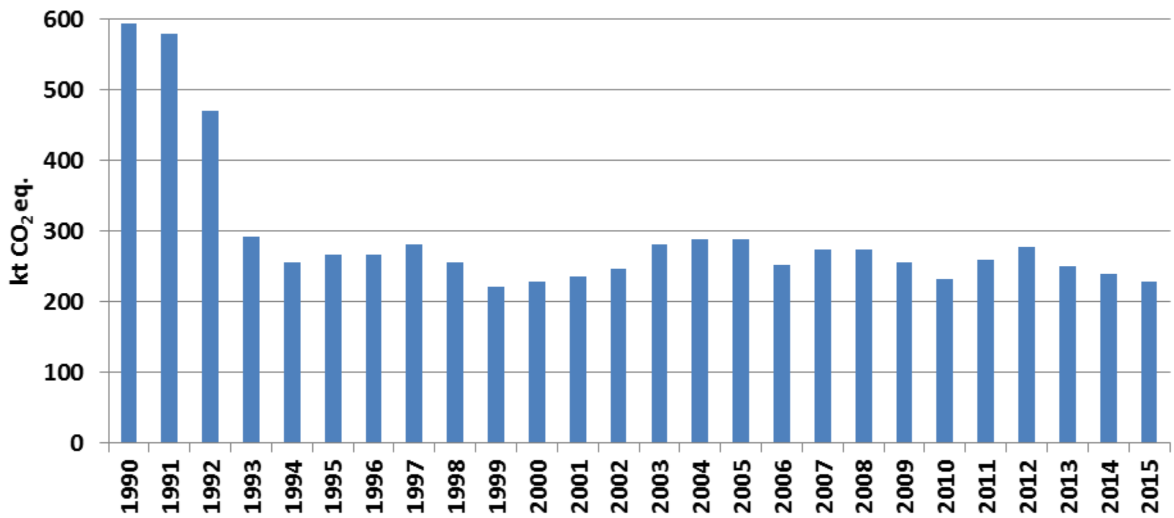

Figure 3.37 Development of GHG emissions in railway (kt CO_2 eq.)

Methodological issues

Methods

When calculating emissions from railway, 2006 IPCC Guidelines Tier 1 and Tier 2 methods have been applied. The summary of the latest key category assessment, methods and EF used is presented in Table 3.35.

Table 3.35 Summary of source category description, CRF 1.A.3.c

CRF	Gas	Method	EF	All sources estimated
1.A.3.c	CO_2	T2	CS	Yes
	CH_4	T1	D	Yes
	N_2O	T1	D	Yes

T1 Tier 1; T2 Tier 2; CS Country Specific; D Default.

Activity data

The data about diesel oil consumption in railway are derived from the CSB. Development of diesel oil consumption is presented in Figure 3.38 and Table 3.36. As we see, starting from 2010 a small portion of biodiesel is used in railway.

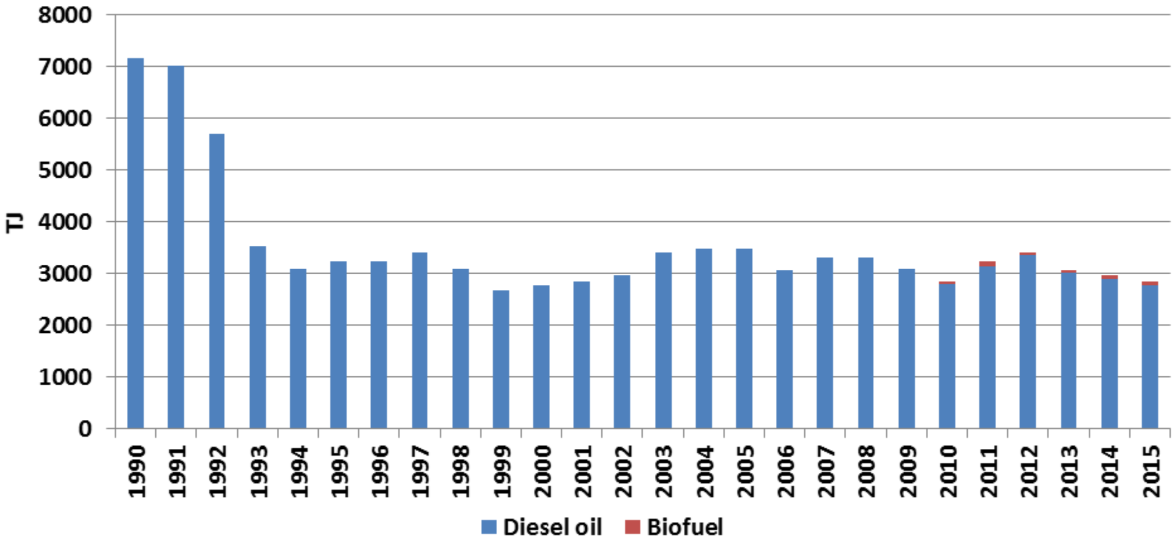

Figure 3.38 Development of fuel consumption in railway (TJ)

Table 3.36 Fuel consumption in railway (TJ)

	Diesel oil	Biodiesel
1990	7181	-
1995	3229	-
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
2013	3017	48
2014	2889	83
2015	2765	74

Emission factors

Country specific EF for CO_2 emissions is used ("Guidance Manual for CO_2 emission estimations" (2004) see Annex A.3.2). Rest of emission factors comes from 2006 IPCC Guidelines and EMEP/EEA 2013 (see Table 3.37).

Table 3.37 Emission factors used in the calculation of emissions from railway

	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ
Diesel oil	74	0.00415	0.0286	1.2332	0.251823	0.10943	0,02353 (2003-2004) 0,09414 (1990-2007) 0.04707 (2008-2015)

3.2.6.1.4 Domestic Navigation (CRF 1.A.3.d)

In 2015, fuel consumption in navigation was responsible for around 0.35% 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 vessels (tugs, barges, towboats, and icebreakers), recreational crafts and personal boats (see Figure 3.39).

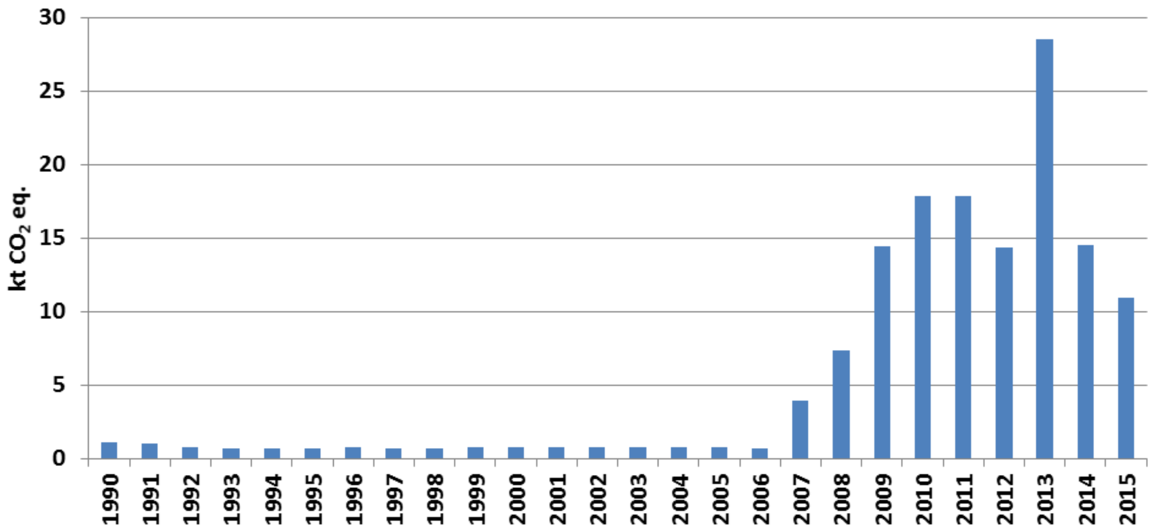

Figure 3.39 GHG emission development in domestic navigation (kt CO_2 eq.)

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 2006-2015 international cargo turnover in ports has increased by approximately 17%. This increasing trend of activity partly explains fuel consumption increasing. On the other hand, fuel consumption is affected by the number of vessels serviced in ports. As shown Figure 3.40 in spite of the rapid increase in the volume of cargo at the port of Riga, the number of serviced ships has remained almost unchanged. The main reason for this trend is the increase in the gross tonnage of vessels. The most significant increase was registered in the average tanker gross tonnage, but also in other cargo carrier groups (container, dry bulk carriers).

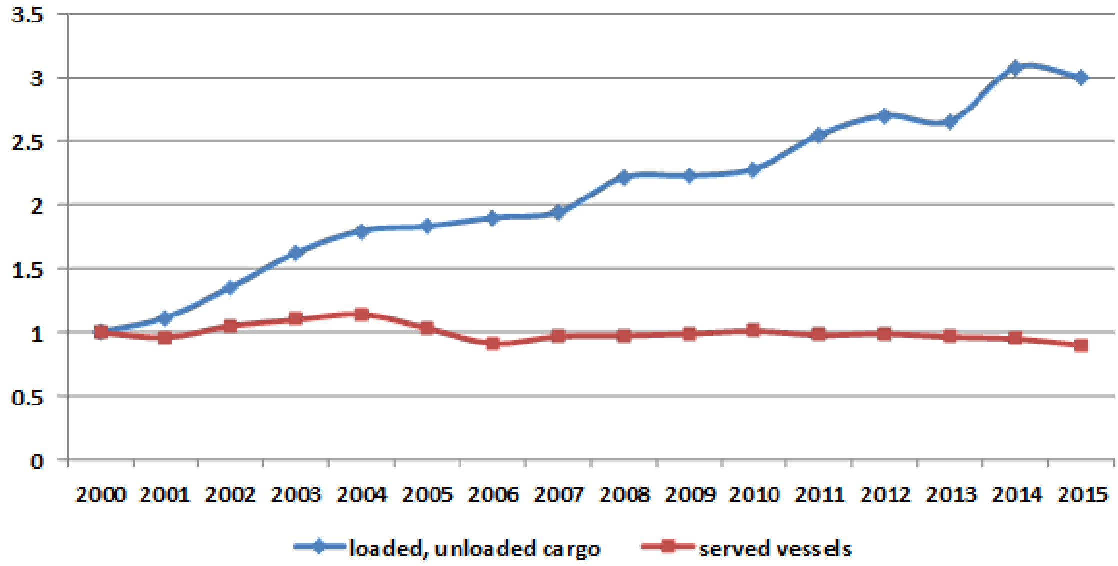

Figure 3.40 Loaded, unloaded cargo and served vessels at Riga port (2000 = 1)

Other additional factor which makes impact to fuel consumption in domestic navigation is weather conditions. This we can definitely see for 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 2010 and 2011. This has made an impact on fuel consumption in 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, Tier 1 and Tier 2 methods from 2006 IPCC Guidelines have been applied. Country specific CO_2 EF is used for emission calculation from diesel fuel consumption. The summary of the latest key category assessment, methods and EF used is presented in Table 3.38.

Table 3.38 Summary of source category description, CRF 1.A.3.d

CRF	Gas	Method	EF	All sources estimated
1.A.3.d	CO_2	T1,T2	CS (diesel); D (gasoline)	Yes
	CH_4	T1	D	Yes
	N_2O	T1	D	Yes

T1 Tier 1; T2 Tier 2; CS Country Specific; D Default.

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 from 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). Development of fuel consumption in domestic navigation is presented in Figure 3.41 and Table 3.39. Diesel oil consumption has decreased by approximately 24% in 2015 compared to 2014.

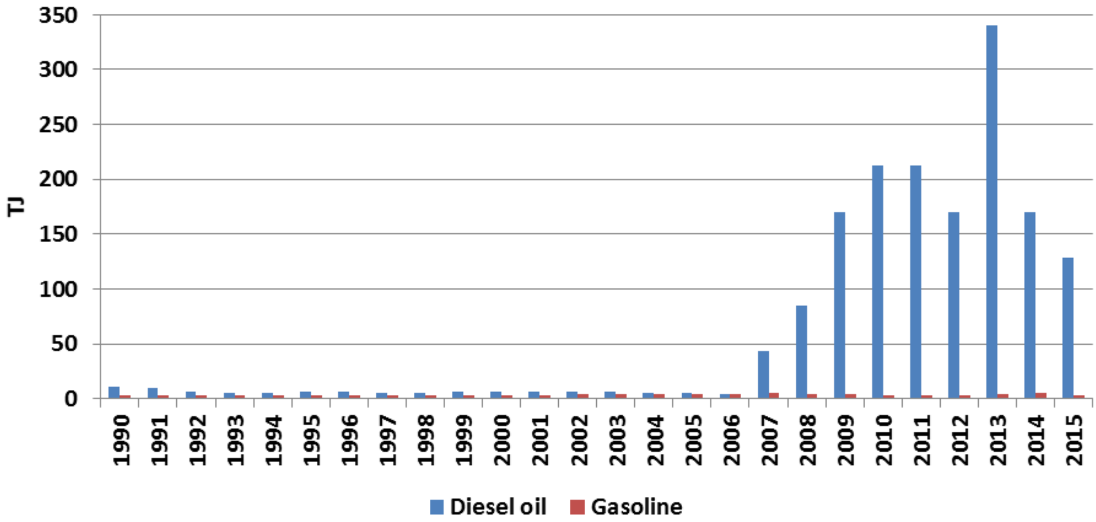

Figure 3.41 Development of gasoline and diesel oil fuel consumption in domestic navigation

Variation in local navigation's fuel consumption in 2012-2015 indicates that this consumption is highly dependent on the harbour services' activities. In 2013 there was done harbour deepening of large scale resulting also in significant increase in fuel consumption. After the realization of noted project, the fuel consumption in 2014 and 2015 come back to roughly 2012 level.

Table 3.39 Fuel consumption in domestic navigation (TJ)

	Diesel oil	Gasoline
1990	11	2
1995	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	85	5
2009	170	4
2010	212	3
2011	212	3
2012	170	3
2013	340	4
2014	170	5
2015	129	3

Emission factors

Default EFs for navigation is used (2006 IPCC Guidelines and EMEP/EEA 2013,Table 3.40).

Table 3.40 Emission factors used in the calculation of emissions from navigation

	CO_2, t/TJ	CH_4, t/TJ	N_2O, t/TJ
Gasoline	69.3	0.0473	0.000296
Diesel oil	74.0	0.004	0.003

3.2.6.1 Uncertainties and time series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6. Activity data about fuel consumption in transport sector is mainly available from 1990 and they are provided by CSB. Considering that CSB gives approximately 2% statistical sample error for statistical data uncertainty in activity data of fuel consumption in transport is ±2% in 2015. Before GHG emission calculation is performed CSB is asked to check and further confirm fuel consumption in sector if fluctuation is more than 20% compare to the previous year.

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 2%. If default CO_2 emission factor is used uncertainty was assigned about 5%. Default CH_4 and N_2O emission factors used in estimation of emissions was taken from 2006 IPCC Guidelines, so uncertainty was assigned 30 - 70 %.

In order to maintain consistency with the time-series the estimation procedures have been developed as described above (chapter 1.6.). However, due to the fact that some of the estimations are not based on activity data but on other factors as LTO cycles in civil aviation sector, a certain degree of uncertainty exists. In road transport one important basic parameter for the COPERT IV model is vehicle-km, which is calculated through another model. This second model is based on the mileage driven by the vehicle noted at time of TA (annual inspection/testing of the vehicle) at Road Traffic Safety Directorate. If it is in place sharp changing of some external factors impacted fuel consumption, for example economy recession, fuel price or energy tax, it will not be shown as clearly in the development of vehicle mileage as in statistics on fuel consumption.

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.

3.2.6.2 Source-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the transport sector in order to achieve these quality objectives. Meetings dedicated for quality ensure and improvement are held annually among inventory and external experts.

All Tier 1 general inventory level QC procedures listed in chapter 1.2. applicable to this sector are used. These measures are implemented every year during the transport sector inventory. In addition, the consumption of every type of fuel in the last year is checked and compared with previous years. If large variations are discovered for certain fuels, responsible CSB staff is contacted for an explanation.

Estimated emissions verification:

- All estimations of the emissions done for a transport sector 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 EF estimated in CRF Reported. EFs are calculated per fuel, substance and CRF-code and checked against the emission factors to make sure that no calculation errors have occurred when emissions were computed. The calculated air transport emissions have been compared and verified with Eurocontrol's emission data for 2008-2015. The calculated activity data for fuel consumption of LTO and cruise mode and emissions were comparable and very close to those estimated by Eurocontrol.
- For road transport a checking is done on less aggregated level than CRF reported. Non CO_2 EF changes that are higher than 10% in time series are double-checked and reasonable explanation for EF changes has to be found.

All findings are documented by using check-lists, available on Regulations of the Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units". 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 above mentioned national legislation. Potential errors and inconsistencies are documented in the special form and corrections are made if necessary. The QC measures have been implemented concerning used activity data, implemented Guidelines, methods and EF. Form then is sent to National Inventory Compiler and it is archived in FTP folder.

Additional QA/QC checks for Tier2 methodology

For emission calculation in road transport additional QA/QC check approach has implemented. QC activities are realized 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 CO2 are calculated based on 2006 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.

3.2.6.3 Source specific recalculations

The following recalculations and improvements of the emission inventories have been made in the transport sector since the emission reporting in 2016. (Table 3.41).

Table 3.41 Recalculations in CRF 1.A.3 Transport

Sub-category	Recalculation	Improvements
Road transport (CRF 1.A.3.b)	LPG CO_2 emissions for 1990 – 2015 have been recalculated	Recalculations have been done due to corrected CO_2 EF for LPG. Total road transport GHG emissions increased by around 0.03% (2015).

3.2.6.4 Source specific planned improvements

No improvements are planned for the sector.

3.2.7 Other Sectors (CRF 1.A.4)

3.2.7.1 Category description

CRF 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 – according to 2006 IPCC Guidelines these emissions have to be reported in sectors producing them.

The CRF subsector 1.A.4. Other sectors were split into subsectors which are in line with 2006 IPCC Guidelines/CRF Reporter structure:

- 1.A.4.a Commercial/Institutional:
  - 1.A.4.a.i Stationary combustion;
  - 1.A.4.a.ii Off-road vehicles and other machinery;
- 1.A.4.b Residential:
  - 1.A.4.b.i Stationary combustion;
  - 1.A.4.b.ii Off-road vehicles and other machinery;
- 1.A.4.c Agriculture/Forestry/Fishing:
  - 1.A.4.c.i Stationary combustion;
  - 1.A.4.c.ii Off-road vehicles and other machinery;
  - 1.A.4.c.iii Fishing.

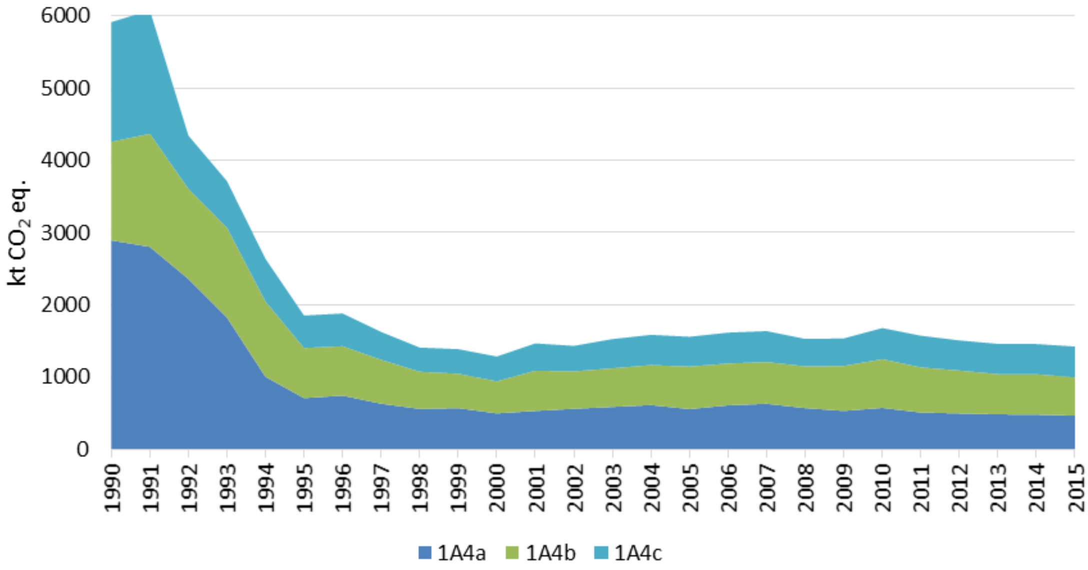

Figure 3.42 GHG emissions in CRF 1.A.4. Other sectors by subsectors (kt CO_2 eq.)

In Figure 3.42, there can be seen the distribution of GHG emissions in CRF 1.A.4 sector. The largest part of emissions contributes to CRF 1.A.4.b Residential (37.2% in 2015). Other subsectors' shares are quite similar – in 1.A.4.a Commercial/Institutional there are 32.7% from 1.A.4 emissions produced, while in 1.A.4.c Agriculture/Forestry/Fisheries, where also offroad emissions from Fisheries have been included, the share of emissions is 30.1%.

Table 3.42 Emissions from Other Sectors (CRF 1.A.4) in 1990–2015 (kt)

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
1990	5620.43	8.83	0.248	5915.26	19.46	162.54	16.75	35.12
1991	5736.54	9.85	0.319	6077.94	21.87	158.36	16.30	32.73
1992	4056.29	8.66	0.241	4344.43	16.88	140.52	15.07	26.62
1993	3420.35	9.19	0.214	3713.89	15.26	147.77	15.66	22.14
1994	2358.56	9.05	0.178	2637.68	12.49	145.26	15.57	17.44
1995	1570.98	9.27	0.166	1852.39	10.42	140.79	16.32	9.95
1996	1592.16	9.45	0.174	1880.39	10.64	148.46	17.01	10.73
1997	1350.21	8.95	0.171	1624.94	8.75	139.47	16.11	8.33
1998	1159.68	8.09	0.156	1408.31	7.45	132.96	15.23	6.31
1999	1141.96	8.01	0.150	1386.72	8.24	128.59	15.02	5.11
2000	1056.08	7.41	0.144	1284.17	7.93	125.21	14.42	3.93
2001	1215.56	8.19	0.153	1465.81	8.77	137.75	15.61	4.49
2002	1188.72	7.90	0.152	1431.44	8.12	132.96	15.29	3.81
2003	1275.19	8.11	0.160	1525.83	9.25	139.98	16.10	3.76
2004	1325.22	8.35	0.172	1585.17	9.30	141.16	16.46	3.65
2005	1299.68	8.24	0.177	1558.39	8.94	143.29	16.55	3.67
2006	1361.77	7.91	0.188	1615.52	8.81	139.12	16.13	3.42
2007	1378.89	7.96	0.197	1636.38	8.48	136.10	16.00	3.06
2008	1299.70	7.07	0.175	1528.63	7.69	132.05	14.92	2.45
2009	1287.78	7.68	0.185	1534.86	7.87	145.11	16.31	2.57
2010	1466.84	6.32	0.180	1678.65	7.79	111.93	12.82	2.28
2011	1363.83	6.19	0.181	1572.35	7.80	117.86	13.19	2.24
2012	1286.70	6.71	0.178	1507.41	7.53	118.84	13.60	2.17

	CO_2	CH_4	N_2O	GHGs (CO_2 eq)	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
2013	1255.42	6.11	0.174	1460.12	7.32	106.49	12.34	2.02
2014	1258.48	5.88	0.173	1457.16	7.33	99.78	11.46	1.98
2015	1226.81	5.79	0.17	1423.58	7.37	96.65	11.17	1.80
Share of Energy total, 2015	18.3%	52.3%	35.8%	20.0%	24.5%	77.7%	52.9%	50.5%
2015 vs 2014	-2.5%	-1.6%	0.9%	-2.3%	0.6%	-3.1%	-2.5%	-9.0%
2015 vs 1990	-78.2%	-34.5%	-29.7%	-75.9%	-62.1%	-40.5%	-33.3%	-94.9%

CO_2 emissions in CRF 1.A.4 sector decreased by 81.2% in 1990-2000 due to reorganizations in the country after the collapse of Soviet Union, as mentioned in previous chapters (Table 3.42). Since 2000, CO_2 emissions started to grow due to thrive in national economy, and increased by 30.6% in 2007. During economic crisis in 2008-2009 the emissions decreased by 5.7% in 2008 and 0.9% in 2009 accordingly. Increased in emissions in the following year is due to recovery of economy. However, in the recent years – 2012, 2013,2014 and 2015 the CO_2 emissions decreased by 5.7%, 8.0%, 7.72% and 10.0%. Comparing with 2011 level – in 2012 a lot more biomass was used, and the use of solid fuels decreased significantly, whereas in 2013 gaseous fuels were used less than in 2012, and also the consumption of biomass reduced. In 2014 the CO_2 emissions are almost in the same level as in 2013. 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. In 2015 decrease in in use of gaseous, solid fuel and biomass continues, however slight increase in liquid fuel use can be seen. Overall CO_2 emissions in 2015 have decreased by 2.5% in comparison with 2014 and by 78.2% in comparison with 1990.

CH_4 and N_2O emissions shows the biomass consumption trend – in 2012 the increase in CH_4 emissions was 8.4% and decrease 1.6% in N_2O emissions respectively, comparing with 2011, and in 2013 there can be seen a decrease in CH_4 and N_2O emissions by 8.9% and 2.1%, comparing with 2012. A decrease in emissions can be seen also in 2014, comparing with 2013 – CH_4 emissions have decreased by 3.9%, and N_2O emissions have a decrease by 0.5%. In 2015 small decrease can be seen -1.6% in CH_4 emissions and slight increase 0.9% in N_2O emissions.

Indirect GHG emissions from CRF 1.A.4 Other sectors were estimated as well. SO_2 had the biggest decrease by 94.9% in 1990–2015. It can be 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 the quality of used liquid fuels in country. NO_x emissions have also decreased by 62.1% in 1990-2015, NMVOC emissions – by 33.3%, and CO emissions – by 40.5%. The decrease can also be explained with fuel switch from solid to natural gas and biomass, which have lower emission factors.

3.2.7.2 Methodological issues

Methods

2006 IPCC Guidelines' 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, for some fuels there are no country-specific emission factors, therefore 2006 IPCC

Guidelines Tier 1 method using default emission factors was used. 2006 IPCC Guidelines' Tier 1 method was used to calculate CH_4 and N_2O emissions from the CRF 1.A.4 sector.

Calculation of all emissions from fuel combustion is done with Excel databases developed by the experts from LEGMC.

The general method for emission data preparation was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (kt)
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 2006 Guidelines;
- EMEP/EEA 2016.

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 CRF 1.A.4 Other sectors are estimated with the same equations and using same methods as for CRF 1.A.1 Energy industries sector, including calculation methods and assumptions for landfill gas and other biogas as in CRF 1.A.1 sector.

For some fuels default CO_2 emission factors from 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.4, were taken due to unavailability of country specific data:

- other liquid fuels – 73.3 kt/PJ;
- coal – 94.6 kt/PJ;
- biodiesel – 70.8 kt/PJ;
- straws – 100 kt/PJ;
- charcoal – 112 kt/PJ;
- waste oils – 73.3 kt/PJ.

For CRF 1.A.4.c.iii Fishing default CO_2 emission factors were taken from 2006 IPCC Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Table 3.5.2:

- diesel oil – 74.1 kt/PJ;
- residual fuel oil – 77.4 kt/PJ.

SO_2 emissions factors

SO_x emission factors for CRF 1.A.4 Other sectors are estimated with the same equations and using same method as for CRF 1.A.1 and CRF 1.A.2 sectors.

Other emission factors

The default CH_4 and N_2O emission factors are taken from 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.3 (CRF 1.A.4.a, 1.A.4.c). For estimating CH_4 emissions from wood in CRF 1.A.4.b.i sector, Tier 2 approach with country specific EFs was used. These factors were obtained in a research "*Estimation of* CH_4 *and N_2O emission factors for solid biomass, taking into account fuel and installation types*". N_2O emission factors for wood products are taken from 2006 IPCC Guidelines, Chapter 2 *Stationary combustion*, Table 2.3. It has to be noted that for wood and charcoal the lowest N_2O EFs were taken from the given range.

$NO_{x,}$ CO and NMVOC emission factors used in estimation of emission were taken from EMEP/EEA 2016, Chapter 1.A.4 Small combustion, Tables 3-12 to 3-25 (CRF 1.A.4.b.i), Tables 3-7 to 3-10 (CRF 1.A.4.a.i, 1.A.4.c.i).

List of other emission factors can be seen in Table 3.43 and Table 3.44.

Table 3.43 CH_4, N_2O, NO_x, NMVOC, CO emission factors in CRF 1.A.4.a and 1.A.4.c (kt/PJ)

	CH_4		**N_2O**	**NO_x**	**NMVOC**	**CO**
	1.A.4.a	1.A.4.c				
Diesel oil	0.01	0.01	0.0006	0.3033	0.0129	0.0403
RFO	0.01	0.01	0.0006	0.3033	0.0129	0.0403
LPG	0.005	0.005	0.0001	0.074	0.023	0.029
Jet fuel	0.01	0.01	0.0006	0.3033	0.0129	0.0403
Other kerosene	0.01	0.01	0.0006	0.3033	0.0129	0.0403
Other liquid	0.01	0.01	0.0006	0.3033	0.0129	0.0403
Waste oils	0.3	0.3	0.004	0.513	0.025	0.066
Shale oil	0.01	0.01	0.0006	0.3033	0.0129	0.0403
Coal	0.01	0.3	0.0015	0.173	0.0888	0.931
Peat briquettes	0.01	0.3	0.0015	0.173	0.0888	0.931
Peat	0.01	0.3	0.0014	0.173	0.0888	0.931
Natural gas	0.005	0.005	0.0001	0.074	0.023	0.029
Wood	0.3	0.3	0.004	0.091	0.3	0.57
CH_4 from landfill gas	0.005	0.005	0.0001	0.074	0.023	0.029
Other biogas	0.005	0.005	0.0001	0.074	0.023	0.029
Straws	0.3	0.3	0.004	0.091	0.3	0.57
Biodiesel	0.01	0.01	0.0006	0.3033	0.0129	0.0403
Charcoal	0.2	0.2	0.001	0.091	0.3	0.57

Table 3.44 CH_4, N_2O, NO_x, NMVOC, CO emission factors in CRF 1.A.4.b (kt/PJ)

	CH_4	**N_2O**	**NO_x**	**NMVOC**	**CO**
	kt/PJ				
Diesel oil	0.01	0.0006	0.069	0.00017	0.0037
RFO	0.01	0.0006	0.069	0.00017	0.0037
LPG	0.005	0.0001	0.042	0.0018	0.022
Other kerosene	0.01	0.0006	0.069	0.00017	0.0037
Coal	0.3	0.0015	0.158	0.174	4.787
Peat briquettes	0.3	0.0015	0.158	0.174	4.787
Peat	0.3	0.0014	0.158	0.174	4.787
Natural gas	0.005	0.0001	0.042	0.0018	0.022

		CH_4	N_2O	NO_x	NMVOC	CO
		kt/PJ				
Wood	Central heating boilers	0.361	0.0015	0.08	0.35	4
	Hot water boilers	0.009	0.0015	0.08	0.35	4
	Combination boilers - central heating and hot water boilers	0.131	0.0015	0.08	0.35	4
	Room furnaces	0.099	0.0015	0.08	0.35	4
	Economic furnaces	0.097	0.0015	0.095	0.25	2
	Kitchen stoves	0.083	0.0015	0.05	0.6	4
	Pellet stoves	IE	IE	0.08	0.01	0.3
Straws		0.3	0.004	0.08	0.6	4
Charcoal		0.2	0.0003	0.08	0.6	4

Gasoline emission factors are used for CH_4 and N_2O emission estimation from off-roads (2006 IPCC Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Table 3.3.1.). As there is no information about distribution between 2-stroke and 4-stroke engines, it was assumed that 25% of consumed gasoline is combusted in 2-stroke engines, while 75% - in 4-stroke engines. Such assumption has been made, based on Danish data which are presented in EMEP/EEA 2016 for air pollutants' calculations. The emission factors for indirect GHGs were taken from Chapter 1.A.4. Non-road mobile sources and machinery. $NO_{x,}$ CO and NMVOC emission factors used in estimation of emission were taken from EMEP/EEA 2016, Chapter 1.A.4 Non-road mobile sources and machinery, Table 3-1.

Also diesel oil and residual fuel oil consumed in Fisheries sector was assumed as consumed by fishing ships and the emission factors were taken from 2006 IPCC Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Table 3.5.2. Emission factors for indirect GHGs are taken from EMEP/EEA 2016, Chapter 1.A.3.d., Table 3-1. It was assumed that not all diesel oil combusts in off-roads, but 99% of amount that is produced in 1.A.4.c. CSB confirmed that 1% of diesel oil is used in stationary combustion.

Emission factors for gasoline consumed in Offroads and diesel oil and residual fuel oil consumed in Fisheries are presented in Table 3.45.

Table 3.45 CH_4, N_2O, NO_x, NMVOC, CO emission factors for gasoline, diesel and RFO (kg/Mg[21])

		Gasoline		Diesel	Offroad Diesel		RFO
		2-stroke	4-stroke		Agriculture	Forestry	
CH_4	1.A.4.a.ii	0.18	0.12	NO	NO	NO	NO
	1.A.4.b.ii	0.18	0.12		NO	NO	
	1.A.4.c.ii	0.17	0.08		0.00415	0.00415	
	1.A.4.c.iii	NO	NO	0.007	NO	NO	0.007
N_2O	1.A.4.a.ii	0.0004	0.002	NO	NO	NO	NO
	1.A.4.b.ii				NO	NO	
	1.A.4.c.ii				0.286	0.286	
	1.A.4.c.iii	NO	NO	0.002	NO	NO	0.002
NO_x	1.A.4.a.ii	2.765	7.117	NO	NO	NO	NO
	1.A.4.b.ii				NO	NO	
	1.A.4.c.ii				34.457	28.471	
	1.A.4.c.iii	NO	NO	78.5	NO	NO	79.3
NMVOC	1.A.4.a.ii	227.289	18.893	NO	NO	NO	NO

[21] *For CH_4 and N_2O – kt/PJ*

		Gasoline		Diesel	Offroad Diesel		RFO
		2-stroke	4-stroke		Agriculture	Forestry	
	1.A.4.b.ii				NO	NO	
	1.A.4.c.ii				3.542	1.997	
	1.A.4.c.iii	NO	NO	2.8	NO	NO	2.7
CO	1.A.4.a.ii	620.739	770.368	NO	NO	NO	NO
	1.A.4.b.ii				NO	NO	
	1.A.4.c.ii				11.469	7.673	
	1.A.4.c.iii	NO	NO	7.4	NO	NO	7.4

Activity data

Mainly emissions from fuel combustion are calculated using fuel consumption data from the CSB Energy Balance. The data collection system for CRF 1.A.4 sector is the same as for CRF 1.A.1 and CRF 1.A.2 sectors. Data on fuel consumption in 1.A.4 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.4 sector according to 2006 IPCC Guidelines.

Gasoline and 99% of diesel oil combustion is reported as off-roads in CRF 1.A.4 sector. Only 1% of diesel oil is combusted stationary in 1.A.4.c.

In CRF 1.A.4.c.iii Fishing it is assumed, that diesel oil and residual fuel oil is consumed by fishing vessels.

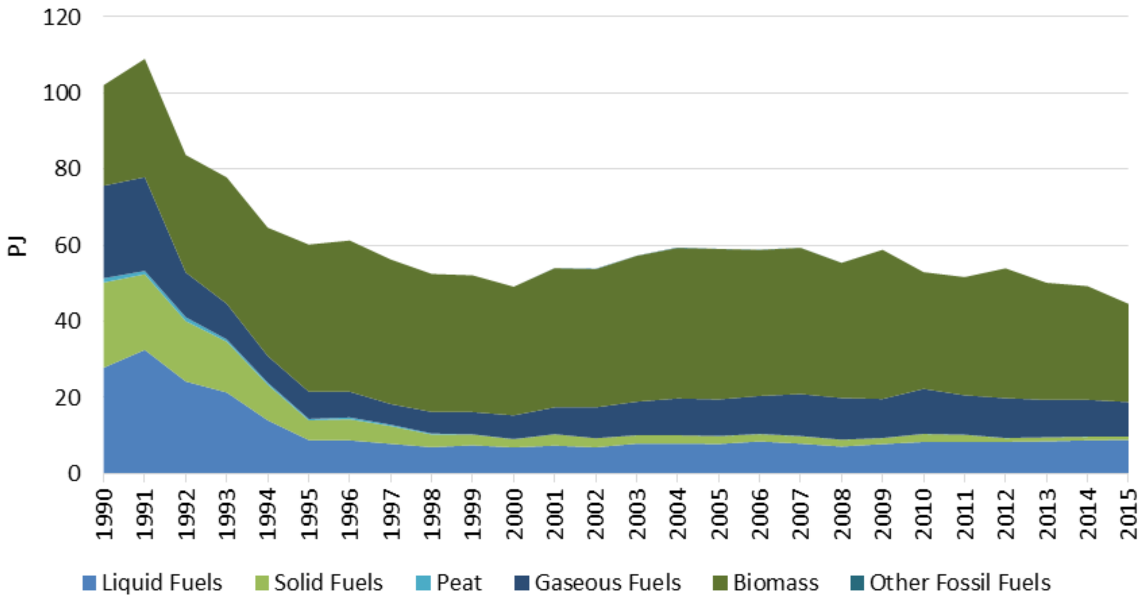

Figure 3.43 Fuel consumption in Other sectors (CRF 1.A.4) for 1990-2015 (PJ)

The biggest decrease in 1990-2015 was for solid fuel consumption – 96.3% and liquid fuels consumption – 68.1% (Figure 3.43), gaseous fuels by 62.5%. 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 dominates as a fuel in CRF 1.A.4 sector. 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 by 13% in 1990–2014 in Other sectors. However, it can be seen that the amounts of biomass have been fluctuating over recent years which can mainly be explained with temperature fluctuations during winter. In recent years use of biomass has decreased and in comparison 1990-2015 use of biomass have decreased by 2.5%. In 2014-2015 there was 13.7% decrease.

Since 1997 gaseous fuel consumption was constantly increasing until 2007, because it had lower costs to and liquid and solid fuels were replaced with natural gas as a fuel. The increase in fuel consumption in CRF 1.A.4 Other sectors is strongly linked to decrease in fuel consumption in CRF 1.A.1 Energy industries when central heating supply consumers switched to individual heating supply. In the recent years a decreased consumption in natural gas is observed, which was influenced by increasing costs of particular fuel.

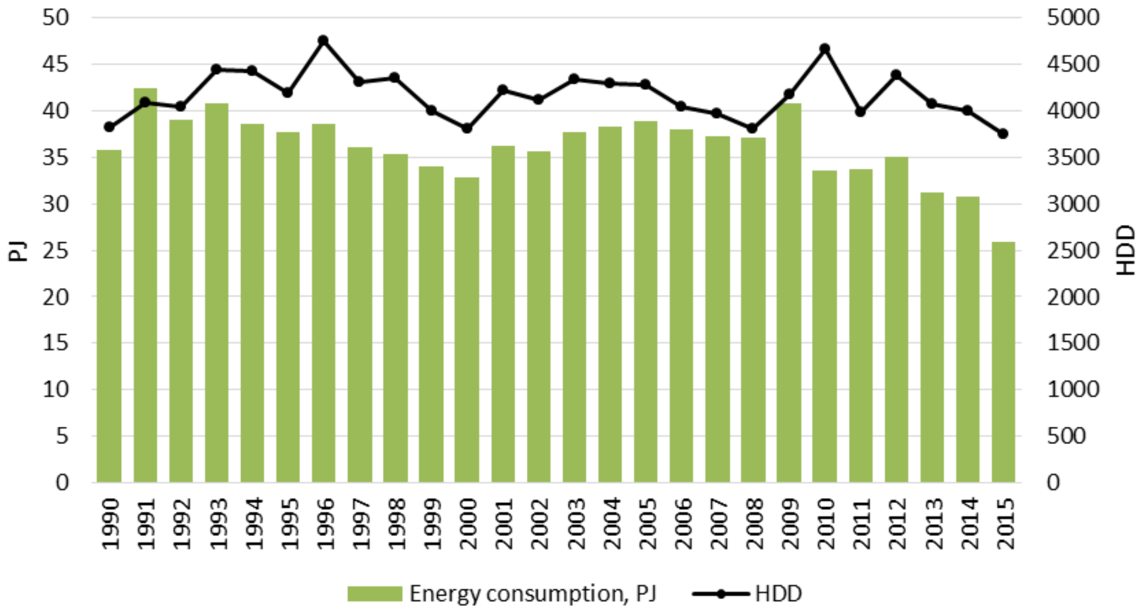

Figure 3.44 Fuel consumption in Residential sector (CRF 1.A.4.b) for stationary combustion and heating degree days in Latvia

As it can be seen in Figure 3.44, fuel consumption in 1.A.4.b sector is related with changes in temperature – in years where heating degree days are more, the amounts of consumed fuel are also larger, especially it can be seen in 1994-2003 and in the most recent years. In 2008 there was considerably low number of HDDs, and also the fuel consumed was less than in 2007. However, in 2009-2010 the correlation between HDDs and consumption is less visible because of impact of global crisis, which clearly affected the Residential sector. In 2011-2013 there can be seen a correlation in HDDs and fuel consumption – in 2012 the number of HDDs was by 9.9% higher than in 2011, and more fuel was consumed. In 2015 number of HDDs was 6.6% less than in 2014 and in result 16% less fuel was consumed. Also changes in heating devices impact amount of fuel used. Higher efficiently boiler will use less fuel to produce same amount of heat.

3.2.7.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty in activity data of fuel combustion in 1.A.4 sector is ±2% in 2015. 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 and peat combustion was assigned as 5% because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass. As fuel consumption in CRF 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 15%. According to 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19, biomass data are generally more uncertain than other data in national energy statistics, because a large fraction of the biomass may be part of the informal economy, and the trade in these type of fuels is frequently not registered in the national energy statistics and balances. Uncertainty of landfill gas stationary combusted in enterprises covered by 1.A.4 Other sectors was assumed rather low – 2% because the combusted fuel amount is obtained directly from landfill plant that has precise measurement equipment for accounting of combusted fuel. Still the methane percentage amount in combusted landfill gas is given approximately, therefore final uncertainty of biomass fuels is assumed as 5%.

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, hence the 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 annual plant specific fuel data is used to estimate emission factor.

CH_4 and N_2O emission factor used in estimation of emissions was taken according to 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.12., which provides the range of default values for uncertainties. The uncertainty both for CH_4 and N_2O EFs was assigned as uncertainties used in previous submissions – 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. Emissions from all sectors are estimated or reported as not occurring / not applicable, therefore there are no "not estimated" sectors.

3.2.7.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed

according to the QA/QC plan in the Energy sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

All documentation and information received for inventory purposes are archived in FTP folder. All findings are documented by using check-lists, available on Regulations of the Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units".

Activity data verification

All sources of energy data are presented in the corresponding NIR chapter as well as disaggregated data at the finest level possible are presented in the corresponding Annex A.3.1. Data completeness has been explained in the previous subchapter.

Activity data have been checked at the data provider – Central Statistical Bureau, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data have been received, the sectoral expert responsible for the emission estimation and reporting are comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

All activity data used in Sectoral Approach are also compared with activity data used in Reference Approach estimations. All significant differences (±5%) are explained in the corresponding subchapter.

Emission factor verification

For country-specific CO_2 emission factors, the sources of the calorific values and carbon content , as well as these values are provided in 3.2.7.2 Methodological issues.

Country specific CO_2 values for year are compared with default ones available on 2006 IPCC Guidelines, Volume 2, Chapter 2 *Stationary combustion*, Table 2.2. Whether country specific CO_2 emission factor is or is not in the confidence interval, can be seen in Table 3.46.

Table 3.46 Comparison of country specific and 2006 IPCC default CO_2 emission factor values (kt/PJ)

	Lower	CS	Upper
Gasoline	67.50	71.18	73.00
Diesel oil	72.60	74.74	74.80
RFO	75.50	77.36	78.80
LPG	61.60	62.75	65.60
Jet fuel	69.70	72.23	74.40
Other kerosene	70.80	72.24	73.70
Other liquid	72.20	72.59	74.40
Shale oil	67.80	77.12	79.20
Peat	100.00	105.99	108.00
Natural gas	54.30	54.63	58.30
Wood	95.00	109.98	132.00
Sludge gas	46.20	51.13	66.00
Landfill gas	46.20	51.13	66.00
Other biogas	46.20	51.13	66.00

All country specific values incorporate in 2006 IPCC default CO_2 lower and upper emission factor values.

Emission verification:

To verify the CO_2 emissions, logical mistakes are checked 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. The emissions for indirect GHGs in the database are cross-checked with emissions reported within CLRTAP for verification purposes.

CO_2 emissions are compared with emissions in Reference Approach estimations, and all significant differences (±5%) are explained in the corresponding subchapter.

3.2.7.5 Category-specific recalculations

Recalculations have been done in CRF 1.A.4 sector due to activity data corrections:

- 1.A.4.a.i Landfill gas in 2012;
- 1.A.4.a.i Lanfrill gas in 2014;
- 1.A.4.c.i Biofuel in 2014;
- 1.A.4.c.ii Gasoline in 2014.

Emission factor changed due to switching from EMEP/EEA 2013 to EMEP/EEA 2016 guidelines.

3.2.7.6 Category-specific planned improvements

It is planned to update CO_2 EFs for most widely used fuels in Latvia.

3.2.8 Other (CRF 1.A.5)

3.2.8.1 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 3.47).

Table 3.47 Emissions from Other sources (CRF 1.A.5) in 1990–2015 (kt)

	CO_2	CH_4	N_2O	Aggregate GHGs	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
1990	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1991	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1992	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1993	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1994	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1995	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
1996	0.19	1.36E-06	5.45E-06	0.19	2.48E-04	0.07	1.18E-03	1.9E-05
1997	0.10	6.82E-07	2.73E-06	0.10	1.24E-04	0.04	5.89E-04	9.3E-06
1998	0.19	1.36E-06	5.45E-06	0.19	2.48E-04	0.07	1.18E-03	1.9E-05
1999	0.15	1.08E-06	4.31E-06	0.15	1.96E-04	0.06	9.30E-04	1.5E-05
2000	0.14	9.67E-07	3.87E-06	0.14	1.76E-04	0.05	8.35E-04	1.3E-05
2001	0.17	1.19E-06	4.75E-06	0.17	2.16E-04	0.06	1.03E-03	1.6E-05
2002	6.88	5.32E-04	1.87E-04	6.95	0.14	0.54	0.013	7.8E-03
2003	6.16	4.61E-04	1.68E-04	6.22	0.12	0.55	0.013	6.9E-03
2004	9.63	7.86E-04	2.61E-04	9.73	0.21	0.57	0.016	1.1E-02

	CO_2	CH_4	N_2O	Aggregate GHGs	NO_x	CO	NMVOC	SO_2
	kt			kt CO_2 eq.	kt			
2005	7.62	5.53E-04	2.08E-04	7.70	0.14	0.75	0.017	8.4E-03
2006	7.51	5.27E-04	2.05E-04	7.59	0.14	0.83	0.018	8.0E-03
2007	2.84	1.12E-04	7.85E-05	2.87	0.03	0.70	0.012	2.5E-03
2008	3.41	1.58E-04	9.40E-05	3.44	0.04	0.73	0.013	2.0E-03
2009	5.34	3.55E-04	1.46E-04	5.39	0.09	0.67	0.014	3.4E-03
2010	7.87	6.17E-04	2.14E-04	7.95	0.16	0.58	0.015	5.0E-03
2011	7.22	5.71E-04	1.96E-04	7.29	0.15	0.51	0.013	4.6E-03
2012	7.33	5.61E-04	1.99E-04	7.40	0.15	0.60	0.014	4.7E-03
2013	6.45	4.56E-04	1.76E-04	6.51	0.12	0.69	0.015	4.1E-03
2014	9.44	7.50E-04	2.56E-04	9.54	0.20	0.65	0.017	6.0E-03
2015	9.57	7.90E-04	2.60E-04	9.67	0.21	0.52	0.015	6.1E-03
Share of Energy total, 2015	0.1%	0.0%	0.1%	0.1%	0.7%	0.4%	0.1%	0.2%
2015 vs 2014	1.3%	5.4%	1.2%	1.3%	5.5%	-19.5%	-9.5%	1.3%
2015 vs 1996	5013.9%	57984.1%	4759.9%	5021.2%	83881.3%	704.0%	1302.7%	32783.6%

Emissions from this sector are not 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 recent years until 2012 there has been an increase of fuel consumption, according to data given by CSB. In 2013 the GHG emissions decreased by 12% comparing with 2012. After 2013 fuel consumption has increased again. Emissions 2014-2015 have increased by 1.3% Only decrease in emissions can be seen with CO (-19.5%) and NMVOC (-9.5%).

3.2.8.2 Methodological issues

Methods

2006 IPCC Guidelines' Tier 1 method was used to calculate GHG emissions from the 1.A.5.b Other Mobile source sector.

Calculations of all emissions from fuel combustion are done with Excel databases developed by experts from LEGMC.

The general method for preparing inventory data was used:

$$Em = EF \times B_q$$

where:
Em – total emissions (kt)
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 2006 IPCC Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Table 3.5.2 and Table 3.6.4 (Table 3.48).

Indirect GHGs emission factors were taken from EMEP/EEA 2016. Country specific emission factors were used to calculate sulphur dioxide (SO_2) emissions.

Table 3.48 CO_2, CH_4, N_2O, NOx, NMVOC, CO emission factors[22]

	CO_2	CH_4	N_2O	NO_x	NMVOC	CO
Aviation gasoline	69.3	0.0005	0.002	4	19	1200
Diesel oil	74.1	0.007	0.002	78.5	2.8	7.4
Jet fuel	71.5	0.0005	0.002	4	19	1200

3.2.8.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.5.b is ±2% in 2015 because official statistical information from CSB is used.

Emission factors used for emission estimation were taken from 2006 IPCC Guidelines. For diesel oil the uncertainty for CO_2 emission factor, according to these Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Section 3.5.1.7, is 2%, but for CH_4 and N_2O it is much higher - about 50%. For aviation gasoline and jet fuel, the uncertainty for CO_2 emission factor, according to 2006 IPCC Guidelines, Volume 2, Chapter 3 *Mobile combustion*, Section 3.6.1.7, is 5%, but for CH_4 and N_2O it is assumed that the uncertainty is very high – 100%.

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.

3.2.8.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the Energy sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

All documentation and information received for inventory purposes are archived in FTP folder. All findings are documented by using check-lists, available on Regulations of the Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units".

Activity data verification

All sources of energy data are presented in the corresponding NIR chapter (3.2.8.2 Methodological issues) as well as disaggregated data at the finest level possible are presented in the corresponding Annex A.3.1. Data completeness has been explained in the previous subchapter.

Activity data have been checked at the data provider – Central Statistical Bureau, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data have been received, the sectoral expert responsible for the emission estimation and reporting are comparing all data changes with the previous

[22] *Units for GHGs are in kt/PJ, for indirect GHGs in kg/Mg.*

inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

All activity data used in Sectoral Approach are also compared with activity data used in Reference Approach estimations. All significant differences (±5%) are explained in the corresponding subchapter.

Emission factor verification

As all emission factors are taken from 2006 IPCC Guidelines, no additional verification procedures have been performed.

Emission verification

To verify the CO_2 emissions, logical mistakes are checked 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. The emissions for indirect GHGs in the database are cross-checked with emissions reported within CLRTAP for verification purposes.

CO_2 emissions are compared with emissions in Reference Approach estimations, and all significant differences (±5%) are explained in the corresponding subchapter.

3.2.8.5 Category-specific planned recalculations

No recalculations are done in particular sector.

3.2.8.6 Category-specific planned improvements

No improvements are planned to be done until the next submission.

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

Under the 1.B Fugitive emissions category CO_2, CH_4 and NMVOC emissions from operations with natural gas and light liquid fuels are reported (Table 3.49).

Table 3.49 Reported fugitive CO_2, CH_4, NMVOC emissions in Latvia in 1990-2015 (kt)

	CO_2	CH_4	Aggregate GHGs	NMVOC
	kt		kt CO_2 eq.	
1990	0.0115	9.90	247.59	4.18
1991	0.0111	9.54	238.49	3.88
1992	0.0101	8.70	217.43	3.59
1993	0.0097	8.32	207.94	3.45
1994	0.0094	8.13	203.20	3.35
1995	0.0092	7.92	197.89	3.19
1996	0.0089	7.63	190.68	3.10
1997	0.0083	7.12	177.96	2.88
1998	0.0079	6.83	170.75	2.75
1999	0.0076	6.51	162.79	2.63
2000	0.0070	6.03	150.64	2.48
2001	0.0073	5.84	146.09	2.47
2002	0.0074	6.10	152.57	2.52
2003	0.0055	4.76	119.08	2.12
2004	0.0055	4.71	117.87	2.11

	CO_2	CH_4	Aggregate GHGs	NMVOC
	kt		kt CO_2 eq.	
2005	0.0062	5.33	133.19	2.28
2006	0.0044	3.82	95.53	1.91
2007	0.0046	3.92	98.07	2.72
2008	0.0047	4.03	100.70	2.50
2009	0.0044	3.81	95.13	2.44
2010	0.0043	3.66	91.61	2.35
2011	0.0054	2.52	63.03	1.40
2012	0.0049	3.18	79.61	1.44
2013	0.0080	4.04	101.01	1.71
2014	0.0138	5.41	135.33	2.34
2015	0.0129	4.11	102.81	2.40
Share of Energy total, 2015	0.0002%	37.2%	1.4%	67.3%
2015 vs 2014	-6.0%	-24.0%	-24.0%	2.7%
2015 vs 1996	146.2%	53.9%	53.9%	77.5%

It is assumed that no GHG emissions are generated during hard coal transportation via railways. Only particulate matters emissions are estimated from coal transportation in Latvia.

There are lasting peat mining and manufacturing traditions in Latvia. As stated in 2006 IPCC Guidelines, Volume 4 *Agriculture, Forestry and Other Land Use*, Chapter 1 *Introduction*, with current state of scientific knowledge, it is possible to provide methods for estimating CO_2 and N_2O emissions associated with management of peatlands, and CO_2 from conversion to wetlands by flooding. However, according to 2006 IPCC Guidelines, Volume 4, Chapter 7 *Wetlands*, all on-site sources of greenhouse gas emissions should be reported under AFOLU *Wetlands* category regardless of the end-use of peat.

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

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

3.3.1.1 Category description

CRF sector 1.B.2.a Oil includes NMVOC emissions from refined oil products storage and distribution. There are no oil refineries in Latvia; therefore NMVOC emissions from gasoline distribution only were calculated for 1990–2015.

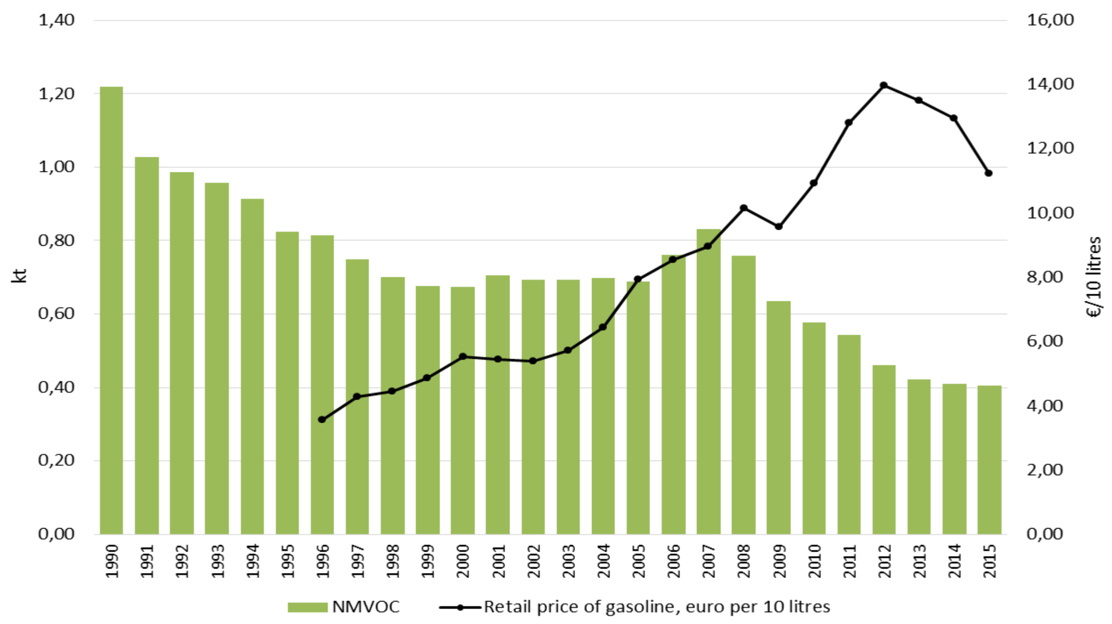

Figure 3.45 Fugitive NMVOC emissions from oil products in 1990–2015

Decrease of NMVOC emissions in whole time series can be generally explained with increasing costs of gasoline therefore it was used less. In 2005-2007 there can be seen a rise in emissions which can be explained with economic growth and prosperity, however, in 2008 due to global crisis, the use of gasoline, as well as NMVOC emissions decreased, and continued to decrease after that because of rapid increase in retail price (Figure 3.45). Since 1990 up to 2015 the NMVOC emissions have decreased by 66.7%. Comparing 2014 with 2015 NMVOC emissions have decreased by 1.1%.

3.3.1.2 Methodological issues

Methods

EMEP/EEA 2016 Tier 1 methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in 1990–2015. It uses the general equation, where emissions are obtained by multiplying the total amount of gasoline sold with the emission factor.

Emission factors

NMVOC emission factor – 2 kg/Mg oil – for emission from gasoline distribution was taken from EMEP/EEA 2016, Chapter 1.B.2.a.v Distribution of oil products, Table 3-1.

Activity data

Activity data for NMVOC emission calculation was used from CSB Energy Balance (Table 3.50).

Table 3.50 Gasoline consumption in Latvia in 1990–2015 (TJ)

1990	26796
1991	22616
1992	21692
1993	21032

1994	20108
1995	18128
1996	17908
1997	16456
1998	15400
1999	14872
2000	14831
2001	15535
2002	15228
2003	15214
2004	15346
2005	15126
2006	16753
2007	18299
2008	16672
2009	13941
2010	12667
2011	11926
2012	10146
2013	9282
2014	9018
2015	8922

3.3.1.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Activity data for fugitive emissions from operations with gasoline were taken from CSB and uncertainty was assumed as very low for about 2% as statistical frame mistake. Uncertainty for emission factor is assumed as 100%, according to 2006 IPCC Guidelines, Volume 2, Chapter 4 *Fugitive emissions*, Table 4.2 (refined product distribution).

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.

3.3.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the Energy sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

All documentation and information received for inventory purposes are archived in FTP folder. All findings are documented by using check-lists, available on Regulations of the

Cabinet of Ministers No. 217 adopted on 27 March 2012 "The National Inventory System of Greenhouse Gas Emission Units".

Activity data verification

All sources of energy data are presented in the corresponding NIR chapter (3.3.1.2 Methodological issues) as well as disaggregated data at the finest level possible are presented in the corresponding Annex A.3.1. Data completeness has been explained in the previous subchapter.

Activity data have been checked at the data provider – Central Statistical Bureau, which has its own internal QA/QC procedures based on mathematic model and analysis to avoid logic mistakes. When activity data have been received, the sectoral expert responsible for the emission estimation and reporting are comparing all data changes with the previous inventory, and all changes are explained in the corresponding subchapter. All fluctuations or changes in NCVs are double checked and agreed with CSB.

Emission factor verification

As all emission factors are taken from EMEP/EEA 2016, no additional verification procedures have been performed.

Emission verification

To verify the NMVOC emissions, logical mistakes are checked 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. The emissions are also cross-checked with emissions reported within CLRTAP for verification purposes.

3.3.1.5 Category-specific recalculations

No recalculations are done in the particular subsector.

3.3.1.6 Category-specific planned improvements

No improvements are planned to be done until the next submission.

3.3.2 Fugitive emissions from natural gas (CRF 1.B.2.b, CRF 1.B.2.c, CRF 1.B.2.d)

3.3.2.1 Category description

CO_2, CH_4 and NMVOC emissions from operations with natural gas are reported in the following sub-sectors CRF 1.B.2.b Natural gas sector:

- 1.B.2.b.i Venting;
- 1.B.2.b.iii All other:
  - 1.B.2.b.iii 4 Transmission and storage;
  - 1.B.2.b.iii 5 Distribution;
  - 1.B.2.b.iii 6 Other (includes leakage at industrial plants and power stations and leakage at residential and commercial sectors)

Table 3.51 Fugitive CH_4, CO_2 and NMVOC emissions from natural gas 1990-2015 (kt)

	CO_2	CH_4	Aggregate GHGs	NMVOC
	kt		kt CO_2 eq.	
1990	0.0115	9.90	247.59	2.97
1991	0.0111	9.54	238.49	2.86
1992	0.0101	8.70	217.43	2.60
1993	0.0097	8.32	207.94	2.49
1994	0.0094	8.13	203.20	2.43
1995	0.0092	7.92	197.89	2.37
1996	0.0089	7.63	190.68	2.28
1997	0.0083	7.12	177.96	2.13
1998	0.0079	6.83	170.75	2.05
1999	0.0076	6.51	162.79	1.95
2000	0.0070	6.03	150.64	1.80
2001	0.0073	5.84	146.09	1.76
2002	0.0074	6.10	152.57	1.83
2003	0.0055	4.76	119.08	1.43
2004	0.0055	4.71	117.87	1.41
2005	0.0062	5.33	133.19	1.60
2006	0.0044	3.82	95.53	1.14
2007	0.0046	3.92	98.07	1.89
2008	0.0047	4.03	100.70	1.74
2009	0.0044	3.81	95.13	1.81
2010	0.0043	3.66	91.61	1.77
2011	0.0054	2.52	63.03	0.86
2012	0.0049	3.18	79.61	0.98
2013	0.0080	4.04	101.01	1.28
2014	0.0138	5.41	135.33	1.93
2015	0.0129	4.11	102.81	2.00
Share of Energy total, 2015	0.0002%	37.2%	1.4%	9.4%
2015 vs 2014	-6.0%	-24.0%	-24.0%	3.5%
2015 vs 1990	12.6%	-58.5%	-58.5%	-32.7%

GHG emissions have a decreasing trend in 1990-2015 by 58.5%. There are few years where the emissions increased, and in all cases the increase is related with repair works and modernisation of existing pipeline system. In comparison with 2014 emissions have decreasing by 24.0% in 2015.

Table 3.52 Pipline length 1990-2015 (km)

	Transport (main) gas pipeline system lenght, km	Distribution pipeline lenght, km
1990	1109	-
1991	1109	-
1992	1112	-
1993	1124	-

	Transport (main) gas pipeline system lenght, km	Distribution pipeline lenght, km
1994	1213	-
1995	1213	-
1996	1213	-
1997	1213	2882
1998	1213	2921
1999	1213	2999
2000	1213	3085
2001	1234	3234
2002	1234	3509
2003	1234	3675
2004	1234	3906
2005	1281	4339
2006	1281	4418
2007	1242	4586
2008	1238	4757
2009	1240	4771
2010	1240	4825
2011	1240	4857
2012	1240	4898
2013	1240	4934
2014	1240	4967
2015	1191	5040

Information about gas pipeline length is received from "Latvijas Gāze" and can be seen in Table 3.52. Pipeline length differs from year to year due to construction of new pipelines and closing old ones.

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 1990–2015, 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, therefore it is assumed as Tier 3 method, using country-specific data and calculations.

LEGMC has methodological material, which describes how the amounts of natural gas leaked are calculated.

Activity data

CH_4 emissions are obtained from the holding company "Latvijas Gāze" and the activity data (millions m^3) are provided in Table 3.53.

Table 3.53 Amounts of natural gas leaked in 1990-2015 (10^6 m^3)

	1.B.2.c.1.ii Venting	1.B.2.b.iii 4 Transmission and storage	1.B.2.b.iii 5 Distribution	1.B.2.b.iii 6 Other	Total
1990	5.61	0.13	0.69	12.44	18.87
1991	5.38	0.13	0.69	11.98	18.17
1992	4.83	0.13	0.59	10.92	16.47
1993	4.58	0.13	0.69	10.44	15.85
1994	4.46	0.13	0.69	10.21	15.48
1995	4.32	0.13	0.69	9.94	15.08
1996	4.13	0.13	0.69	9.58	14.53
1997	3.80	0.13	0.69	8.94	13.56
1998	3.63	0.11	0.69	8.58	13.01
1999	3.42	0.11	0.69	8.18	12.40
2000	3.11	0.11	0.69	7.57	11.48
2001	0.30	0.10	0.69	10.03	11.14
2002	0.98	0.10	0.69	9.86	11.63
2003	1.09	0.10	0.69	7.20	9.07
2004	1.56	0.09	0.69	6.63	8.98
2005	3.25	0.09	0.69	6.12	10.15
2006	1.80	0.08	0.69	4.71	7.28
2007	1.76	0.07	0.69	4.95	7.47
2008	2.44	0.07	0.69	4.48	7.67
2009	1.78	0.06	0.69	4.71	7.25
2010	1.64	0.06	0.69	4.59	6.98
2011	1.77	0.05	0.69	1.70	4.21
2012	1.34	0.05	0.69	3.35	5.43
2013	1.09	0.04	0.69	4.06	5.89
2014	1.53	0.04	0.66	5.69	7.93
2015	0.95	0.04	0.71	4.35	6.03

3.3.2.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The level of uncertainty was determined by natural gas distributing company „Latvijas Gāze". The uncertainty both for activity data (gas amounts) and CH_4, CO_2 and NMVOC emissions from gas venting and natural gas leakages in gas distribution and transmission systems, as well as in gas storage facility is assigned as quite low – 10%, as these were 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.iii 6) the uncertainty for the emissions is assumed as 35%.

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

3.3.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed

according to the QA/QC plan in the Energy sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

"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 for the organization that is internationally verified and approved by the Environment State Bureau. Underground storage "Inčukalns" also has an ISO standard and all the information obtaining procedures are controlled and verified.

3.3.2.5 Category-specific recalculations

No recalculations are done in the particular subsector.

3.3.2.6 Category-specific planned improvements

No improvements are planned to be done until the next submission.

3.4 CO_2 TRANSPORT AND STORAGE (CRF 1.C)

There is no CO_2 captured and further storaged in Latvia. There is a research done to find the potential sites for CO_2 geological storage in Latvia within international project "Assessing European Capacity for Geological Storage of Carbon Dioxide" (EU GeoCapacity)[23,24]. Latvia has a storage potential in local structures in the Cambrian water-saturated sandstone. In one of such geological structures, an underground storage of natural gas was established already in 1968 – the Inčukalns natural gas storage. For modelling the potential costs, the largest CO_2 source in Latvia in 2005 from ETS was taken, and as potential storages were selected the two largest ones. The modelling results demonstrated that the efficiency of the establishment of CO_2 storages there is too low. The unsatisfactory results are associated with the inefficient injection of small volumes of CO_2 in the storages, and the cost of the establishment of infrastructure is quite high, and the expenditure is unfounded with the low level of CO_2 injection.

[23] *http://www.co2geonet.com/NewsData.aspx?IdNews=44&ViewType=Old&IdType=18*
[24] *http://meteo.lv/fs/CKFinderJava/userfiles/files/Geologija/Potential%20sites.pdf*

4 INDUSTRIAL PROCESSES AND PRODUCT USE (CRF 2)

4.1 OVERVIEW OF SECTOR

Greenhouse gas emissions from Industrial Processes and Product Use (IPPU) contributed 6.7% to the total anthropogenic greenhouse gas emissions excluding LULUCF, including indirect CO_2 in 2015 (Figure 4.1) totalling 760.54 kt CO_2 eq.

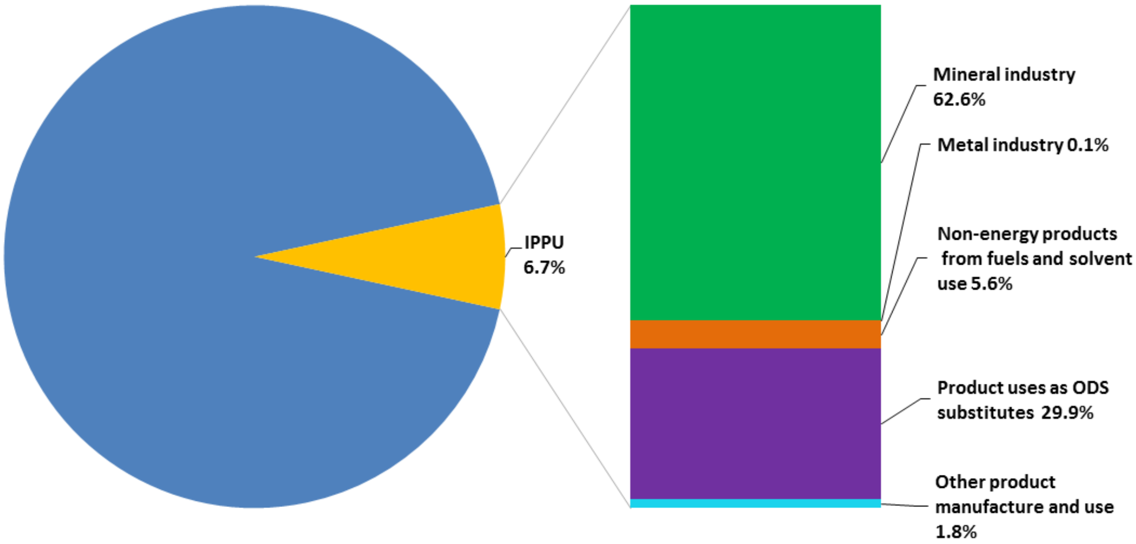

Figure 4.1 Emissions from the industrial processes and product use sector compared with the total emissions in 2015

The majority (62.6%) of IPPU emissions originate in 2.A Mineral industry (CO_2 emissions from Cement production (61.4%) and Lime production (0.1%) , Other process uses of carbonates (1.1%) and Glass production (0.1%)). The second largest emission category under IPPU sector is 2.F Product uses as substitutes for ODS constituting 29.9% from IPPU emissions and 2.0% from total GHG emissions in Latvia (excluding LULUCF, including indirect CO_2). Almost all 2.F. emissions comes from 2.F.1 Refrigeration and air conditioning appliances (96.0%). Remaining sectors generating emissions in IPPU are 2.D Non-energy products from fuels and solvent use (5.6%) and 2.G Other product manufacture and use constituting 1.8% from total IPPU emissions in 2015.

Sources of emissions from IPPU sector reported in Latvia`s GHG inventory are as follows:

- Mineral Industry (CRF 2.A)
    - Cement Production (CRF 2.A.1)
        - CO_2 from clinker production
        - SO_2, NOx, CO, NMVOC from cement production
    - Lime Production (CRF 2.A.2)
        - CO_2 from limestone and dolomite use in lime production
    - Glass Production (CRF 2.A.3)
        - CO_2 from raw material use in glass production
        - NMVOCs from glass fibre production
    - Other Process Uses of Carbonates (CRF 2.A.4)
        - CO_2 from Ceramics (Bricks and tiles production) (CRF 2.A.4.a)

        - CO_2 from Other uses of Soda Ash (waste water neutralization in glass fibre production plant) (CRF 2.A.4.b)
        - Other (NOx, CO and emissions from cement production, NMVOCs from cement and glass fibre production) (CRF 2.A.4.d)
- Metal Industry (CRF 2.C)
    - Iron and Steel Production (CRF 2.C.1)
        - CO_2 emissions from use of crude iron as raw material
        - CH_4, NOx, SO_2, CO, MNVOC emissions from total iron and steel production
        - CO_2 emissions from limestone, dolomite, quicklime, coke and carbon electrodes use in steel production
- Non-energy products from fuels and solvent use (CRF 2.D)
    - CO_2 from lubricant use (CRF 2.D.1)
    - CO_2 from paraffin wax use (CRF 2.D.2)
    - Other (CRF 2.D.3)
        - CO_2 and NMVOCs from Solvent use
        - CO_2 and NMVOCs from road paving with asphalt
        - CO_2, CO and NMVOCs from asphalt roofing
        - CO_2 from urea use
- Product uses as Substitutes for ODS (CRF 2.F)
    - HFCs from Refrigeration and Air Conditioning (CRF 2.F.1)
        - Commercial Refrigeration (CRF 2.F.1.a)
        - Domestic Refrigeration (CRF 2.F.1.b)
        - Industrial Refrigeration (CRF 2.F.1.c)
        - Transport Refrigeration (CRF 2.F.1.d)
        - Mobile Air-Conditioning (CRF 2.F.1.e)
        - Stationary Air-Conditioning (CRF 2.F.1.f)
    - HFCs from Foam Blowing Agents (CRF 2.F.2)
        - Closed Cells (CRF 2.F.2.a)
        - Open Cells (CRF 2.F.2.b)
    - HFCs from Fire Protection (CRF 2.F.3)
    - HFCs from Aerosols (CRF 2.F.4)
        - Metered Dose Inhalers (CRF 2.F.4.a)
- Other product manufacture and use (CRF 2.G)
    - SF_6 from Electrical Equipment (CRF 2.G.1)
    - N_2O From Product Uses (CRF 2.G.3)
- Other Production (CRF 2.H)
        - NMVOC emissions from food and beverages production (2.H.1)
        - CO_2 emissions from limestone use in sugar production for 2005-2006 (2.H.1)
        - SO_2 emissions from Pulp and Paper production for 1990 – 1996 (2.H.2).

Emissions from the Chemical Industry (CRF 2.B), Electronics Industry (CRF 2.E) are not occurring (NO) in Latvia. In CRF Reporter some information and data in the parent categories (green and grey cells) in corresponding CRF tables might be missing due to CRF internal issue which does not allow to directly enter NO in green and grey cells without adding child nodes.

Therefore cells were left blank. It was confirmed by CRF help desk that this issue be improved in the future releases of the software.

4.1.1 Description

Emissions from IPPU have been increased by 7.9% since 1990 and decreased by 7.7% in 2015 compared to 2014 (Figure 4.2, Table 4.1).

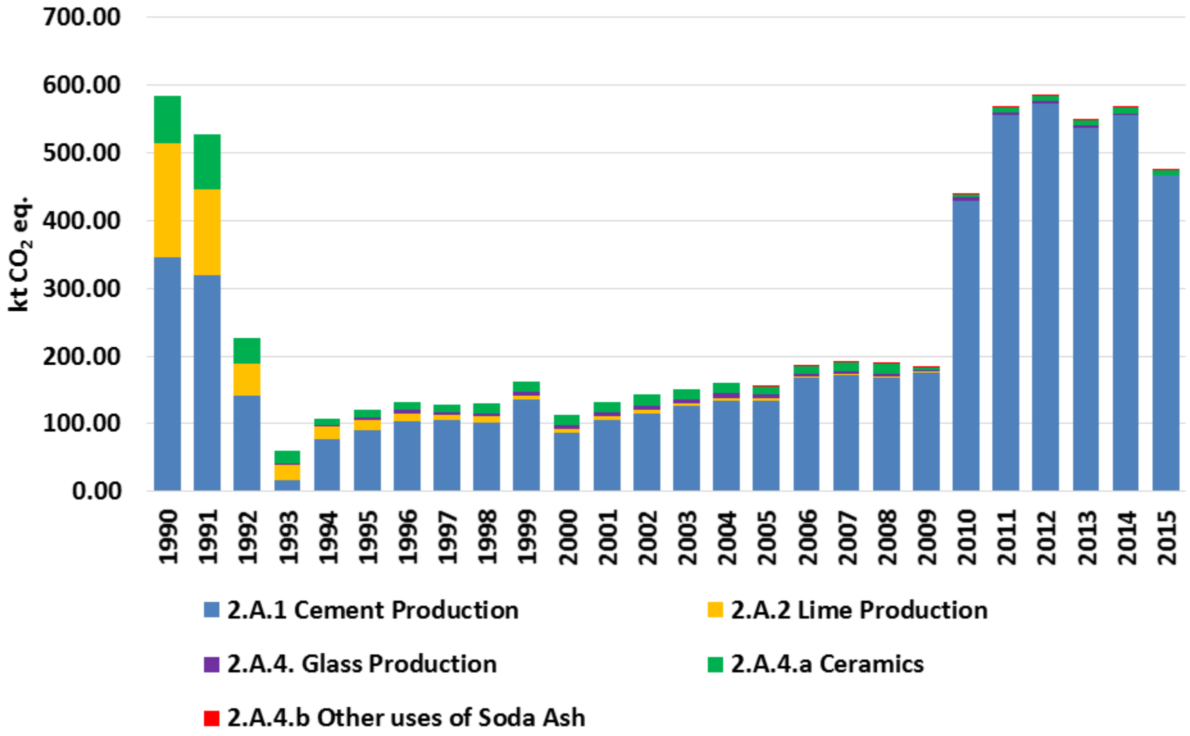

Figure 4.2 GHG emissions from Industrial Processes and Product Use in 1990–2015 (kt CO_2 eq.)

Emission fluctuations through years are mainly linked with the economic situation in the country. The largest decrease in emissions occurred between years 1991 and 1993, when industry was affected by a crisis. It has to be noted that at the beginning of 1990s during the countrywide change in government system the national economy statistics was not well kept. Therefore there is a lack of statistical data regarding industry during this time period or they are vague. The data extrapolation was carried out for the sectors where it was possible.

A key drivers for IPPU emission growth starting from 1994 are overall increase of activity in industrial production processes (cement and lime production). Since that time sharp development of construction activities has been observed and industrial production of building materials also increased. Changes in export of products from Latvia to Commonwealth of Independent States (CIS) countries has also caused emission fluctuations 1998-2000.

F-gas emissions have also been increasing significantly since 1995. This growth is reflected in IPPU emission curve. The sharp increase of F-gase emissions is related to growing demand for refrigeration and air conditioning equipment along with improving economic situation in Latvia. There is no manufacturing of F-gases containing products in the country thus emissions mainly depend on consumption of imported products.

Since 2010 rapid emission growth could be observed in Mineral industry where CO_2 emission increase was a result of setting up of new dry process technological plant in cement production.

In 2014 the CO_2 and CH_4 emissions from metal industry have decreased by 100% compared to 1990 due to insolvency of the only metal production plant in Latvia however in 2015 the metal production company begun to produce steel again therefore emissions again appeared.

Table 4.1 Greenhouse gas emission trend in 1990–2015 (kt CO_2 eq.)

Year	Total	2.A Mineral Industry	2.C Metal Industry	2.D Non-Energy Products from Fuels and Solvent	2.F Product Uses as Substitutes for ODS	2.G Other Product Manufacture and Use	2.H. Other
1990	705.05	584.35	69.76	47.69	NE,NO	3.25	NA,NO
1991	623.70	526.98	54.44	39.05	NE,NO	3.24	NA,NO
1992	311.00	227.31	43.36	37.10	NE,NO	3.22	NA,NO
1993	150.99	60.70	48.10	39.04	NE,NO	3.15	NA,NO
1994	197.15	106.46	50.16	37.43	NE,NO	3.09	NA,NO
1995	208.02	120.32	45.49	36.48	2.50	3.22	NA,NO
1996	217.51	131.07	44.27	36.23	2.76	3.19	NA,NO
1997	229.64	127.89	60.28	34.78	3.35	3.35	NA,NO
1998	237.86	129.46	62.79	36.40	5.75	3.47	NA,NO
1999	270.43	162.11	61.51	36.22	6.96	3.63	NA,NO
2000	223.37	112.78	61.26	35.95	9.59	3.78	NA,NO
2001	245.76	132.55	60.43	35.61	12.92	4.25	NA,NO
2002	260.95	143.29	60.49	35.29	16.44	5.45	NA,NO
2003	277.65	150.77	64.77	36.28	20.27	5.56	NA,NO
2004	309.16	159.64	68.71	38.72	36.06	6.03	NA,NO
2005	308.25	153.97	50.16	40.70	52.06	6.52	4.85
2006	369.93	184.57	48.54	38.70	86.61	6.78	4.73
2007	394.40	190.21	44.52	39.91	112.51	7.24	NA,NO
2008	402.89	188.62	38.43	36.00	132.10	7.73	NA,NO
2009	405.14	182.85	39.12	30.36	142.38	10.43	NA,NO
2010	680.25	439.64	38.80	36.38	155.01	10.41	NA,NO
2011	807.14	567.22	16.68	36.28	175.99	10.97	NA,NO
2012	881.70	584.38	64.92	40.13	181.18	11.09	NA,NO
2013	819.79	549.62	19.63	41.40	197.21	11.94	NA,NO
2014	823.68	568.97	0.01	37.02	205.63	12.05	NA,NO
2015	760.54	476.21	1.04	42.55	227.06	13.69	NA,NO
Share of total % in 2015	-	62.6%	0.1%	5.6%	29.9%	1.8%	-
2015 versus 2014	-7.7%	-16.3%	11360.8%	14.9%	10.4%	13.6%	-
2015 versus 1990	7.9%	-18.5%	-98.5%	-10.8%	8984.8%	321.2%	-

Key categories under IPPU sector are listed in Table 4.2. Information regarding approaches used for key category analysis available in Chapter 1.5 and Annex 1.

Table 4.2 Key categories of IPPU sector in 2017 submission

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
2.A.1. Cement Production	CO_2	L1,L2,T1,T2	X	X
2.A.2. Lime Production	CO_2	T1	X	X
2.A.4. Other process uses of carbonates	CO_2	T1,T2		X
2.C.1 Iron and Steel Production	CO_2	T1		X
2.D.3. Solvent Use	CO_2	L1		X
2.F.1. Refrigeration and air conditioning	HFCs	L1,L2	X	X

4.2 MINERAL INDUSTRY (CRF 2.A)

4.2.1 Category description

2.A Mineral industry sector is the main emission source under IPPU sector. Sources of non-energy CO_2 emissions under 2.A sector is a cement production (98%), lime production (0.2%), glass production (0.1%), metal production and other process uses of carbonates (1.7%). Mineral industry sector GHG emissions amounts to 476.21 kt CO_2 eq. (4.2%) of total anthropogenic GHG emissions without LULUCF, with indirect CO_2 and 62.6% from total IPPU emissions in Latvia in 2015.

Emissions from Mineral industry have decreased by 18.5% since 1990 and by 16.3% compared to 2014 (Figure 4.3 and Table 4.3).

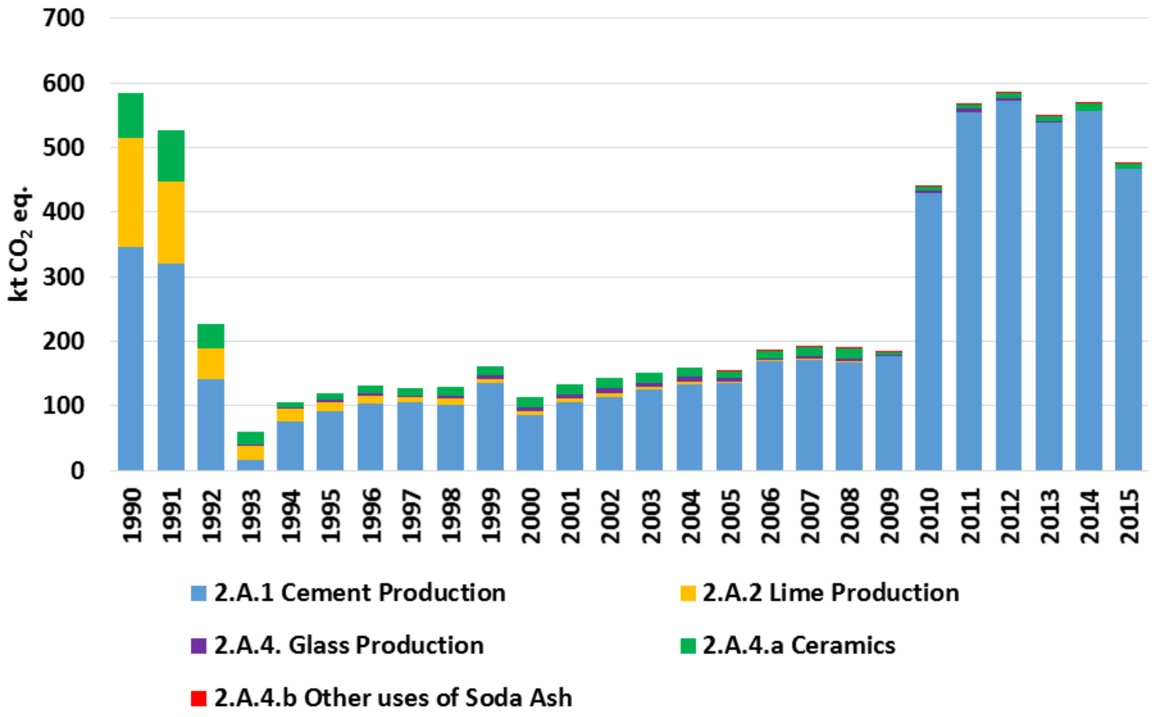

Figure 4.3 Emissions from Mineral industry in 1990–2015 (kt CO_2 eq.)

CO_2 emissions are strongly influenced by economic situation in the country. Emission curve reflects economic crisis in time period 1991–1993 after transition of national economy due to broke down of the former Soviet Union market when significant amount of industrial producers stopped their activity (Table 4.3). Since 1993 Latvia`s economy started to revover and GDP started to increase hence industrial production and IPPU emissions increased till 2007.

Due to Latvia's economic downturn in 2007–2008 the industry development was slowing down as the financing and real estate sectors started to dominate in national economy. In 2009-2010 emissions from 2.A.1 Cement production have been significantly growing due to setting up a new technology and installations increasing it`s capacity approximately 2.4 times. In 2015 compared to 2014 the produced clinker amount has decreased by 16% due to decrease of export amounts and reduced activity in building sector which caused lower demand for cement.

Table 4.3 Emissions from 2.A Mineral Industry in 1990–2015 (kt)

	CO_2						NOx	CO	NMVOC	SO_2
	2.A	2.A.1	2.A.2	2.A.3	2.A.4.a	2.A.4.b				
1990	584.35	345.78	169.02	0.36	69.18	NO	0.90	NO,NA,NE	0.16	3.41
1995	120.32	91.07	14.85	3.40	11.00	NO	0.24	NO,NA,NE	0.04	0.90
2000	112.78	86.33	6.10	5.93	14.41	NO	0.23	NO,NA,NE	0.04	0.85
2005	153.97	134.46	2.63	5.71	10.97	0.20	0.36	NO,NA,NE	0.07	1.35
2006	184.57	168.59	1.86	2.69	11.21	0.22	0.45	NO,NA,NE	0.08	1.69
2007	190.21	170.73	2.05	4.43	12.78	0.22	0.56	0.02	0.09	1.77
2008	188.62	167.48	2.01	4.03	14.91	0.20	0.55	0.02	0.09	1.75
2009	182.85	176.18	0.58	2.60	3.38	0.11	0.62	0.02	0.04	1.77
2010	439.64	428.87	0.71	4.47	5.49	0.10	0.58	0.85	0.02	0.12
2011	567.22	555.13	0.15	4.32	7.51	0.10	1.10	1.76	0.03	0.41
2012	584.38	572.33	0.45	3.77	7.58	0.24	1.59	3.56	0.01	0.44
2013	549.62	537.64	0.39	3.29	7.67	0.62	1.64	2.62	0.01	0.23
2014	568.97	555.86	0.66	0.94	10.88	0.63	1.89	2.26	0.02	0.21
2015	476.21	466.71	0.72	0.46	7.64	0.67	1.87	1.65	0.01	0.19
Share of IPPU total in 2015, %	62.30%	61.06%	0.09%	0.06%	1.00%	0.09%	-	-	-	-
2015 versus 2014	16.30%	-16.04%	10.00%	-51.48%	-29.81%	7.23%	-1.25%	-27.15%	-48.54%	-10.03%
2015 versus 1990	-18.51%	34.97%	-99.57%	28.62%	-88.96%	241.20%[25]	106.87%	94.59%	-93.85%	-94.35%

Under 2.A Mineral industry SO_2, NO_x, NMVOC and CO emissions from cement production and NMVOC emissions from glass fibre production are reported. NMVOCs from glass fibre production, NO_x, CO and NMVOC emissions from cement production are reported in 2.A.4.d Other sector because it is not technically possible to enter data under relevant sectors in CRF Reporter. Indirect CO_2 emissions were estimated from NMVOC emissions in 2.A.3 sector from glass fibre production sector directly.

[25] *2015 versus 2005*

Reported emissions, calculation methods and type of emission factors for the 2.A Mineral Industry in the Latvia`s GHG inventory are summarized in Table 4.4.

Table 4.4 GHG emission categories, methods and gases reported from 2.A Mineral Industry

Category	Method used	Gases reported
2.A Mineral Industry		
1. Cement Production	Tier2	CO_2, CO, NMVOC, SO_2, NOx
2. Lime Production	Tier2	CO_2
3. Glass Production	Tier3	CO_2, CO, NMVOC, SO_2, NOx
4. Other Process Uses of Carbonates		
4.a Ceramics		
Production of bricks	Tier2	CO_2
Production of tiles	Tier1,2	CO_2
4.b Other uses of soda ash	Tier 1	CO_2

4.2.2 Cement Production (CRF 2.A.1)

4.2.2.1 Category description

CO_2, NOx, CO, NMVOC and SO_2 emissions are estimated from Cement production sector.

In 2015 GHG emissions from Cement production amounted 466.71 kt CO_2 eq (4.1%) from Latvia`s total CO_2 equivalent emissions including indirect CO_2, without LULUCF and 61.1% from total IPPU sector emissions. Compared to 2014 emissions have decreased by 16.0%, but compared to 1990 emissions have increased by 35.0% (Table 4.3 and Figure 4.4).

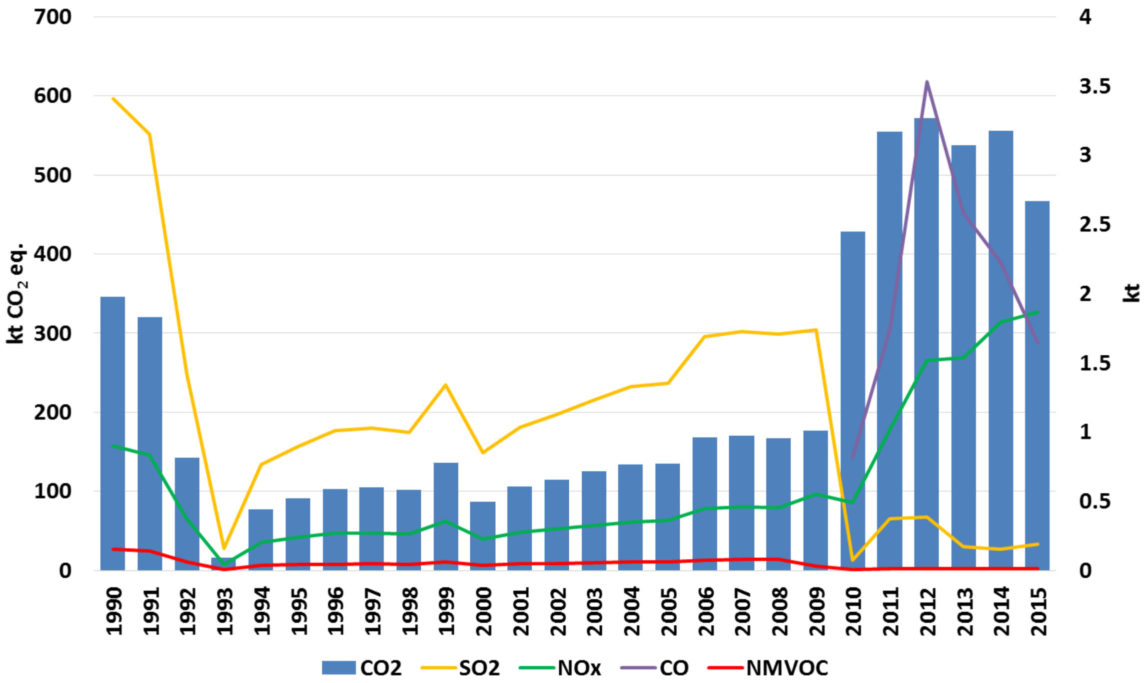

Figure 4.4 Emissions from Cement production in 1990–2015 (kt CO_2 eq.)[26]

[26] *SO_2, NOx, NMVOC, CO on secondary axis*

The emission curve represents the total situation in national economy when the big decrease happened in the beginning of the 1990s due to changes in national economy, domestic market and production demand. CO_2 emissions from Cement Production had decreased by 95.4% in 1990-1993. Increase of emissions in period 2000-2007 by 97.8% represents the development of building sector and development of external market. In the middle of 2009 new production plant with dry process kiln production technology was built instead of the old one where the wet process kiln technology was used. Consequently the cement kiln dust recovery was stopped and further cement kiln dust was collected and transported to landfill for storage. Therefore amount of cement kiln dust and CKD/clinker ratio increased in 2010-2015 affecting CO_2 emissions.

NMVOC emissions have decreased in 2009-2010 by 72.0% due to adjustment of emission factor for new dry production process that is lower than for the old production plant's wet kiln process technology. SO_2, NOx and CO emissions are automatically measured at plant site.

Starting from 2010 fully dry process kiln is used in cement production in Latvia. 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, decrease of SO_x emissions can be observed. Tyres and lube oil consisting of sulphur compounds were used as raw materials.

For 2010 SO_x, NO_x and CO data are not representative as new technology began to operate with full capacity only in July on 2nd half of year 2010 and fully in 2011. Emissions from 2.A.1 sector increased in 2010 by 29.4% due to capacity building in cement production comparing with previous years. Production of cement clinker is depending on the demand in internal and external market. In 2015 produced amount of clinker have decreased by about 16% compared to 2014 due to decrease of exported amounts and decrease of building activities in Latvia.

4.2.2.2 Methodological issues

Activity data

The produced clinker is not weighted directly in the cement production plant as they have non-stop production process but estimated from final produced amount of cement clinker. As plant produce many types of cement, clinker activity data are estimated taking into account different cement types multiplying with cement/clinker ratio and also mass balance of cement, clinker and used additives in cement production. Producer does the mass balance approach calculation at plant site. Cement production activity data from plant is available according to annual EU Emissions Trading System (EU ETS) GHG report by plant[27]. Data are publicly available. As data of produced clinker is not available (plant has non-stop production process) the alternative is to take total amount of cement clinker data and estimate clinker 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 produced cement. Activity data of cement and clinker is plant- specific data reported by

[27] *http://www.vvd.gov.lv/izsniegtas-atlaujas-un-licences/seg-atlaujas/?company_name=cemex&org_id=&perm_date_from=&perm_date_to=&s=1*

cement clinker producer. Final clinker data are calculated using plant mass balance approach in two steps:

1) Clinker production = ((cement export – cement stock changes) * clinker/cement ratio)) - clinker export – clinker stock changes ;
2) Produced clinker = used clinker + clinker export – clinker import + clinker stock change.

Approach (1) is used for each produced cement type to calculate produced clinker amount that is produced in respective plant and these are plant-specific data. For inventory there is available already calculated (by above mentioned mass balance approach) final clinker data from particular producer in the annual GHG report. CaO content is measured in the cement production company and CO_2 EF for produced clinker is estimated according to equation 2.4 from 2006 IPCC Guidelines[28].

As it is 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.

Table 4.5 CKD correction factor in 1990–2015

	Produced clinker (kt)	Produced cement kiln dust (kt)	CKD / clinker ratio (%)
1990	668.50	NA	NA
1995	175.69	15.00	8.54
2000	167.18	10.00	5.98
2005	265.40	1.53	0.58
2006	330.65	2.89	0.87
2007	338.31	3.35	0.99
2008	334.46	0.99	0.30
2009	340.99	8.08	2.37
2010	834.94	7.02	0.84
2011	1095.23	10.87	0.99
2012	1129.11	13.29	1.18
2013	1054.95	12.43	1.18
2014	1093.04	12.92	1.18
2015	918.410	12.96	1.41

The reliable and official data of cement kiln dust (CKD) for 1990-1994 is not available. It was confirmed also by clinker producer that there are no such data in producer archives and also Central Statistical Bureau doesn't have any information on CKD for this time period therefore the default CKD correction factor 1.02 according to 2006 IPCC Guidelines is used from 1990 till 1994.

[28] http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol3.html , *Mineral industry emissions ,p 2.12*

Although official statistical data resulted in different CKD ratio and it changes year to year depending on produced amount of clinker and cement kiln dust, in latest years there are quite stable situation in clinker production and 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 web page http://www.meteo.lv/lapas/uznemumi-kuriem-izsniegtas-siltumnicefekta-gazu-emisijas-atlaujas-2-pe?id=1253&nid=575, after responsible for such information publication is State Environmental Service of Latvia - http://www.vvd.gov.lv/izsniegtas-atlaujas-un-licences/seg-atlaujas/, internal verification documentation is confidential. The cement clinker is produced only from limestone and CKD amount changes due to production technology. For the years 2005-2008 CKD has decreased due to improvement of used technology.

Emission factors and calculations

Tier 2 method from 2006 IPCC Guidelines for CO_2 emission factor and emission estimation. CO_2 emissions from clinker production are estimated using 2006 IPCC Guidelines equation 2.2[29]

$$CO_2\ Emissions = M_{cl} \times EF_{cl} \times CF_{ckd}$$

where:
CO_2 Emissions- emissions of CO_2 from cement production, tonnes
M_{cl} – weight (mass) of clinker produced, tonnes
EF_{cl} – emission factor for clinker, tonnes CO_2 /tonne clinker. This clinker emission factor (EF_{cl}) is not corrected for CKD
CF_{ckd} – emissions correction factor for CKD, dimensionless

Till 2009 Tier 2 approach from EMEP/EEA 2016 was used to calculate NOx, NMVOC, SO_2 emissions from cement production taking into account produced amount of clinker in wet and dry process kiln and technology based EFs. Since 2010 these emissions are automatically measured in cement plant.

CO_2 emission factor is calculated for all time series according to CaO content in used limestone that is measured in laboratory of cement production plant (Table 4.6).

CO_2 emission factor is calculated using equation 2.4 from 2006 IPCC Guidelines[30] taken into account plant-specific data on CaO content of clinker and the fraction of CaO that was derived from a carbonate source (generally $CaCO_3$):

$$EF_{clc} = (0.785 \times CaO_{\ content}) \times CKD_{correction}$$

where:
EF_{clc} – clinker production EF (kt/kt)
0.785 – molecular weight ration of CO_2 to CaO in the raw material ($CaCO_3$)
CaO – CaO content (weight fraction) in produced clinker (%)
$CKD_{correction}$ – correction factor for cement kiln dust

[29] http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol3.html, *Mineral industry emissions, p 2.9*
[30] http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol3.html , *Mineral industry emissions ,p 2.12*

CKD correction factor is calculated using equation 2.5 from 2006 IPCC Guidelines:

$$CF_{ckd} = 1 + (M_d/M_{cl}) \times C_d \times F_d \times (EF_c/EF_{cl})$$

where:

CF_{ckd}- emissions correction factor for CKD, dimensionless
M_d- weight of CKD not recycled to the kiln, tonnes
M_{cl}- weight of clinker produced, tonnes
C_d- fraction of original carbonate in the CKD (i.e., before calcination), fraction
F_d – fraction calcination of the original carbonate in the CKD, fraction
EF_c – emission factor for the carbonate (2006 IPCC Guidelines Chapter 2 Table 2.1), tonnes CO_2 /tonne carbonate
EF_{cl} -emission factor for clinker uncorrected for CKD (i.e., 0.51 tonnes CO_2/ tonne clinker), tonnes CO_2/ tonne clinker

Table 4.6 Average CaO content in clinker (%) and average CO_2 emission factor in 1990–2015 (t CO_2 / t clinker)

	Average CaO content (%)	CO_2 EF without CKD factor	CKD correction factor	CO_2 EF with CKD correction factor
1990	64.60	0.507	1.02	0.52
1995	64.06	0.503	1.03	0.52
2000	64.41	0.506	1.02	0.52
2005	64.41	0.506	1.00	0.51
2006	64.75	0.508	1.00	0.51
2007	64.06	0.503	1.00	0.50
2008	63.72	0.500	1.00	0.50
2009	65.27	0.512	1.01	0.52
2010	65.24	0.512	1.00	0.51
2011	64.34	0.505	1.00	0.51
2012	64.30	0.505	1.00	0.51
2013	64.65	0.508	1.00	0.51
2014	64.51	0.506	1.00	0.51
2015	64.41	0.506	1.01	0.51

For 1996–2005 average CaO content data (64.41%) of 1995 and 2006 was used in emission calculation since the data for average CaO content in produced clinker for years 1996–2005 was not available in cement production plant. Afterwards data of average CaO content were available from plant laboratory and reported to LEGMC for CO_2 emission factor calculation.

Indirect GHG emission factors

EFs for NO_x, NMVOC and SO_2 are not available in EMEP/EEA 2016[31] therefore the EFs from EMEP/CORINAIR 2007[32] were used. Indirect GHG emissions are emitted in the production according to cement production plant. Till 2009 the EFs were divided for dry and wet process

[31] *http://www.eea.europa.eu/publications/emep-eea-guidebook-2016 , Mineral products, Cement Production*
[32] *http://www.eea.europa.eu//publications/EMEPCORINAIR5 , Group 4: Production processes, B3311pdf. (pages 12-13)*

kiln technology. Since NO_x, CO and SO_2 emissions as plant-specific data are measured automatically in dry process production plant and these data are available in national database "2-Air". "Cemex", the only cement production plant, has indicated in its "2-Air" report that indirect GHG emissions arise from technological processes which include also heat generation to maintain certain temperatures during particular process.

Regarding calculation of indirect GHGs since 2010, to avoid double counting, the following fuel types - used tyres, ecofuel, coal, natural gas consumed in "Cemex" - are subtracted from Energy part and their emissions can be considered as included elsewhere "IE" (2.A.1 sector under IPPU) in case of cement producer "Cemex".

Evaporation from raw materials depends on composition of this material. Mainly it is raw material containing sulphates and sulphides that evaporates in very small amount before to the production process. Mainly SOx reaction happens in middle of process in high temperatures. At the end of the process all necessary SOx amount is fixed in clinker contain and residual SOx are detected in chimney and emitted to the air. For both technologies only NMVOC emissions are estimated using EFs provided in EMEP/CORINAIR 2007 (Table 4.7).

Table 4.7 EFs for cement clinker production emission estimation (kt/kt)

	NOx	NMVOC	SO_2
wet process kiln	0.00135	0.00023	0.0051
dry process kiln	0.00175	0.00001	0.0051

4.2.2.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of cement production data is taken from Cement production plant`s GHG report under EU ETS (2.5% uncertainty for activity data of clinker production and 7.5% uncertainty for activity data of CKD).

The total uncertainty U_{total} is being calculated, using following formula of combined uncertainty:

$$U_{total} = \sqrt{(U_1^2 + U_2^2 + ... + U_n^2)}$$

where:
U_{total} *= the percentage uncertainty in the product of the quantities*
U_i *= the percentage uncertainties associated with each of the quantities*

Combined activity data uncertainty is calculated as 8%.

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 according to 2006 IPCC Guidelines.

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. GHG emissions from the sector are estimated or reported excepting 2.A.4.c sector for wich NO is reported.

All industrial production historical data used in emission estimation from 2.A Mineral Products sector till 2005 are obtained from mineral producers, but since 2005 data are taken from 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 who checks whether 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 verified. 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, AD and emission changes and attention was paid to important changes that increase/decrease and are explained in NIR.

4.2.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed with Tier 2 method from 2006 IPCC Guidelines.

Emissions are checked using time series consistency check for the IEF estimated in CRF Reporter and all IEF changes - 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.

Checks performed pursuant to Article 7(1)(l) of Regulation (EU) No 525/2013 are done to compare EU ETS data with GHG inventory emissions. These checks results with differences represented in Table 4.8.

Table 4.8 Differences between CO_2 emissions under ETS and inventory data of cement production 2013 till 2015

2.A.1 Cement Production (kt CO_2 eq.)			Difference
Year	IPCC methodology 2006 IPCC Guidelines Volume 3 Chapter 2 equation 2.2	Monitoring and Reporting Regulation[33] Art.30 and 31.	
2013	537.64	560.38	4.23%
2014	555.86	580.63	4.46%
2015	466.71	488.97	4.77%

Differences between CO_2 emissions under EU ETS and GHG inventory are caused by use of different emission calculation methodologies from cement production under UNFCCC reporting (2006 IPCC Guidelines) and European Union Monitoring Reporting Regulation (EU

[33] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0601&from=EN*

MRR)[34]. There is only one cement plant in Latvia which uses Tier 1 method under ETS reporting. In Tier 1 default EFs are taken for CO_2 emission calculation as it is not possible to obtain all necessary laboratory measurements in plant laboratory to apply higher Tier method as this laboratory is not accredited.

4.2.2.5 Category-specific recalculations

According to ERT recommendation CO_2 emissions for time period 1990-1994 were recalculated applying default CKD correction factor 1.02 as the amount of CKD was not available for these years.

Small amounts of NOx, SO_2 and CO emissions from smaller technological processes (cement mills and drying kiln) were also added from 2010 till 2014.

4.2.2.6 Category-specific planned improvements

No improvements are planned for this sector.

4.2.3 Lime Production (CRF 2.A.2)

4.2.3.1 Category description

Under 2.A.2 sector CO_2 emissions from limestone and dolomite use in lime production in two lime production plants are reported. Lime production sector CO_2 emissions constitute 0.72 kt (0.09%) of total IPPU emissions in Latvia in 2015. CO_2 emissions from 2.A.2 sector decreased by about 99.6% since 1990 and increased by about 10.0% compared to 2014 (Figure 4.5 and Table 4.9).

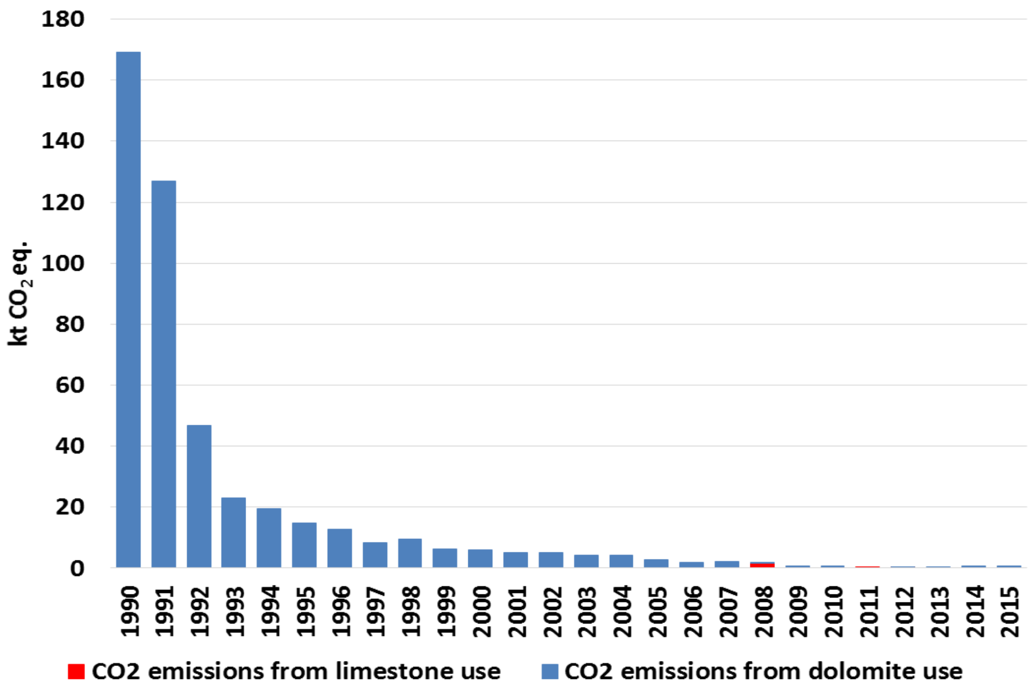

Figure 4.5 CO_2 emission from limestone and dolomite use in lime production 1990–2015 (kt CO_2 eq.)

[34] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0601&from=EN*

As it can be seen in Figure 4.5 the CO_2 emissions from dolomite use in lime production are continuously decreasing since the beginning of 1990s due to recession of overall national economy. In 2008-2009 emissions have decreased significantly due to the economic crisis. Afterwords emissions from lime production are fluctuating due to economic situation and changes in industrial activities in the country.

4.2.3.2 Methodological issues

Activity data

Activity data were taken from lime production plants which are participants of the EU ETS. Reports per period till 2012 were published on LEGMC home page (http://www.meteo.lv/lapas/uznemumi-kuriem-izsniegtas-siltumnicefekta-gazu-emisijas-atlaujas-2-pe?id=1253&nid=575). Since 2013 State Environmental Service takes response of publication of GHG permits, verification and GHG reports. Reports from lime production company available here: http://www.vvd.gov.lv/izsniegtas-atlaujas-un-licences/seg-atlaujas/?company_name=saulkalne+s&org_id=&perm_date_from=&perm_date_to=&s=1.

Limestone in lime production were used 2007-2012. Since 2013 limestone is not used anymore, but dolomite is still used in lime production in one plant (Table 4.9).

Table 4.9 Limestone and dolomite use in lime production and produced lime 1990–2015 (kt)

	Limestone (kt)	Dolomite (dry) (kt)	Total produced lime from dolomite and limestone (kt)
1990	NO	383.25	214.23
1995	NO	33.67	19.21
2000	NO	13.84	7.89
2005	NO	5.97	3.16
2006	NO	4.22	2.23
2007	1.08	3.58	2.50
2008	3.65	0.90	2.52
2009	0.23	1.09	0.70
2010	0.35	1.25	0.86
2011	0.35	NO	0.20
2012	0.32	0.69	0.55
2013	NO	0.89	0.47
2014	NO	1.49	0.79
2015	NO	1.63	0.87

Activity data fluctuates in whole time series. Largest decrease could be observed at the beginning of 1990s when enonomic situation in the county was unstable due to change from a centrally planned economy to a market economy. In latest years there is an overall decrease of activity in sector 2.A.2 due to reduced industrial activity.

Emission factors and calculations

CO_2 emissions from lime production in two direct lime production plants are calculated on the basis on data of carbonates – dolomite and limestone use. CO_2 emissions from limestone use in lime production processes are estimated using Tier 2 method from 2006 IPCC Guidelines based on plant specific activity data and emission factors from EU MRR.

According to 2006 IPCC Guidelines the CO_2 emissions from dolomite use in lime production are calculated taken into account Tier 2 equation 2.9 and plant specific laboratory measurements of CaO and MgO. These data are considered as plant specific. Activity data and laboratory measurements are available directly from the lime producer.

Table 4.10 CO_2 emission factors for limestone and dolomite use (t CO_2/t raw material)

	1990–2015
Limestone use in lime production	0.440
Dolomite use lime production	0.441028

The used CO_2 emission factor for dolomite use in lime production is considered as plant specific as CaO and CaO*MgO content is taken into account according to 2006 IPCC Guidelines Tier 2 method, equation 2.9:

$$EF_{lime} = SR_{CaO*MgO} * CaO * MgO\ Content$$

where:
EF lime - emission factor for dolomite lime, tonnes CO_2/tonne lime
*$SR_{CaO*MgO}$ – stoichiometric ratio of CO_2 and CaO*MgO, tonnes CO_2/tonne CaO*MgO*
*CaO*MgO content – CaO*MgO content, tonnes CaO*MgO/tonne lime*

According to laboratory measurements made in lime production plant the 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 plant`s laboratory data:

- average content of water in dolomite is 5.24%;
- average content of water in produced lime is 0%;
- average content of dolomite (dry) is 94.76% or 947.6 kg dolomite.

947.6 kg dolomite complete decomposes and pullulates:

491.14 kg $CaCO_3$ × 0.440 (emission factor) = 216.10 kg CO_2

386.62 kg $MgCO_3$ × 0.522 (emission factor) = 201.82 kg CO_2.

Average moisture content in dolomite (5.24%) is taken into account when activity data of used dolomite is estimated for the inventory. The amount of used dolomite (wet) are multiplied with moisture content coefficient k=0.9476. As a result amount of dry dolomite is obtained. CO_2 emissions are calculated by multiplying dry dolomite amount with EF=0.441028 tCO_2/t dolomite.

4.2.3.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of lime production activity data is taken from Lime production plant`s GHG report under EU ETS (8 % uncertainty for activity data of lime production).

CO_2 emission factor for 2.A.2 sector is estimated based on plant specific data of used dolomite characterizations so average uncertainty of 2% is assumed according to 2006 IPCC Guidelines.

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, AD and emission changes and attention was paid to important increase/decrease that are explained in NIR.

4.2.3.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed with Tier 1 method from 2006 IPCC Guidelines.

Activity data are taken from the annual GHG reports that lime production plant submits 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. 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 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.

Checks performed pursuant to Article 7(1)(l) of Regulation (EU) No 525/2013 are done and (European Union Emission Trading system) EU ETS data are compared to GHG inventory emissions. Results of these checks are represented in Table 4.11.

Table 4.11 Differences between CO_2 emissions under ETS and inventory data of lime production 2013 till 2015

2.A.2 Lime Production (kt CO_2 eq.)			Difference (%)
Year	IPCC methodology 2006 IPCC Guidelines Volume 3 Chapter 2 equation 2.9	Monitoring and Reporting Regulation[35] Art.30 and 31.	
2013	0.391	0.275	29.70
2014	0.655	0.460	29.82
2015	0.721	0.506	29.83

Differences between CO_2 emissions under EU ETS and GHG inventory are caused by use of different emission calculation methodologies from lime production under UNFCCC reporting (2006 IPCC Guidelines) and EU ETS reporting[36].

Under EU ETS lime producer using dolomite (one company in LV) uses EU MRR methodology and calculates EF differently from 2006 IPCC Guidelines by taking into account CO_2 content 16.99% in lime. As a result the EF from lime production facility using dolomite is 0.2932822 which is different from the EF calculated according to 2006 IPCC Guidelines (0.441028). This caused differences between these 2 methodologies reflected in Table 4.11.

4.2.3.5 Category-specific recalculations

CO_2 emissions from lime production from dolomite were recalculated according to ERT recommendation to correct EF from lime production facility using dolomite consumption according to the 2006 IPCC Guidelines and to submit the corrected emission estimation of CO_2 from lime production using correct activity data and disaggregate the activity data from the 2.A.2 category to identify limestone and dolomite. CO_2 emissions from used limestone, dolomite and produced quicklime in steel production process were allocated from 2.A.1 to 2.C.1 sector.

CO_2 emissions were recalculated according to 2006 IPCC Guidelines taking into account "dry dolomite" as AD and corrected EF from lime production facility using dolomite consumption according to the 2006 IPCC Guidelines (0.441028) based on $CaCO_3$ and $MgCO_3$ conversion to CO_2.

AD of used dolomite was corrected with moisture coefficient (k=0.9476) and EF=0.441028 for CO_2 emission calculation from dolomite use lime production was taken into account. Emissions of used lime, dolomite and limestone in steel production process were allocated to sector 2.C.1 Steel production.

4.2.3.6 Category-specific planned improvements

No improvements are planned for the sector.

[35] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0601&from=EN*

[36] *Under EU ETS up to 2012 the calculation methodologies from EU ETS directive 2003/87/EC and Monitoring and Reporting guidelines were used but starting the EU ETS Phase 3 in 2012 the Monitoring and reporting Regulation is used for the emission calculation.*

4.2.4 Glass production (CRF 2.A.3)

4.2.4.1 Category description

Glass production sector constitutes 0.46 kt CO_2 eq. which is 0.06% of total IPPU emissions in Latvia in 2015.

CO_2 emissions from 2.A.3 sector have been increasing by 28.6 % since 1990 and decreased by 51.5 % comparing with 2014 (Figure 4.6 and Table 4.3).

Emissions are calculated using the use of carbonates as activity data. Emissions from raw materials used in glass production are reflected in Figure 4.6.

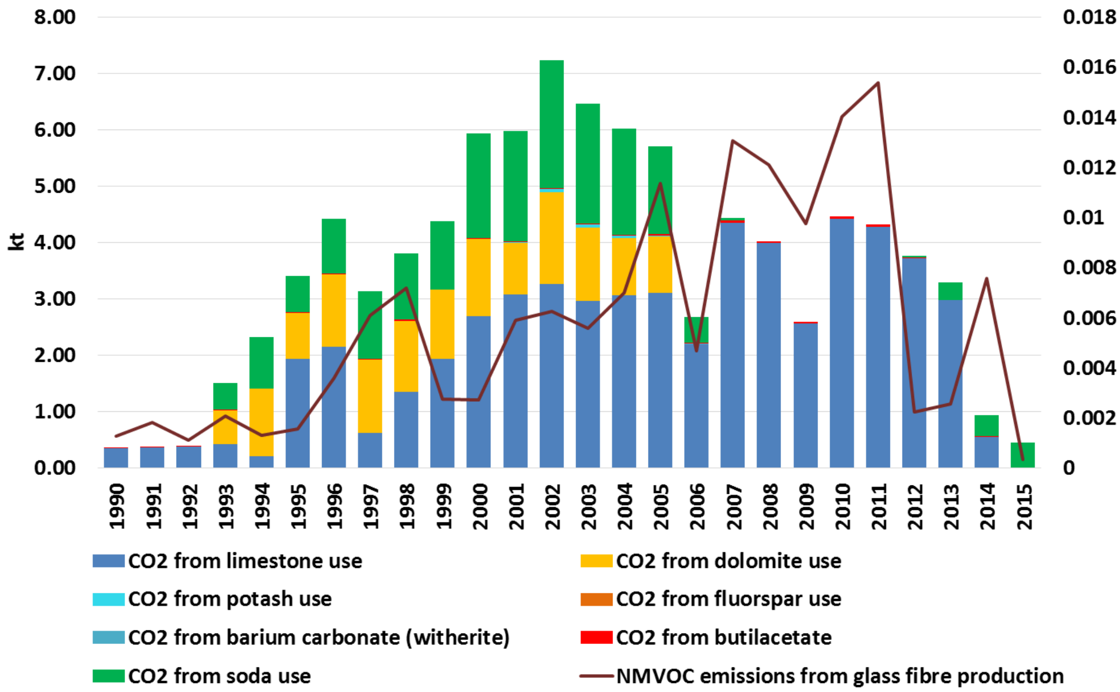

Figure 4.6 Emissions from raw materials used in glass production 1990-2015 (kt)[37]

Limestone, dolomite fluorspar, potash, witherite (barium carbonate), butilacetate and soda ash are typically used as raw materials in the production of glass in Latvia from which CO_2 emissions are calculated. Additionally NMVOC emissions from glass production and glass fibre production were 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.

[37] *NMVOC emissions on secundary axis*

4.2.4.2 Methodological issues

Activity data

Activity data of used carbonates are collected from individual companie`s annual GHG reports under EU ETS. For years before the data from applications for getting GHG permit were used.

Amount of raw materials used in glass production is quite small and fluctuates in whole time series.

Use of potash were used in two glass production facilities from 2001-2007. Although use of potash increased sharply in 2004-2005, the use stopped in 2005 due to closure of glass production plant. Use of witherite occured only in 2005-2007 in glass production manufacturing plant but in 2008 and 2009 the plant suspended it`s activity. NMVOC emissions from glass production stopped in 2005 when the glass production plant stopped it`s activity. Since 2005 NMVOC emissions are still emitted but in smaller amounts from glass fibre production facility (Figure 4.6).

NMVOC emissions for time period 1997-2015 were taken from national database "2-AIR" where glass fiber production plant reported its emissions divided by NMVOC sub-type. For time period 1990-1996 only butylacetate data is available from glass fiber production company's application for getting GHG permit within EU ETS. For year 2005, also glass production company had reported NMVOC emissions (these emissions are reported under 2.A.4.d sector in CRF Reporter) but since then glass production is not operating therefore NMVOC emissions from glass production are reported only for 2005 (Table 4.12).

Table 4.12 Activity data for raw materials use in glass production 1990-2015 (kt)

	Use of potash	Use of fluorspar	Use of barium carbonate (whiterite)	Use of butylacetate	Use of dolomite	Use of limestone	Soda ash use
	kt						
1990	NO	NO	NO	0.00	NO	0.80	NO
1995	NO	0.12	NO	0.00	1.70	4.43	1.55
2000	NO	0.08	NO	0.00	2.88	6.13	4.48
2005	0.04	0.27	0.01	0.01	2.09	7.07	3.74
2006	0.02	0.22	0.02	0.00	NO	4.99	1.12
2007	0.01	0.20	0.01	0.01	NO	9.90	0.09
2008	NO	0.26	NO	0.01	NO	9.07	NO
2009	NO	0.41	NO	0.01	NO	5.85	NO
2010	NO	0.62	NO	0.01	NO	10.07	NO
2011	NO	0.59	NO	0.02	NO	9.73	NO
2012	NO	0.64	NO	0.00	NO	8.47	0.09
2013	NO	NO	NO	0.00	NO	6.77	0.74
2014	NO	NO	NO	0.01	NO	1.26	0.88
2015	NO	NO	NO	0.00	NO	NO	1.10

Activity data fluctuates in whole time series. Considerable decrease occur in the beginning of 1990s as a consequence of changes in structure of country's national economy. Dolomite use in glass production ended in 2005 as one glass production plant stopped it`s activity. The total amount of raw material used was affected by the closing of glass production plant and suspending of activity of another glass production plant.

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. In 2015 only soda ash as raw material in glass production is used.

Emission factors and calculations

Emissions are calculated using Tier 3 method (Equation 2.12 from 2006 IPCC Guidelines), as various types of carbonates consumed for glass production have been collected from annual GHG reports by glass producers under EU ETS.

$$CO_2\ Emissions = \sum_i (M_i \bullet EF_i \bullet F_i)$$

where:
$CO_{2\ Emissions}$ = emissions of CO_2 from glass production, tonnes
EF_i = emissions factor for the particular carbonate i, tonnes CO_2/tonne carbonate
M_i = weight or mass of the carbonate i consumed (mined), tonnes
F_i = fraction calcination achieved for the carbonate i, fraction

According to 2006 IPCC Gudelines it was assumed that the fraction calcination is equal to 1.00.

CO_2 emission factors used to estimate emissions from use of raw materials in glass production are taken from 2006 IPCC Guidelines (Volume 3, Chapter 2, pp. 2.7, Table 2.1) and plants annual GHG reports within EU ETS (Table 4.13). NMVOC emissions for time period 1997-2015 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 getting GHG permit during the implementation of ETS in Latvia.

Table 4.13 Emission factors for materials use in glass production (t emissions / t product or raw material)

	1990 – 2015
Fluorspar use	0.0017
Potash use	0.32
Barium carbonate (witherite) use	0.223
Butylacetate use (NMVOC)[38]	1.0
Limestone use	0.440
Dolomite use	0.477
Soda ash use	0.415

Indirect CO_2 emissions from glass fibre production processes were estimated according to 2006 IPCC Guidelines. An explanation of indirect CO_2 emission estimation based on carbon

[38] *For emission estimation only for year 1990-1996, since 1997 the plant reported data from national database "2-AIR" is used*

conversion factor and average default carbon content amount is provided. CO_2 emission factor is not provided in methodology and it is not possible to obtain activity data for direct CO_2 emission estimation.

NMVOC emissions were taken as activity data for CO_2 calculation and CO_2 emissions were estimated using carbon conversion factor.

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

where:
E_{CO2} – CO_2 emissions (kt)
EF_{CO2} – estimated CO_2 emission factor
NMVOC – NMVOC emissions (kt)

For CO_2 emission from glass fibre production estimation 80% of carbon content conversion factor are used. According to 2006 IPCC Guidelines[39], indirect emissions of CO_2 from atmospheric oxidation of emitted NMVOC are calculated and reported in the inventory. The average amount of carbon in NMVOC is assumed to be 80%[40].

The CO_2 emission factor from 2006 IPCC Guidelines was estimated using following equation:

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

where:
EF_{CO2} – CO_2 emission factor (kt/kt)
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.

4.2.4.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of glass production activity data is taken from Glass production plant`s GHG report under EU ETS (2.5 % uncertainty for activity data of glass production). The uncertainty is quite low 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 EU ETS so the activity data is adequately verified.

As default emission factors for limestone, dolomite and soda ash use are used the uncertainty is assumed quite high. Other CO_2 emission factors for this sector are taken from glass production plant. As the default Tier 1 methodology is used for emission calculation from glass production sector, the default EF uncertainty 60% from 2006 IPCC Guidelines is 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

[39] *http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_7_Ch7_Precursors_Indirect.pdf (page 7.6)*
[40] *Basing of the most often used average carbon conversion factor*

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, AD and emission changes and attention was paid to important increase/decrease that are explained in NIR.

4.2.4.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed according to 2006 IPCC Guidelines.

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.

Checks performed pursuant to Article 7(1)(l) of Regulation (EU) No 525/2013 are done to comparing EU ETS data with GHG inventory emissions. Small differences are represented in Table 4.14.

Table 4.14 Differences between CO_2 emissions under ETS and inventory data of glass production for 2013 -2015

2.A.3 Glass production + 2.A.4.b Other Use of Soda Ash (soda used in waste water neutralization in glass fibre production company)			**Difference**
kt CO_2 eq.			
Year	2006 IPCC Tier 3 method	EU MRR[41] Annex IV section 11	
2013	3.92	3.91	0.26%
2014	1.57	1.55	1.27%
2015	1.13	1.13	0.0%

During UNFCCC review in 2016 (FCCC/ARR/2016/LVA #I13) it was recommended that Latvia make efforts to collect the necessary data and ensure that the Tier 2 method is properly applied or estimate CO_2 emissions by applying a Tier 1 method from the 2006 IPCC Guidelines, using a default cullet ratio and national-level AD.

During in-dept quality control of available activity data and emission calculation approach in this sector the significant misunderstanding was discovered. Actually Latvia already calculates CO_2 emissions from glass and glass fibre production by using Tier 3 method (Equation 2.12 from 2006 IPCC Guidelines) as various types of carbonates consumed for glass production have been collected plant-levelly. Exact amount of used carbonates is derived from glass and glass fibre producing companies annual GHG reports under EU ETS and this data is multiplyied with emission factors from 2006 IPCC Guidelines and from

[41] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0601&from=EN*

Commission Regulation (EU) No 601/2012) . Therefore it is not necessary to switch to Tier 1 or Tier 2. Previously it was mistakenly outlined in NIR, that the default 2006 IPCC guideline`s method is used for CO_2 emission calculation in this category.

Recalculations were not done, but text in NIR was updated according to explanation above.

4.2.4.5 Category-specific recalculations

No recalculations were done for this category.

4.2.4.6 Category-specific planned improvements

No improvements are planned for this category.

4.2.5 Ceramics (2.A.4.a)

4.2.5.1 Category description

Under Ceramics sector CO_2 emissions from bricks and tiles production are reported.

Ceramics sector emissions constitute 7.64 kt (1.0%) of total IPPU emissions in Latvia in 2015.

CO_2 emissions from 2.A.4.a sector are decreased by 89.0% since 1990 and by 29.8 % comparing with 2014 (Figure 4.7).

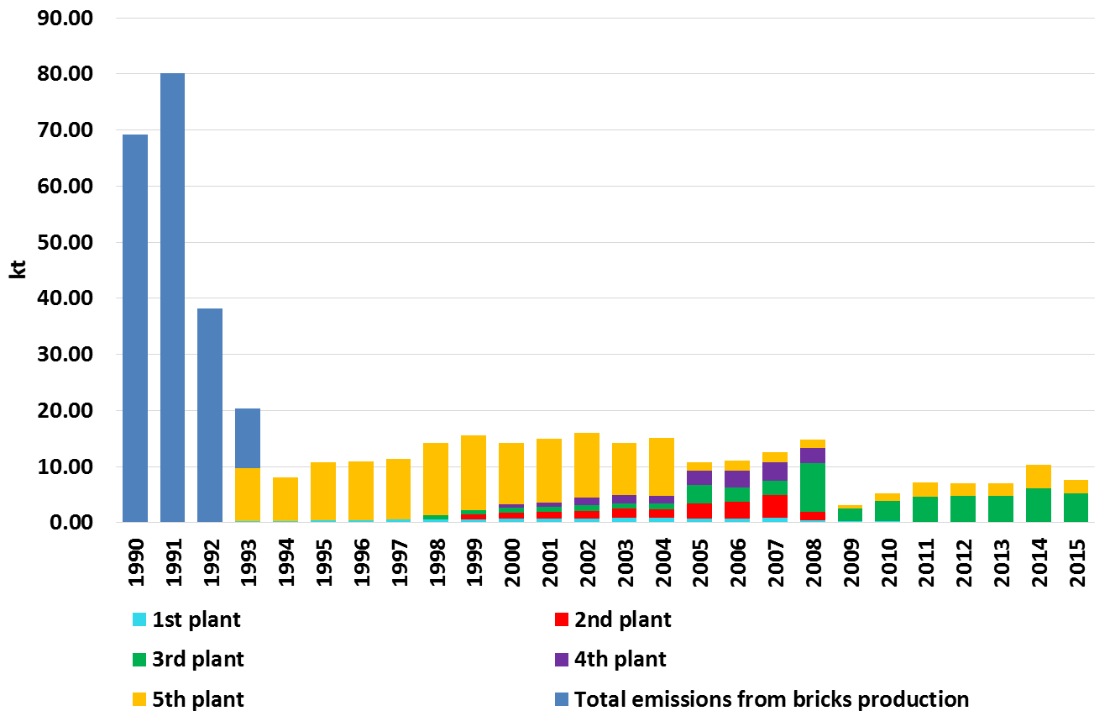

Figure 4.7 CO_2 emissions from bricks and tiles production 1990-2015 (kt)

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.

Only plants No 1 and No 5 were operating in time period 1990-1993 so the indicator IE was previously used for both these plants in time period 1990-1993. As it was not possible to obtain the data for raw materials used in Bricks production companies No 1 and No 5, there wasn't possible to estimate the emissions using the same methodology for 1993-2008 and to 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.

There is only one tiles production plant in Latvia and CO_2 emissions from use of clay in tile production process in 1995-2014 are reported in 2.A.4.a sector. The tiles production plant and all bricks production plants are participants of EU ETS so the data from plant's annual GHG reports is available for inventory.

Emissions are decreasing since 2005 with some fluctuation due to decrease of activity of tiles production plant. Still in 2009 the CO_2 emissions have decreased approximately 4 times as the building and construction sector became inactive. In 2010 activity of tiles and bricks production is increased by 62.8%. From 2010-2014 activity of ceramics production is increased about 88.6%. Due to demand of such production in market in 2014 there is increased produced ceramics about 42.7% (Figure 4.7).

4.2.5.2 Methodological issues

There is only one tiles production plant in Latvia and CO_2 emissions from use of clay in tile production process in 1995-2014 are reported in 2.A.4 sector. The tiles production plant is participant of EU ETS therefore the data from plant's annual GHG reports is available for inventory. In 2015 tiles production was stoped due to financial complications and decrease of demand. Therefore plant were not using clay and emissions from tiles production are not occurring in 2015 (Table 4.15).

Table 4.15 Activity data for tiles production (kt) and reported CO_2 emissions (kt)

	Use of clay in tiles production (kt)	CO_2 emissions (kt)
1990	NO	NO
1995	2.034	0.18
2000	2.594	0.23
2005	1.685	0.15
2006	1.748	0.15
2007	2.242	0.20
2008	0.525	0.05
2009	2.861	0.25
2010	2.497	0.22
2011	3.484	0.31
2012	6.033	0.53

	Use of clay in tiles production (kt)	CO_2 emissions (kt)
2013	6.684	0.59
2014	6.556	0.58
2015	NO	NO

Default methodology was used to estimate emissions by multiplying activity data with emission factor. CO_2 emission factor – 0.08794 (t CO_2/t dry clay) which is used to estimate emissions from clay use in tiles production is taken from EU Monitoring Reporting Guidelines (MRG)[42].

CO_2 emission estimation from bricks production for 1990-1993

For 1990-1993 no plant specific data is available from bricks production plants therefore CO_2 emission estimation for these 3 years is done based on final produced bricks amount if average weight of one brick is known.

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

If final amount of produced bricks is known, it is possible to determine approximate clay consumption (Table 4.16). In CO_2 emission estimation emission factor 0.047 tCO_2/t used clay is used.

Table 4.16 Data and assumptions used for CO_2 emission estimation for 1990-1993

	1990	**1991**	**1992**	**1993**
produced bricks (thousand pieces)	471800	546423	259918	722020
average weight of one brick (kg)	3.9	3.9	3.9	3.9
produced bricks (tonnes)	1840020	2131049.7	1013680.2	281587.8
average produced bricks / used clay ratio	1.25	1.25	1.25	1.25
used clay (kt)	**1472.016**	**1704.84**	**810.9442**	**225.2702**
CO_2 emission factor of used clay tCO_2/t used clay	0.047	0.047	0.047	0.047
CO_2 emissions (kt)	69.1848	80.1275	38.1144	10.5877

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 latest years due to availability of necessary activity data and laboratory measurements of used raw materials.

[42] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:LV:PDF, page 80*

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 t CO_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 2008-2012 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[43].

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 (kt)
AD_{raw} – activity data of used raw materials – clay (kt)
$AD_{CaO,MgO}$ – CaO and MgO content in used raw materials (%)
EF – CO_2 emission factor of CaO and MgO (kt/kt)
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[44] (Table 4.17).

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

Activity data

As MgO and CaO content data was not available for years 1993-2004 therefore 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 4.17 Data and assumptions used for CO_2 emission estimation from 1st bricks production plant

	Use of clay (kt)	MgO content (%)	CaO content (%)	MgO amount (kt)	CaO amount (kt	MgO CO_2 EF (tCO_2/t oxide)	CaO CO_2 EF (tCO_2/t oxide)	CO_2 emissions (kt)	Average CO_2 EF (tCO_2/t oxides)
1990	NO	NO	NO	NO	NO	NO	NO	NO	NO
1995	2.700	4.90%	11.60%	0.132	0.313	1.092	0.785	0.390	0.876
2000	4.800	4.90%	11.60%	0.235	0.557	1.092	0.785	0.694	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

In 2013 1st bricks production plant is not operating anymore.

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[45] is used in plant's emission estimation for its application for GHG permit as well for reporting of annual CO_2 emission:

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

[44] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 81)*
[45] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 79)*

where:
CO_2 – CO_2 emissions from 2nd bricks production plant (kt)
AD_{raw} – activity data of used clay (kt)
AD_{CaCO3} – $CaCO_3$ content in used clay (%)
EF_{CaCO3} – $CaCO_3$ emission factor (kt/kt)
AD_{MgCO3} – $MgCO_3$ content in used clay (%)
EF_{MgCO3} – $MgCO_3$ emission factor (kt/kt)

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 4.18).

Table 4.18 Data and assumptions used for CO_2 emission estimation from 2nd bricks production plant

	1990	1995	2000	2005	2006	2007	2008
Use of clay (kt)	NO	NO	16.37	22.983	28.559	37.203	13.975
$MgCO_3$ content (%)	NO	NO	5.00%	10.98%	9.56%	9.52%	9.50%
$CaCO_3$ content (%)	NO	NO	9.00%	13.06%	13.15%	13.10%	13.10%
$MgCO_3$ amount (kt)	NO	NO	0.819	2.523	2.729	3.542	1.328
$CaCO_3$ amount (kt)	NO	NO	1.473	3.002	3.756	4.874	1.831
$MgCO_3$ CO_2 EF (tCO_2/t oxide)	NO	NO	0.522	0.522	0.522	0.522	0.522
$CaCO_3$ CO_2 EF (tCO_2/t oxide)	NO	NO	0.440	0.440	0.440	0.440	0.440
CO_2 emissions (kt)	NO	NO	1.076	2.638	3.077	3.993	1.500
Average CO_2 EF (tCO_2/t oxides)	NO	NO	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 2006 IPCC Guidelines. Still in the application the plant had reported the MgO and CaO content data in used dry clay therefore 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[46] – 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 (kt)
AD_{raw} – activity data of used raw materials – clay (kt)
$AD_{CaO,MgO}$ – CaO and MgO content in used raw materials (%)
EF – CO_2 emission factor of CaO and MgO (kt/kt)
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 therefore the data was recalculated using the emission estimation method as for 2005-2007. Following equation from MRG is used to estimate emissions for 2005-2012:

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

where:
CO_2 – CO_2 emissions from 3rd bricks production plant (kt)
AD_{raw} – activity data of used clay (kt)
AD_{CaCO3} – $CaCO_3$ content in used clay (%)
EF_{CaCO3} – $CaCO_3$ emission factor (kt/kt)
AD_{MgCO3} – $MgCO_3$ content in used clay (%)
EF_{MgCO3} – $MgCO_3$ emission factor (kt/kt)

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[47] (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[48] to recalculate the emissions (Table 4.19, Table 4.20).

[46] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 80)
[47] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 81)
[48] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 79)

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 4.19, Table 4.20).

According to production plant's application for GHG permit and annual GHG reports activity data of used raw materials is estimated using following equation:

$$AD_{raw} = AD_{clay} \times (1 - M)$$

where:
AD_{raw} – activity data of used raw materials – dray clay (kt)
AD_{clay} – amount of used clay (kt)
M – moisture content of clay in bricks pressing process (%)

For year 2005-2014 the activity data was estimated by using following equation from bricks production plant's GHG report:

$$AD_{raw} = \sum (AD_{bulk} \times M_{av})$$

where:
AD_{raw} – activity data of used raw materials – clay (kt)
AD_{bulk} – amount of dried bulk materials (pieces)
M_{av} – average mass with 0% moisture content (kt)

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 of production is estimated. Therefore for year 2005-2015 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 4.19 Data and assumptions used for CO_2 emission estimation from 3rd bricks production plant

	1990	**1995**	**2000**
use of clay (kt)	NO	NO	10.25
moisture content (%)	NO	NO	17.00%
used raw materials – dry clay (kt)	NO	NO	8.51
MgO content (%)	NO	NO	8.03%
CaO content (%)	NO	NO	3.02%
MgO amount (kt)	NO	NO	0.683
CaO amount (kt)	NO	NO	0.257
MgO CO_2 EF (tCO_2/t oxide)	NO	NO	1.092
CaO CO_2 EF (tCO_2/t oxide)	NO	NO	0.785
CO_2 emissions (kt)	**NO**	**NO**	**0.95**
Average CO_2 EF (tCO_2/t oxides)	NO	NO	1.008

Table 4.20 Data and assumptions used for CO_2 emission estimation from 3rd bricks production plant (continuation)

	Use of clay (kt)	$MgCO_3$ content (%)	$CaCO_3$ content (%)	$MgCO_3$ amount (kt)	$CaCO_3$ amount (kt)	$MgCO_3$ CO_2 EF (tCO_2/t oxide)	$CaCO_3$ CO_2 EF (tCO_2/t oxide)	CO_2 emissions (kt)	Average CO_2 EF (tCO_2/t oxides)
2005	29.891	10.75%	12.79%	3.213	3.823	0.522	0.440	**3.359**	0.477
2006	22.316	10.75%	12.79%	2.399	2.854	0.522	0.440	**2.508**	0.477
2007	23.854	10.75%	12.79%	2.564	3.051	0.522	0.440	**2.681**	0.477
2008	77.687	10.75%	12.79%	8.351	9.936	0.522	0.440	**8.730**	0.477
2009	19.814	10.75%	12.79%	2.13	2.534	0.522	0.440	**2.230**	0.477
2010	32.513	10.75%	12.79%	3.495	4.158	0.522	0.440	**3.650**	0.477
2011	38.914	10.75%	12.79%	4.183	4.977	0.522	0.440	**4.370**	0.477
2012	40.698	10.75%	12.79%	4.375	5.205	0.522	0.440	**4.570**	0.477
2013	49.705	NA	NA	NA	NA	NA	NA	**4.772**	0.096
2014	63.733	NA	NA	NA	NA	NA	NA	**6.145**	0.096
2015	54.317	NA	NA	NA	NA	NA	NA	**5.237**	0.096

According to data from plant GHG annual report average CO_2 EF=0.096 tCO_2/t oxides already include $CaCO_3$ and $MgCO_2$ emission factors.

4th bricks production plant

The CO_2 emission estimation from 4th 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 t CO_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.

To make emission estimation more consistent the CO_2 emissions from 4[th] 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 4.21).

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 [49].

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 (kt)
AD_{clay} – activity data of used clay (kt)
$ADCaCO_3$ – $CaCO_3$ content in used clay (%)
$EFCaCO_3$ – $CaCO_3$ emission factor (kt/kt)
$ADMgCO_3$ – $MgCO_3$ content in used clay (%)
$EFMgCO_3$ – $MgCO_3$ emission factor (kt/kt)

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 Monitoring Reporting Guidelines[50] 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

[49] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (pages 78,79)*
[50] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF (page 79)*

used clay content data and its estimation parameters available from bricks production plant. For year 2008 that particular data was no available therefore the percentage amount of carbonates of year 2007 was used (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:

$$AD_{raw} = \sum \left(AD_{bulk} \times M_{av} - M_{bulk} \times moisture / 100 \right) - M_{chippings} - M_{tenisite}$$

where:
AD_{raw} – activity data of used raw materials – clay (kt)
AD_{bulk} – amount of dried bulk materials (pieces)
M_{av} – average mass (kt)
M_{bulk} – mass of dried bulk materials loaded in furnace
moisture/100 – average moisture content of clay (%)
$M_{chippings}$ – mass of dried scobs (kt)
$M_{tenisite}$ – mass of tenisite (granulated burnt defectives of ceramics) (kt)

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 4.21 Data and assumptions used for CO_2 emission estimation from 4th bricks production plant

	1990	1995	2000	2005	2006	2007	2008
use of clay (kt)	NO	NO	9.000	25.246	29.826	34.166	27.329
$MgCO_3$ content (%)	NO	NO	1.80%	6.47%	6.47%	6.67%	6.67%
$CaCO_3$ content (%)	NO	NO	11.48%	14.62%	14.62%	13.71%	13.71%
$MgCO_3$ amount (kt)	NO	NO	0.162	1.634	1.929	2.28	1.824
$CaCO_3$ amount (kt)	NO	NO	1.033	3.691	4.361	4.684	3.747
$MgCO_3$ CO_2 EF (tCO_2/t oxide)	NO	NO	0.522	0.522	0.522	0.522	0.522
$CaCO_3$ CO_2 EF (tCO_2/t oxide)	NO	NO	0.440	0.440	0.440	0.440	0.440
CO_2 emissions (kt)	NO	NO	0.539	2.477	2.926	3.251	2.601
Average CO_2 EF (tCO_2/t oxides)	NO	NO	0.451	0.465	0.465	0.467	0.467

In year 2009 the bricks production plant is not operating due to economic 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 therefore 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[51]. 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 (kt)
AD_{raw} – activity data of used raw materials – clay (kt)
$AD_{CaO,MgO}$% / 100 – CaO and/or MgO content in used raw materials (%)
EF – CO_2 emission factor of CaO and/or MgO (kt/kt)
CF – conversion factor

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 (kt)
AD_{raw} – activity data of used raw materials – clay (kt)
$AD_{additive}$% / 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 (kt/kt)
CF – conversion factor

In latest years 2008-2013 the CO_2 emissions were estimated for different bulks of used clay therefore CaO and MgO content data for these bulks differs. Therefore the CO_2 emissions were estimated separately. In 2015 there is used EF=0.014 (tCO_2/t oxides) that already include CO_2 EFs from MgO and CaO (Table 4.22).

Table 4.22 Data and assumptions used for CO_2 emission estimation from 5th bricks production plant

	Use of clay (kt)	MgO content (%)	CaO content (%)	MgO amount (kt)	CaO amount (kt)	MgO CO_2 EF (tCO_2/t oxide)	CaO CO_2 EF (tCO_2/t oxide)	$CaCO_3$ (additive) (kt)	CO_2 emissions (kt)	Average CO_2 EF (tCO_2/t oxides)
1990	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1995	107.38	1.43%	10.39%	1.536	11.152	1.092	0.785	0.000	**10.431**	0.822
2000	112.50	1.43%	10.39%	1.609	11.683	1.092	0.785	0.000	**10.928**	0.822

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

	Use of clay (kt)	MgO content (%)	CaO content (%)	MgO amount (kt)	CaO amount (kt)	MgO CO_2 EF (tCO_2/t oxide)	CaO CO_2 EF (tCO_2/t oxide)	$CaCO_3$ (additive) (kt)	CO_2 emissions (kt)	Average CO_2 EF (tCO_2/t oxides)
2005	88.29	0.39%	1.75%	0.344	1.545	1.092	0.785	0.000	**1.589**	0.841
2006	94.44	0.39%	1.75%	0.368	1.653	1.092	0.785	0.342	**1.849**	0.841
2007	80.90	0.36%	1.47%	0.291	1.189	1.092	0.785	1.218	**1.787**	0.845
2008	26.32	1.23%	0.32%	0.324	0.084	1.092	0.785	0.000	**1.594**	1.029
	28.33	1.35%	0.41%	0.382	0.116	1.092	0.785			1.020
	28.82	1.26%	0.38%	0.363	0.110	1.092	0.785			1.021
	13.21	1.09%	0.25%	0.144	0.033	1.092	0.785			1.035
2009	1.05	1.09%	0.25%	0.011	0.003	1.092	0.785	0.000	**0.647**	1.035
	21.02	1.07%	0.27%	0.225	0.057	1.092	0.785			1.030
	22.05	1.16%	0.27%	0.256	0.060	1.092	0.785			1.034
	1.19	1.12%	0.23%	0.013	0.003	1.092	0.785			1.040
2010	0.82	1.12%	0.23%	0.009	0.002	1.092	0.785	1.019	**1.396**	1.040
	21.05	1.23%	0.26%	0.259	0.055	1.092	0.785			1.038
	21.15	1.13%	0.24%	0.239	0.051	1.092	0.785			1.038
	20.80	1.16%	0.28%	0.241	0.058	1.092	0.785			1.032
2011	17.72	1.12%	0.23%	0.198	0.041	1.092	0.785	2.875	**2.638**	1.040
	26.51	1.23%	0.26%	0.326	0.069	1.092	0.785			1.038
	25.05	1.13%	0.24%	0.283	0.060	1.092	0.785			1.038
	24.07	1.16%	0.28%	0.279	0.067	1.092	0.785			1.032
2012	21.17	1.12%	0.23%	0.237	0.049	1.092	0.785	2.465	**2.287**	1.040
	20.83	1.23%	0.26%	0.256	0.054	1.092	0.785			1.038
	18.59	1.13%	0.24%	0.210	0.045	1.092	0.785			1.038
	21.41	1.16%	0.28%	0.248	0.060	1.092	0.785			1.032
2013	20.75	1.02%	0.25%	0.212	0.052	1.092	0.785	5.863	**3.744**	1.032
	20.28	1.22%	0.39%	0.247	0.079	1.092	0.785			1.018
	18.48	1.20%	0.30%	0.222	0.055	1.092	0.785			1.031
	20.60	1.20%	0.03%	0.247	0.006	1.092	0.785			1.085
2014	76.93	NA	NA	NA	NA	NA	NA	6.932	**4.163**	0.014
2015	64.53	NA	NA	NA	NA	NA	NA	3.265	**2.403**	0.014

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[52]. In plant's application to GHG permit unknown source emission factor was used therefore 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:

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

$$AD_{raw} = \sum \left(AD_{bulk} \times M_{av} - M_{bulk} \times moisture / 100 \right)$$

where:
AD_{raw} – activity data of used raw materials – clay (kt)
AD_{bulk} – amount of dried bulk materials (pieces)
M_{av} – average mass (kt)
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 not 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.

4.2.5.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The uncertainty of activity data for this sector is assumed as 7.5%. The activity data reported in bricks production plant's annual GHG reports within EU 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 bricks and tile production are the default ones from Monitoring and Reporting Regulation within EU ETS[53] so the uncertainty of emission factors is assumed as 50%.

Only CO_2 emissions from tiles and bricks production are estimated. Other emissions are not estimated due to lack of official emission estimation methodology and emission factors.

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 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.

Time series consistency was checked by verifying IEF, AD and emission changes and attention was paid to important increase/decrease that are explained in NIR.

[53] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF*

4.2.5.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

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

CO_2 emission factors for tiles production are taken from MRG[54] and are the default ones therefore there is no need to re-check correctness of emission factors.

QA/QC check is performed with Tier1 method from 2006 IPCC Guidelines.

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.

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.

Checks performed pursuant to Article 7(1)(l) of Regulation (EU) No 525/2013 are done to comparing EU ETS data with GHG inventory emissions.

4.2.5.5 Category-specific recalculations

Minor recalculations in tiles production were made due to precision of EF from 0.08 to 0.08794 1995-2015.

4.2.5.6 Category-specific planned improvements

No improvements are planned in this sector.

4.2.6 Other uses of Soda Ash (2.A.4.b)

4.2.6.1 Category description

Under this category CO_2 emissions from waste water neutralization using Soda ash have been estimated 2005-2015. Till 2005 soda ash wasn`t used in waste water neutralization.

In 2015 CO_2 emissions constitute 0.67 kt CO_2 eq which are 7.2% higher than in 2014. Comparing with 2005 the emissions have grown by 241% due to increase of production amounts (Figure 4.8)

[54] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:229:0001:0085:EN:PDF*

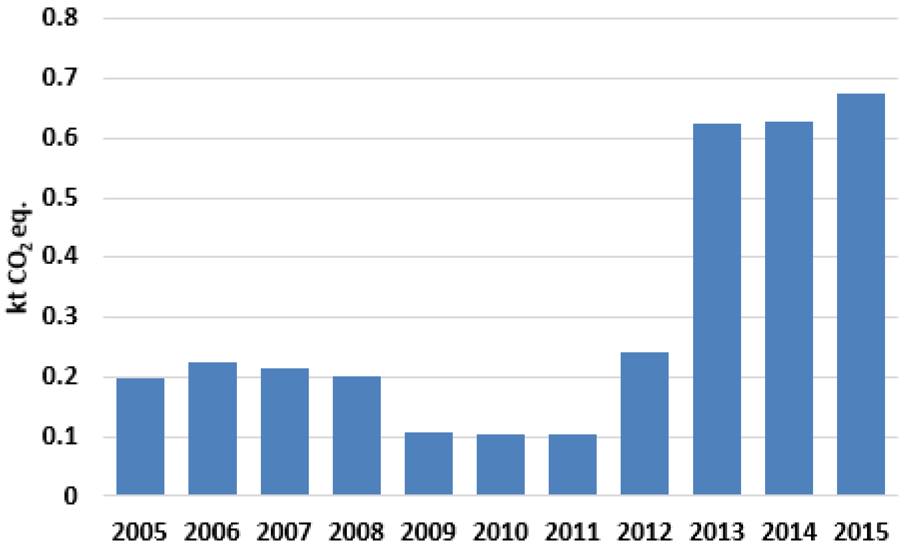

Figure 4.8 CO_2 emissions from other uses of soda ash 2005-2015, kt CO_2 eq.

4.2.6.2 Methodological issues

Activity data

Glass fibre production company annually reports amounts of used soda ash in waste water neutralization within the EU ETS since 2005. These data are available in annual GHG reports (Table 4.23).

Table 4.23 Amount of used Soda for waste water nautralization (kt)

	Soda use for waste water nautralization (kt)
1990	NO
1995	NO
2000	NO
2005	0.48
2006	0.54
2007	0.52
2008	0.49
2009	0.26
2010	0.25
2011	0.25
2012	0.58
2013	1.50
2014	1.51
2015	1.62

Emission factors and calculations

Emissions are calculated according to 2006 IPCC Guidelines default methodology by multiplying amount of soda used with appropriate emission factor. Emission factor for soda ash is taken from EU MRR (0.415 tCO_2/t).

4.2.6.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Activity data for emission calculation from other uses of soda ash is taken from glass production plant`s annual GHG report under EU ETS. According to that the 7.5% uncertainty for activity data could be applied.

As the emission factor for CO_2 emission calculation is default from EU MRR (0.415 tCO_2/t) the uncertaimty of emission factor is assumed 50%.

4.2.6.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed with Tier1 method from 2006 IPCC Guidelines.

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.

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.

Checks performed pursuant to Article 7(1)(l) of Regulation (EU) No 525/2013 are done to comparing EU ETS data with GHG inventory emissions.

4.2.6.5 Category-specific recalculations

No recalculation has been done for the sector.

4.2.6.6 Category-specific planned improvements

No improvements are planned in this sector.

4.2.7 Other Process Uses of Carbonates (2.A.4.d)

Under sector 2.A.4.d Other emissions of NOx, CO from cement production and NMVOC emissions from cement production and glass production are reported as it is not technically possible to report these emissions under 2.A.1 Cement production sector and 2.A.3 Glass production sector in CRF Reporter directly under relevant categories. Detailed description about indirect emissions from cement production are included in NIR Chapter 4.2.2.2 Methodological issues.

NMVOC emissions from Glass production are reported under sector 2.A.4.d and summed up with NMVOCs from cement production that are reported under this sector due to reason mentioned above.

4.3 CHEMICAL INDUSTRY (CRF 2.B)

4.3.1 Category description

Although there are strong traditions of the chemical industry in Latvia there are no chemical industry production processes listed in 2006 IPCC Guidelines or EMEP/EEA 2016 generating GHG emissions.

The biggest part of chemical industry is medicine production and then small part of paints and varnishes production.

In 2.B.10.a sector particular matters from phosphate fertilizers are calculated but these emissions are not reported under Climate Convention as GHGs.

There are no F-gases emissions under sectors 2.B.9.a By-Product Emissions and 2.B.9.2 Fugitive emissions so there are no child nodes added under these categories in CRF Reporter. Corresponding CRF tables are left blank due to CRF internal issue which does not allow to directly enter NO in green and grey cells without adding child nodes. It was confirmed by CRF help desk that this issue will be improved in the future releases of the software. Some F-gases data in the parent categories (green and grey cells) in corresponding CRF tables are missing due to this reason.

4.4 METAL INDUSTRY (CRF 2.C)

CO_2, CH_4 and indirect GHGs (NOx, CO, NMVOC, SO_2) from 2.C.1 Iron and Steel production are reporter under 2.C Metal Industry. There are no GHG emissions under rest of the sectors under 2.C. therefore these categories are NO in CRF Reporter.

There are no F-gases emissions under sectors 2.C.3. Aluminium production, 2.C.4. Magnesium production in Latvia therefore in CRF Reporter the corresponding CRF tables are left blank due to CRF internal issue which does not allow to directly enter NO in green and grey cells without adding child nodes. Some F-gases data in the parent categories (green and grey cells) in corresponding CRF tables are missing due to this reason.

4.4.1 Iron and Steel Production (CRF 2.C.1)

4.4.1.1 Category category description

Only one company produces steel in Latvia. Metal industry sector emissions constitute 1.04 kt CO_2 eq (0.1%) of total IPPU emissions in Latvia in 2015. CO_2 emissions from 2.C.1 sector have decreased by 98.5% since 1990 and increased by 11361% comparing with 2014 (Figure 4.9 and Table 4.24). In 2014 only 0.09 kt crude steel were produced from scrap metal because production was almost stoped due to the company's bankruptcy. In 2015 the company resumed to produce steel therefore emissions appeared again showing comparably big growth compared to 2014.

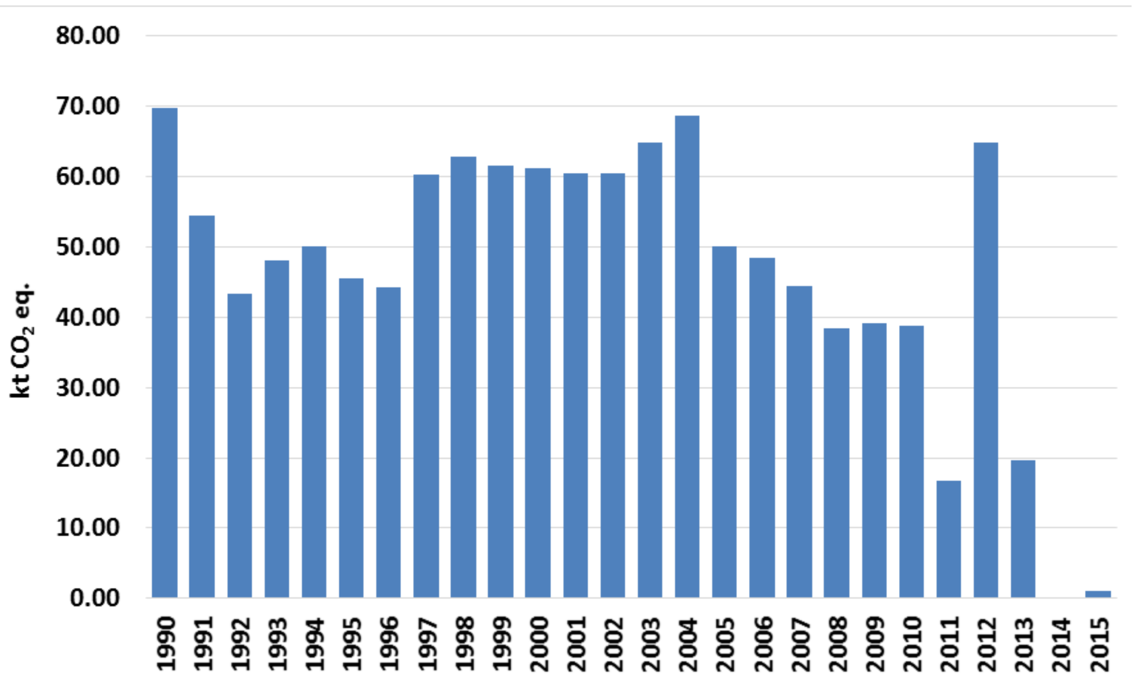

Figure 4.9 CO_2 emissions from Metal industry 1990-2015 (kt CO_2 eq.)

CO_2 emissions from crude iron as input material in iron and steel production in open-heart furnaces (OHF) as well as crude iron used in electric arc furnaces (EAF) are included in the inventory according to 2006 IPCC Guidelines. The indirect GHG emission sources are also included under iron and steel production.

Table 4.24 Emissions from 2.C Metal Production in 1990–2015 (kt)

	CO_2	CH_4	NOx	CO	NMVOC	SO_2
1990	69.69	0.003	2.805	0.001	0.011	0.088
1995	45.46	0.001	1.425	0.000	0.006	0.045
2000	61.20	0.003	2.551	0.001	0.010	0.080
2005	50.09	0.003	2.827	0.001	0.011	0.089
2006	48.48	0.003	2.828	0.001	0.011	0.089
2007	44.45	0.003	2.847	0.001	0.011	0.089
2008	38.37	0.003	2.705	0.001	0.011	0.085
2009	39.06	0.002	2.246	0.000	0.009	0.070
2010	38.74	0.003	2.730	0.001	0.011	0.086
2011	16.66	0.001	0.022	0.000	0.008	0.010
2012	64.81	0.004	0.109	0.001	0.038	0.050
2013	19.60	0.001	0.025	3.28E-04	0.009	0.012
2014	0.01	4.63E-07	1.20E-05	1.57E-07	4.26E-06	5.55E-06
2015	1.04	6.24E-05	0.002	2.12E-05	0.001	0.001
2015 versus 2014	11358%	13386%	13386%	13386%	13386%	13386%
2015 versus 1990	-98.51%	-97.73%	-99.94%	-96.14%	-94.78%	-99.15%

Considerable emission decrease occurred in time period 1990–1992 due to changes in Latvia's national economy (Table 4.24). Decrease of CO_2 emissions in 1990–1996 also occurred due to decrease of used crude iron in 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 emissions increased almost twice in 2002–2003 when amount of used crude iron increased but amount of used scrap metal remains at the same level. Final amount of steel products produced in the only metal production plant fluctuates in small range in latest years. After the crisis in 2008-2009 all emissions from metal production increased in 2010. In 2011 sharp decrease of emissions were observed due to switching of metal production technology so amount of steel produced EAF (about 75%) and mass of steel produced in OHF (about 69%) also decreased. Since mid-2011 the OHF is not used in this company anymore (the installations are dismantled). In 2011 the metal production plant was working only 4 months. Since 2011 entire amount of crude steel is produced in EAF only and plant worked only 5-7 months in a year. In 2014 only 0.09 kt crude steel were produced from scrap metal that caused 0.01036 kt CO_2 emissions. In 2015 the metal production company resume to produce steel therefore emissions appeared again.

4.4.1.2 Methodological issues

Reported emissions, calculation methods and type of emission factors for the 2.C Metal Industry in the Latvian inventory are summarized in Table 4.25.

Table 4.25 GHG emission categories, methods and gases reported from 2.C

Category	Method used	Gases reported
C. Metal Industry		
1. Iron and Steel Production	Tier1,2	CO_2, CH_4, NOx, CO, NMVOC, SO_2

Activity data

For 1990-2006 the used amount of raw materials in different types of production installations – OHF and EAF – was used as activity data reported by CSB. 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 OHF and in EAF. These amounts are estimated by using amount of raw materials used in OHF and EAF (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 OHF and in EAF is divided from total produced crude steel.

For 2007-2008 the total produced crude steel amount as output by used production technologies in OHF and EAF was reported by plant but the plant couldn't report the used raw materials as input 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 hearth furnaces;
- 95.52% of total used crude iron was used in open hearth 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 that is produced from crude iron. It is estimated by using crude iron / scrap metal ratio since amounts of used scrap metal in OHF and used crude iron in the same furnaces are known. Then this ratio number is multiplied with amount of steel produced in OHF to estimate amount of crude steel produced directly from crude iron.

Coke, coke fine and carburizators 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 was previously reported in 1.A.2.a Iron & Steel sector of Energy sector. Since 2016 submission allocation of used coke, coke fine and carburizators was made from Energy sector to IPPU as only crude steel production plant use these high carbon content carburizators only for process not for combustion to get energy.

In steel production facility lime, limestone and dolomite is also used for steel smelting in OHF. Quicklime is produced only from limestone in vertical shaft kiln. The plant reports their non-marketed quicklime production data for 2005-2013 within EU ETS so the estimated emissions as well as used activity data and emission factors are taken from plant's annual GHG report.

For submission 2017 the amount of limestone, dolomite and produced non-marketed lime (quicklime) used for steel production processes were allocated from 2.A.2 Lime production sector to 2.C.1 Iron & Steel production sector. Data for CO_2 emission estimations from steel production are given in Table 4.26 below.

Table 4.26 Data for estimation of CO_2 emissions from steel production

	Crude steel production, t	Used coke (t)	Used Limestone, t	Used Dolomite, t	Used Carbon electrodes, t	Used quicklime, t	% mass of steel produced in OHF	Mass of steel produced in OHF, t	Mass of steel produced in EAF, t	% mass of steel produced in EAF	Used scrap metal in steel production, t	Crude iron used in OHF, t	Crude iron used in EAF t	Crude iron/scrap metal ratio	Amount of crude steel in what production crude iron where involved (in OHF), t	Amount of crude steel in what production crude iron where involved (in EAF), t	Carbon content in crude iron	Carbon content in crude steel	Conversion factor	Total CO_2 emissions from furnaces + input material consumed in iron and steel production (kt)	CO_2 total emissions from Iron and Steel (CO_2 eq)
1990	550000	11362	14300	33000	10	10452	98.7	543074	6926	1.3	537227	107732	1161	20.1	110293	1389	3.5	0.25%	3.664	**69.69**	**69.76**
1995	279326	6207	14300	33000	5	10452	98.7	275747	3579	1.3	285015	37086	413	13.0	36346	466	3.5	0.25%	3.664	**45.46**	**45.49**
2000	500292	10061	14300	33000	6	13416	99.2	496434	3858	0.8	503123	70637	476	14.0	70240	542	3.5	0.25%	3.664	**61.20**	**61.26**
2005	554345	6757	6326	29706.56	9	17096.64	98.9	548472	5873	1.1	527950	104010	970	19.7	109210	1157	3.5	0.25%	3.664	**50.09**	**50.16**
2006	554546	5207	12025	30491	9	11757.9	98.9	548419	6127	1.1	531026	105769	1021	19.9	110454	1220	3.5	0.25%	3.664	**48.48**	**48.54**
2007	558156	3731	9017	30405	2	12939.1	99.8	556814	1342	0.2	463940	109248	257	23.6	131434	316	4.0	0.30%	3.664	**44.45**	**44.52**
2008	530462	4575	5378	26245	63	14842.4	99.3	526964	3498	0.7	492450	88319	533	17.9	95136	627	3.0	0.30%	3.664	**38.37**	**38.43**
2009	440458	4950	8472	22393	3	8851.3	99.9	440016	442	0.1	413058	68783.6	63	16.7	73346	74	4.0	0.20%	3.664	**39.06**	**39.12**
2010	535301	3986	4147	28115	7	16324.8	99.8	534168	1133	0.2	476868	81340	166	17.1	91307	193	4.0	0.20%	3.664	**38.74**	**38.80**
2011	167624	3949	2	246	302	NO	NO	NO	167624	100	187103	NO	3389	1.8	3037	3037	4.0	0.20%	3.664	**16.66**	**16.68**
2012	836431	15190	541	1555	1171	NO	NO	NO	836431	100	900803	NO	13387	1.5	12431	12431	4.0	0.20%	3.664	**64.81**	**64.92**
2013	193190	3710	0.3	NO	585	NO	NO	NO	193190	100	227834	NO	3185	1.4	2701	2701	4.0	0.20%	3.664	**19.60**	**19.63**

	Crude steel production, t	Used coke (t)	Used Limestone, t	Used Dolomite, t	Used Carbon electrodes, t	Used quicklime, t	% mass of steel produced in OHF	Mass of steel produced in OHF, t	Mass of steel produced in EAF, t	% mass of steel produced in EAF	Used scrap metal in steel production, t	Crude iron used in OHF, t	Crude iron used in EAF t	Crude iron/scrap metal ratio	Amount of crude steel in what production crude iron where involved (in OHF), t	Amount of crude steel in what production crude iron where involved (in EAF), t	Carbon content in crude iron	Carbon content in crude steel	Conversion factor	Total CO_2 emissions from furnaces + input material consumed in iron and steel production (kt)	CO_2 total emissions from Iron and Steel (CO_2 eq)
2014	92.51	3	NO	NO	NO	NO	NO	NO	93	100	121	NO	NO	NO	NO	NO	4.0	0.20%	3.664	**0.009**	**0.01**
2015	12475.91	239	NO	NO	23	NO	NO	NO	12476	100	14181	NO	5	0.03	NO	4	4.0	0.20%	3.664	**1.04**	**1.04**

Emission factors and calculations

2006 IPCC Guidelines, EMEP/CORINAIR 2009 and EMEP/EEA 2016 were used to calculate direct and indirect GHG emissions from the 2.C.1 Steel Production sector. There is only one Iron & Steel production plant in Latvia that produces crude steel by melting crude iron and scrap metals. The plant is participant of EU ETS and annualy submits GHG report to LEGMC.

For CO_2 emission calculation from 2.C.1 sector Tier 2 method from 2006 IPCC Guidelines is used. It is based on estimation of carbon losses through the production processes when remaining carbon is emitted to air.

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.

Equation 4.9 from 2006 IPCC Guidelines is used to calculate CO_2 emissions from steel production:

$$E_{CO2,\ non\text{-}energy} = [PC*C_{PC} + L*C_L + D*C_D + CE*C_{CE} + O_b*C_b + S_{in}*C_{in} - S_{out}*C_{out}]*44/12$$

where:

PC-quantity of coke consumed in iron and steel production (not including sinter production), tonnes
C_{PC} *–carbon content in coke, tC/tonne*
L-quantity of limestone consumed in iron and steel production, tonnes
C_L *–carbon content in limestone, tC/tonne*
D- quantity of dolomite consumed in iron and steel production, tonnes
C_D *–carbon content in dolomite, tC/tonne*
CE-quantity of carbon electrodes consumed in EAFs, tonnes
C_{CE} *–carbon contents in carbon electrodes, tC/tonne*
O_b *–quantity of other carbonaceous and process material (quicklime), tonnes*
C_b *–carbon content of other carbonaceous material (quicklime), tC/tonne*
S_{in} *–amount of used metal in steel production process as input material (crude iron), tonnes*
C_{in} *- carbon content in input material (crude iron), tC/tonne*
S_{out} *– amount of produced metal material as output material (crude steel), tonnes*
C_{out} *– carbon content in output material (crude steel), tC/tonne*

According to information reported by steel producer:

- Average carbon content of crude iron using in steel production is 3.5% in 1990-2006, 4% for 2007, 2009-2013 and 3% for 2008;
- Average carbon content of produced steel is 0.25% for 1990-2006, 0.3% for 2007-2008 and 0.2% for 2009-2013.

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.

Till 2008 the default emission factor- 1.5 kg carbon per tonne of steel was used but afterwards data reported by steel production plant has been used. There are used as far as possible plant provided activity data and emission factors and as possible applicable higher tier method according to available data.

Emission factors of methane and indirect GHG emissions are taken from EMEP/CORINAIR 2007 and EMEP/EEA 2016 guidelines for estimations of emissions from processes in OHFs, where 95% of total steel production is produced till 2010 and for electric arc furnace starting from year 2011 (Table 4.27).

Table 4.27 Emission factors of metal production (t/t)

	CH_4	NO_x	CO	NMVOC	SO_2
Iron and Steel Production					
OHF	0.000005	0.0051	0.000001	0.00002	0.00016
EAF	0.000005	0.00013	0.0017	0.000046	0.00006

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.

4.4.1.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The uncertainty of activity data for this sector is assumed as 5%. The activity data reported in iron and steel production plant's annual GHG report within EU ETS is verified by accredited verifiers and Latvia's Regional Environmental Boards so the activity data is adequately verified.

As the material-specific default carbon contents for process materials are used from 2006 IPCC Gudelines, the 10% emission factor uncertainty could be applied.

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, AD and emission changes and attention was paid to important increase/decrease that are explained in NIR.

4.4.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed with Tier1 method from 2006 IPCC Guidelines.

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.

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.

Checks performed pursuant to Article 7(1)(l) of Regulation (EU) No 525/2013 are done to comparing EU ETS data with GHG inventory emissions. There are differences in sector 2.C.1 in 2013 and 2014 between ETS and inventory data. See Table 4.28 below.

Table 4.28 Differences between CO_2 emissions under ETS and inventory data of steel production for 2013 and 2015

2.C.1 Iron and Steel (kt CO_2 eq.)			Difference
Year	2006 IPCC Guidelines, Volume 3, Chapter 4, equation 4.9	EU MRR[55] Art.25	
2013	19.603	14.072	28.22%
2014	0.009	0.011	20.59%
2015	1.036	0.877	15.10%

Difference is caused by different emission calculation methodologies that are used under UNFCCC reporting (2006 IPCC Guidelines) and EU ETS Reporting. According to 2006 IPCC Guidelines the CO_2 emissions from 2.C.1 are estimated taking into account only particular part of used raw materials that generate CO_2 emissions in production process. As mostly scrap metals are used in production of crude steel in Latvia, only amount of used crude iron as input material in crude steel production is taken into account. During remelting of scrap metal the CO_2 emissions are not generated. The crude iron/ scrap metal ratio is used in emission calculation.

Under EU ETS CO_2 emissions by plant are calculated by multiplying AD (used raw materials) with EF without any division into used technologies that gives very approximately calculated CO_2 emissions that differ from emissions reported in GHG inventory.

4.4.1.5 Category-specific recalculations

In 2017 submission CO_2 emissions from 2.C.1 were recalculated in all time series according to 2006 IPCC Guidelines taking into account all input and output process materials (coke, limestone, dolomite, carbon electrodes and quicklime). Also the amount of limestone, dolomite and produced non-marketed lime (quicklime) used for steel production processes were allocated from 2.A.2 Lime production sector to 2.C.1 Iron & Steel production sector.

4.4.1.6 Category-specific planned improvements

No improvements are planned in this sector.

[55] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0601&from=EN*

4.5 NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE (CRF 2.D)

Under 2.D Non-energy Products from Fuels and Solvent Use sector there are reported emissions from Paraffin wax, Lubricant use and Other (including Solvent use, Asphalt roofing and Road paving with asphalt, urea use).

Non-energy products from fuels and solvent use sector GHG emissions amounts to 42.55 kt which is 5.6% from total IPPU emissions and 0.4% of total CO_2 equivalent emissions including indirect CO_2, without LULUCF in Latvia in 2015. CO_2 emissions from 2.D sector have decreased by 10.8% since 1990 and increased by 14.9% comparing with 2014 due to increased amount of lubricants and imported solvent products and greater activity in road paving in 2015 (Figure 4.10). The main part of this sector emissions constitute 2.D.3 Other subsector with 23.91 kt (56.2 %) from total 2.D sector emissions. 2.D.3 Other subsector includes emissions from Solvent use, Asphalt roofing, Road paving with asphalt and Urea use. Solvent use sector constitutes 95.4% of 2.D.3 Other sector. Remaining part of emissions (4.6%) from 2.D.3 Other constitute Asphalt roofing, Road pawing with asphalt and Urea Use.

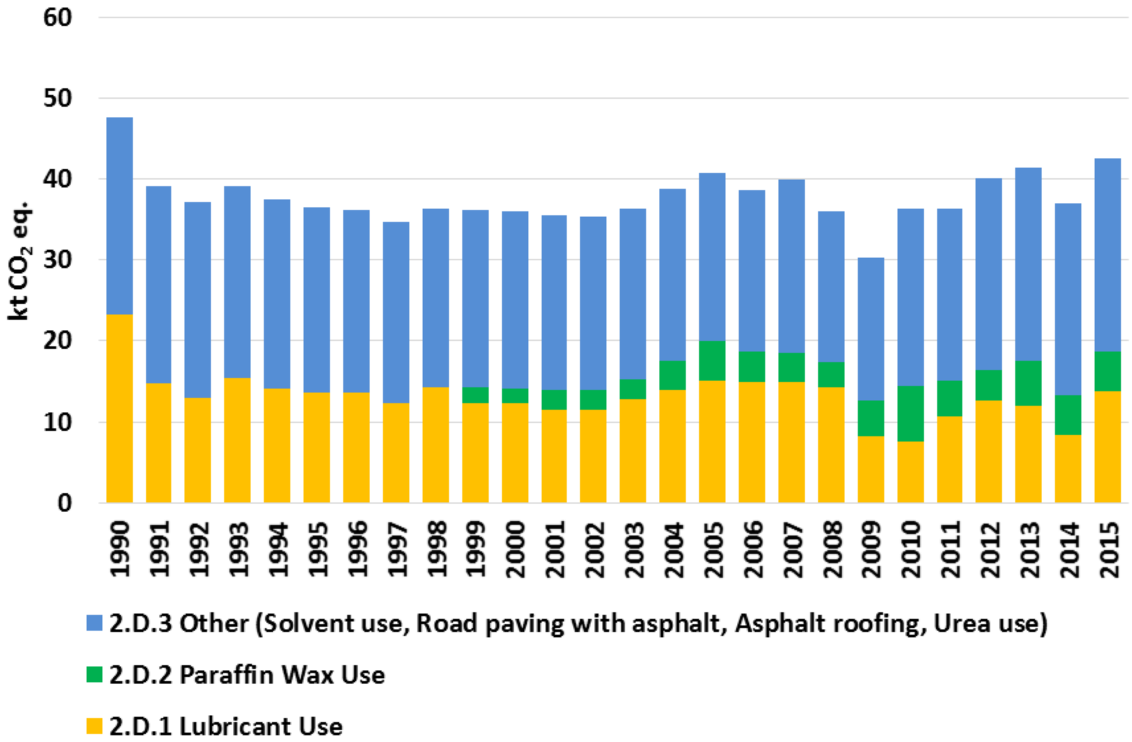

Figure 4.10 Emissions from Non-energy Products from Fuels and Solvent Use sector 1990-2015 (kt CO_2 eq.)

Reported emissions, calculation methods and type of emission factors for the 2.D Non-energy Products from Fuels and Solvent Use in the Latvian inventory are summarized in Table 4.29.

Table 4.29 GHG emission categories, methods and gases reported from 2.D

Category	Method used	Gases reported
D. Non-energy Products from Fuels and Solvent Use		
1.Lubricant Use	Tier1	CO_2
2. Paraffin Wax Use	Tier1	CO_2
3. Other		
Solvent Use	Tier1,2	CO_2, NMVOC
Road paving with asphalt	Tier1	CO_2, NMVOC
Asphalt roofing	Tier1	CO_2, NMVOC, CO
Urea use	Tier1	CO_2

4.5.1 Lubricant Use (CRF 2.D.1)

4.5.1.1 Category description

Lubricant use subsector emissions amounts 13.72 kt (32.2%) of total Non-energy sector products` emissions in Latvia in 2015. CO_2 emissions from 2.D.1 sector decreased by 41.0% since 1990 and increased by 65.4% comparing with 2014 due to increased lubricant consumption in transportation appliances (Figure 4.11 and Table 4.30).

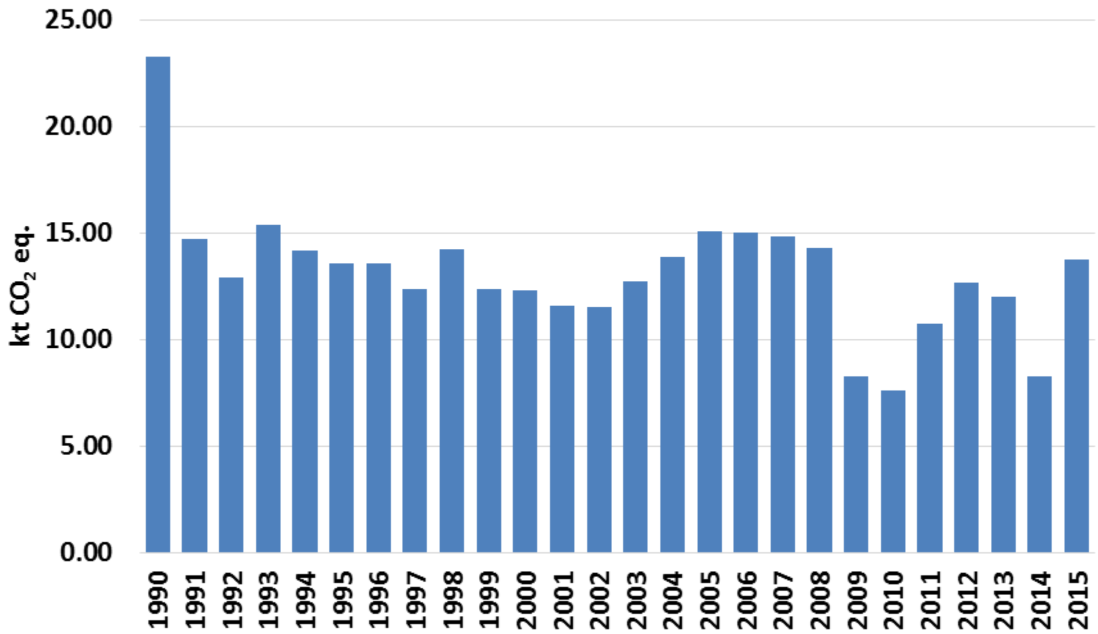

Figure 4.11 CO_2 emissions from Lubricant use 1990-2015 (kt)

Under this category lubricant consumption are reported as feed stocks in Latvia. Emissions from lubricant is reported as „CO_2 not emitted" because it is assumed that CO_2 emissions is captured and not emitted to the air.

Consumption and emissions of lubricants are reported in sector 2.D.1 for all years in time series 1990-2015 (Table 4.30).

Table 4.30 CO_2 emissions from lubricant use 1990-2015

	CO_2 emissions (kt)
1990	23.25
1995	13.57
2000	12.31
2005	15.09
2006	14.99
2007	14.86
2008	14.31
2009	8.28
2010	7.62
2011	10.73
2012	12.66
2013	12.03
2014	8.30
2015	13.72
Share in IPPU total in 2015	1.8%
2015 versus 2014	+65.4%
2015 versus 1990	-41.0%

4.5.1.2 Methodological issues

Activity data

Lubricant consumption data from CSB Energy Balance was used as activity data for emission calculation.

Lubricants are mainly used in transport sector. The amount of oil from which the oil film has been formed on the inner cylinder walls is calculated. This oil film further is exposed to combustion and burned along with the fuel.

Share of used lubricants in transport sector is calculated according to kilometres travelled. It includes used lubricants for each of the subgroups of road transport separately, including 2 -stroke motocycles for which petrol engine should be lubricated by a mixture of lubricating oil and petrol.

CO_2 emissions from the lubricants consumed in transport are estimated and reported under transport sector and constitute 6.9% of total lubricants amount in 2015. The rest of the lubricants are used as feedstocks and CO_2 emissions from them are calculated and reported under 2.D.1 sector.

Table 4.31 Activity data for lubricant use 1990-2015

	Total consumption of lubricants (TJ)	Consumption of lubricants in 1.A.3.b (TJ)	Consumption of lubricants in Lubricants Use sector (TJ)	Share of total lubricants used in 1.A.3.b sector (%)
1990	1632.54	47.24	1585.30	2.9
1995	962.78	37.44	925.34	3.9

	Total consumption of lubricants (TJ)	Consumption of lubricants in 1.A.3.b (TJ)	Consumption of lubricants in Lubricants Use sector (TJ)	Share of total lubricants used in 1.A.3.b sector (%)
2000	879.06	40.05	839.01	4.6
2005	1088.36	59.18	1029.18	5.4
2006	1088.36	66.40	1021.96	6.1
2007	1088.36	75.14	1013.22	6.9
2008	1046.50	70.86	975.64	6.8
2009	627.90	63.19	564.71	10.1
2010	586.04	66.50	519.54	11.3
2011	795.34	63.54	731.80	8.0
2012	920.92	57.74	863.18	6.3
2013	879.06	59.10	819.96	6.7
2014	627.90	62.14	565.76	9.9
2015	1004.64	69.06	935.58	6.9

Emission factors and calculations

CO_2 emissions are calculated according to Tier 1 method and emission factors as well as default carbon content are taken from 2006 IPCC Guidelines. Carbon content for lubricant is 20.0 kg/GJ according to 2006 IPCC Guidelines Volume 3 Chapter 5 Table 5.2.

Net calorific value (NCV) for lubricants is 41.86 $TJ/10^3$ t and is reported in CSB Energy Balance [56].

CO_2 emissions are calculated using 2006 IPCC Guidelines equation 5.2[57]:

$$CO_2\ Emissions = LC \times CC_{Lubricant} \times ODU_{Lubricant} \times 44/12$$

where:
CO_2 emissions= CO_2 Emissions from lubricants, tonne CO_2
LC= Total lubricant consumption, TJ
$CC_{Lubricant}$=carbon content of lubricants (default), tonneC/TJ (=kg/ C/TJ)
$ODU_{Lubricant}$ =ODU(Oxidised during use) factor (based on default composition of oil and grease) fraction
44/12= mass ratio of CO_2/C

4.5.1.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Activity data are taken from CSB of Latvia and uncertainty are assumed as 2%.

As the default ODU factor is used, the uncertainty (50%) from 2006 IPCC Guidelines is applied for ODU emission factor.

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[56] *http://data.csb.gov.lv/pxweb/lv/vide/vide__ikgad__energetika/EN0020.px/?rxid=a7ccdc56-327e-45d0-9488-41a1f701ae14*

[57] *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 5: Non-Energy Products from Fuels and Solvent Use, p.5.7*

The carbon content coefficients is taken from 2006 IPCC Guidelines and are based on two studies of the carbon content and heating value of lubricants, from which an uncertainty range of about 3%.

The total emission factor uncertainty U_{total} is being calculated, using following formula of combined uncertainty:

$$U_{total} = \sqrt{(U_1^2 + U_2^2 + \ldots + U_n^2)}$$

where:
U_{total} = the percentage uncertainty in the product of the quantities
U_i = the percentage uncertainties associated with each of the quantities

Combined emission factor uncertainty is calculated as 50%.

4.5.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed according to 2006 IPCC Guidelines. There are compared the amounts discarded, recovered and combusted in Transport sector with total consumption figures in the calculation to check the internal consistency data and ODU factors if they are used in the calculation of different source categories across sectors.

4.5.1.5 Category-specific recalculations

Previously the total amount of used lubricants (including amount used in transport) was reported as activity data in CRF under 2.D.1. sector. In 2017 submission amount of used lubricants is reported without amount used in transport in CRF Reporter. Emissions are not affected.

4.5.1.6 Category-specific improvements

No improvements are planned in this sector.

4.5.2 Paraffin Wax Use (CRF 2.D.2)

4.5.2.1 Category description

Paraffin wax use subsector emissions constitutes 4.91kt (11.5%) of total Non-energy sector emissions in Latvia in 2015. CO_2 emissions from 2.D.2 sector have been increased by 166.7% since 1999 and stayed at the same level as in 2014 (Figure 4.12 and Table 4.32).

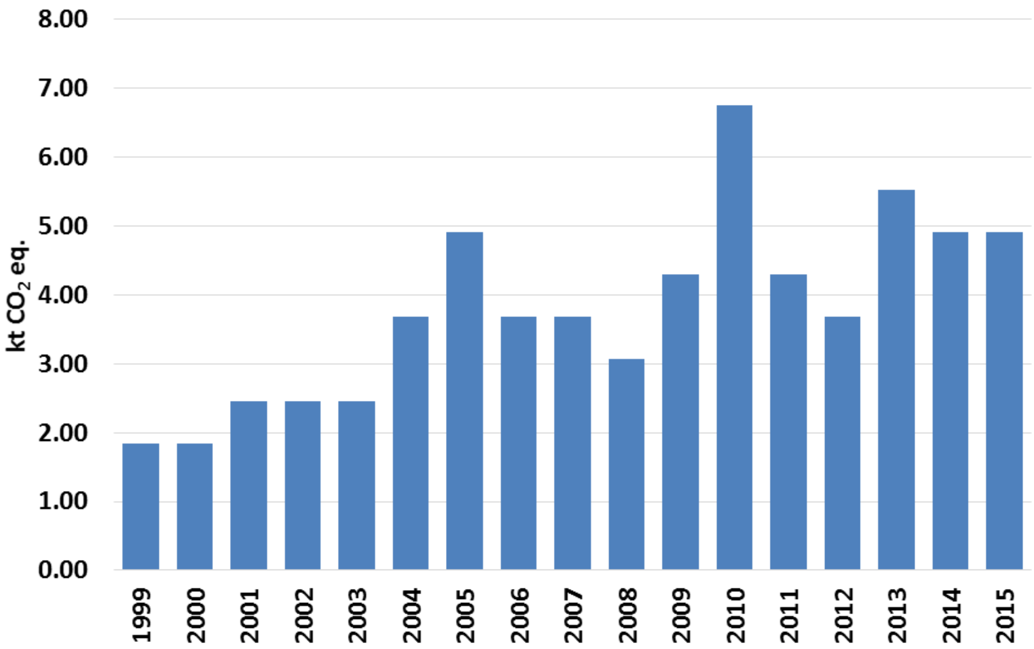

Figure 4.12 CO_2 emissions from Paraffin wax use 1990-2015 (kt)

Under this category paraffin wax consumption is reported as feedstocks in Latvia. Paraffin wax mainly is used in chemical substance in chemical production as well as plastic, rubber and furniture production. Emissions from paraffin wax is reported as „CO_2 not emitted" because it is assumed that CO_2 emissions is captured and not emitted into the air.

Consumption and emissions of paraffin wax are reported in sector 2.D.2 for all years in time series 1999-2015 (Table 4.32).

Table 4.32 Activity data and CO_2 emissions from paraffin wax use 1990-2015

	Consumption of paraffin wax (TJ)	CO_2 emissions (kt)
1990	NO	NO
1995	NO	NO
2000	125.58	1.84
2005	334.88	4.91
2006	251.16	3.68
2007	251.16	3.68
2008	209.30	3.07
2009	293.02	4.30
2010	460.46	6.75
2011	293.02	4.30
2012	251.16	3.68
2013	376.74	5.52
2014	334.88	4.91
2015	334.88	4.91
Share in IPPU total in 2015	-	0.6%
2015 versus 2014	0.0%	0.0%
2015 versus 1999	166.7%	166.7%

4.5.2.2 Methodological issues

Activity data

Paraffin wax consumption data from CSB Energy Balance was used as activity data for emission calculation. Data from CSB about paraffin wax consumption are available only from 1999.

Emission factors and calculations

CO_2 emissions are calculated according to Tier1 method and emission factors as well as default carbon content are taken from the 2006 IPCC Guidelines. Carbon content for paraffin wax is 20.0 kg/GJ as default one taken from 2006 IPCC Guidelines Volume 3 Chapter 5 pp 5.12.

Net calorific value (NCV) for lubricants is 41.86 TJ/10^3 t and is reported in CSB Energy Balance[58].

CO_2 emissions are calculated using 2006 IPCC Guidelines equation 5.4[59]:

$$CO_2\ Emissions = PW \times CC_{Wax} \times ODU_{Wax} \times 44/12$$

where:
CO_2 emissions= CO_2 Emissions from waxes, tonne CO_2
LC= Total wax consumption, TJ
CC_{Wax}=carbon content of paraffin wax (default), tonneC/TJ (=kg/ C/TJ)
ODU_{Wax}= Oxidised during use (ODU) factor for paraffin wax, fraction
44/12= mass ratio of CO_2/C

4.5.2.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Activity data are taken from CSB of Latvia and uncertainty is assumed 2%.

The default ODU factor for paraffin wax is taken from 2006 IPCC Guidelines. Due to lack of information regarding application of paraffin wax in the country, the uncertainty of ODU factor is assumed 100 %.

The carbon content coefficient is taken from 2006 IPCC Guidelines and uncertainty is 5%.

The total emission factor uncertainty U_{total} is being calculated, using following formula of combined uncertainty:

$$U_{total} = \sqrt{(U_1^2 + U_2^2 + \ldots + U_n^2)}$$

where:
U_{total} = the percentage uncertainty in the product of the quantities
U_i = the percentage uncertainties associated with each of the quantities

Combined emission factor data uncertainty is calculated as 100%.

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[58] *http://data.csb.gov.lv/pxweb/lv/vide/vide__ikgad__energetika/EN0020.px/?rxid=a7ccdc56-327e-45d0-9488-41a1f701ae14*
[59] *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 5: Non-Energy Products from Fuels and Solvent Use, p.5.11*

4.5.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts

QA/QC check is performed according to 2006 IPCC Guidelines. There are compared the amounts discarded, recovered and combusted with total consumption figures in the calculation to check the internal consistency data and ODU factors if they are used in the calculation of different source categories across sectors.

4.5.2.5 Category-specific recalculations

No recalculations were done in this category.

4.5.2.6 Category-specific improvements

No specific improvements are planned in this sector.

4.5.3 Other (CRF 2.D.3)

4.5.3.1 Category description

This chapter describes emissions from Solvent Use, Road paving with asphalt and Asphalt roofing sector under Other (CRF 2.D.3).

Solvent Use

Solvent Use sector (2.D.3) is a key source of indirect CO_2 emissions of Latvian inventory. The Solvent use is estimated as a key category in level and trend by using Approach 1 without LULUCF. Quantitative information regarding key categories is available in Annex 1 of this submission.

The use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC). NMVOC emissions are regarded as an indirect greenhouse gases as it over a period of time will oxidize into CO_2 when emitted to the atmosphere. In general the CO_2 emissions from Solvent Use sector have been constantly increasing (Figure 4.13) in the time series 1990-2015. Solvent Use emissions in 2015 increased by 13.09% compared to 2014.

According to 2006 IPCC Guidelines and EMEP/EEA 2016 Solvent Use sector covers emissions from the four SNAP (Selected Nomenclature for Air Pollution) subcategories:

- SNAP 0601: Paint application (Including such activities as paints and varnishes from decorative, industrial and other coating applications);
- SNAP 0602: Degreasing, Dry cleaning (Degreasing includes cleaning products from water-insoluble substances such as grease, fats, oils waxes and tars. Dry cleaning refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibres using organic solvents);

- SNAP 0603: Chemical products manufacturing or processing (Including the processing of polyester, PVC, foams and rubber, manufacture of paints, inks, glues and adhesives and finishing of textile);
- SNAP 0604: Other use of solvents and related activities (Including such activities as "enduction" (i.e. coating) of glass wool and mineral, printing industry, fat and oil extraction, uses of glues and adhesives, wood preservation, domestic use (other than paint application) and vehicle underseal treatment and vehicle dewaxing).

Latvia`s reported NMVOC and indirect CO_2 emissions from NMVOC under Solvent Use sector in 2015 are shown in Table 4.33.

Table 4.33 Reported emissions from Solvent Use in Latvia in 2015

CATEGORY		TITLE	EMISSIONS
SNAP	NRF		
0601	2D3d	Paint application	NMVOC, indirect CO_2
0602	2D3e	Degreasing	NMVOC, indirect CO_2
0602	2D3f	Dry cleaning	NMVOC, indirect CO_2
0603	2D3g	Chemical products	NMVOC, indirect CO_2
0604	2D3h	Printing industry	NMVOC, indirect CO_2
0604	2D3a	Domestic solvent use (other than paint application)	NMVOC, indirect CO_2
0604	2D3i	Other solvent use	NMVOC, indirect CO_2

Solvent Use sector was the largest pollution source of NMVOC emissions in Latvia in 2015 and it covered over 25.2% (10.38 kt) from the total Latvia's NMVOC emissions. The main share of total indirect emissions contributed SNAP 0601: Paint application – 41.17% or 4.27 kt and SNAP 0603: Chemical products – 27.03% or 2.81 kt (Figure 4.13).

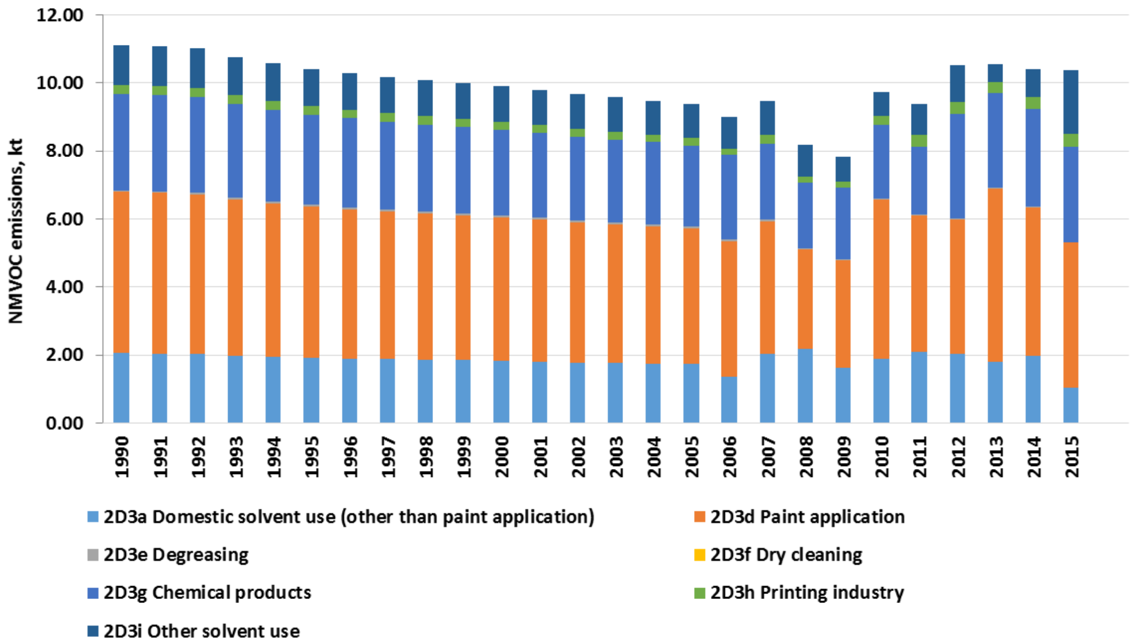

Figure 4.13 Total NMVOC emissions from Solvent Use for the period 1990-2015, kt

In general the NMVOC emissions from Solvent Use sector have been constantly increasing since the beginning of 1990s till 2015 mostly due to the the economic situation in the country. The slightly decrease in emissions occurred between years 1991 and 1997, when industry was affected by a crisis. In subsequent years there has been observed NMVOC emission increase till 2006 which resulted in import growth of NMVOC containing products. At the end of 2008 the world was struck by the economic crisis which also affected the Solvent Use sector in Latvia till 2009. As shown there is slight increase of NMVOC emissions of Solvent Use sector during the later period of 2010 till 2015. For instance, emissions of NMVOC have increased by 6.76%, from 9.72 kt NMVOC in 2010 to 10.38 kt NMVOC in 2015 (see Table 4.34).

Table 4.34 NMVOC and indirect CO_2 emissions from Solvent Use for the period 1990-2015, kt

	NMVOC, kt	Indirect CO_2 emissions, kt
1990	11.11	24.43
1991	11.07	24.34
1992	11.01	24.20
1993	10.77	23.68
1994	10.58	23.27
1995	10.42	22.90
1996	10.29	22.61
1997	10.18	22.39
1998	10.08	22.17
1999	9.99	21.97
2000	9.90	21.77
2001	9.80	21.55
2002	9.67	21.25
2003	9.58	21.06
2004	9.48	20.85
2005	9.37	20.60
2006	9.01	19.80
2007	9.47	20.83
2008	8.19	18.01
2009	7.84	17.24
2010	9.72	21.37
2011	9.38	20.61
2012	10.52	23.13
2013	10.56	23.21
2014	10.41	22.89
2015	10.38	22.82

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. At the same time enterprises tend to provide a stockpiles taking into account economic situation. This in turn affects amount of CO_2 emission, causing fluctuations of time series.

Road paving with asphalt (2.D.3.b) and Asphalt roofing (2.D.3.c)

In this sector emissions from road paving activities are reported.

Table 4.35 Activity data for Road paving and Asphalt roofing 1990-2015

	Amount of bitumen mixtures used (kt)	% of asphalt used for Road Paving	% of asphalt used for Asphalt roofing	Road Paving with asphalt (kt)	Asphalt roofing (kt)
1990	39.00	80%	20%	31.20	7.80
1995	116.99	80%	20%	93.59	23.40
2000	423.64	90%	10%	381.28	42.36
2005	1165.02	90%	10%	1048.51	116.50
2006	1116.70	90%	10%	1005.03	111.67
2007	1492.52	90%	10%	1343.27	149.25
2008	1536.66	90%	10%	1382.99	153.67
2009	838.45	90%	10%	754.60	83.84
2010	937.18	90%	10%	843.46	93.72
2011	1481.48	90%	10%	1333.33	148.15
2012	1584.97	90%	10%	1426.48	158.50
2013	1255.14	90%	10%	1129.62	125.51
2014	1289.97	90%	10%	1160.97	129.00
2015	1474.68	90%	10%	1327.21	147.47

According to CSB data the biggest share of NMVOC and CO_2 emissions are originating during road paving with asphalt. Just small part of all bitumen mixtures is used in asphalt roofing sector (Table 4.35).

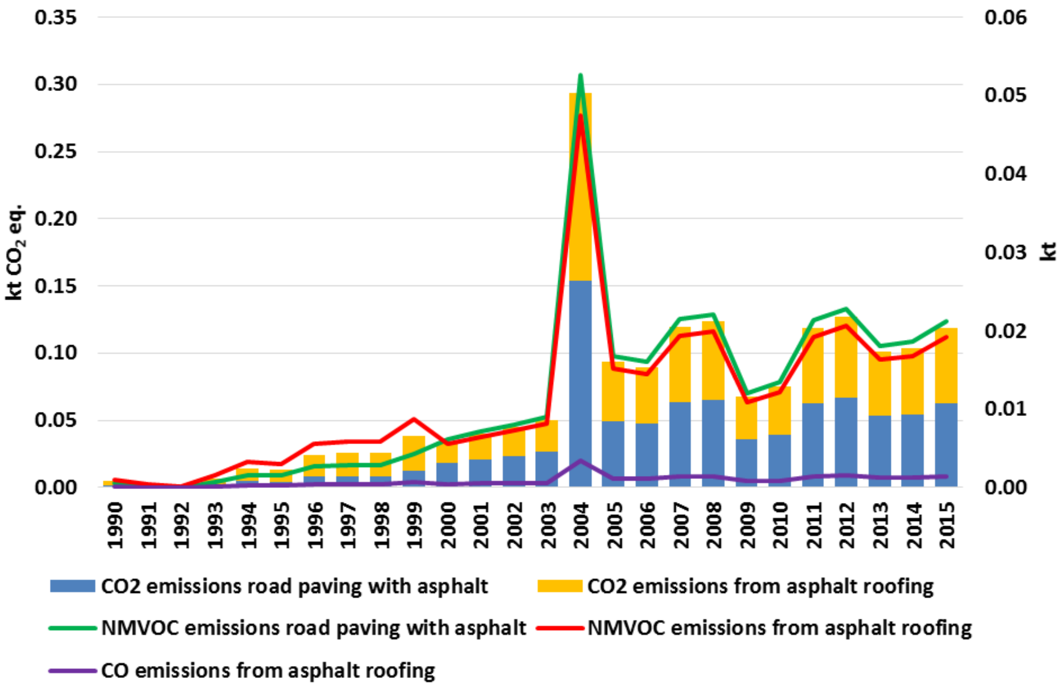

Figure 4.14 Emissions from asphalt roofing and road paving in 1990–2015 (kt CO_2 eq.; kt)[60]

The emissions from these two particular sectors are constantly increasing since the beginning of 1990s. Slight emission decrease in 1999-2000 could be 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 could be explained with Latvia's accession to EU in the May of 2004 before and after when the road paving works were very active and there were built VIA Baltic that connects all Baltic States. In 2011 and 2012 there are raised activity for road paving and asphalt roofing about 58.1% and 7.0% respectively. In 2013 overall activity of bitumen use in industrial processes had decreased by about 20.8% and was related to financial resources that were assigned directly to this sector for road paving or asphalt roofing. In 2015 emission increase has been observed because according to Latvia`s State Road Network Statistics the length of renewed and constructed bituminous pavements (km) increased compared with 2014 (Figure 4.14).

Urea use

Urea are used as catalyst in fuel consumption and calculated under 1.A.3 Transport sector but emissions are reported under 2.D Non-energy Products from Fuels and Solvent Use (Table 4.36).

Table 4.36 Data from Urea use 2006-2015 (kt)

	Urea consumption	CO_2 emissions
1990	NO	NO
1995	NO	NO
2000	NO	NO
2005	NO	NO
2006	2.006	0.133

[60] *NMVOC and CO emissions on secondary axis*

	Urea consumption	CO_2 emissions
2007	2.007	0.419
2008	2.008	0.497
2009	2.009	0.471
2010	2.01	0.563
2011	2.011	0.521
2012	2.012	0.528
2013	2.013	0.538
2014	3.427	0.817
2015	4.116	0.981

4.5.3.2 Methodological issues

Solvent Use

The NMVOC inventory is carried out to fulfil the obligations of the United Nations Economic Commission for Europe's Convention on Long-Range Transboundary Air Pollution (UNECE CLRTAP).

NMVOC emissions from Solvent Use sector (except 2D3f and partly 2D3g) were calculated according to EMEP/EEA 2016 methodology based on Tier 1 or Tier 2 approach and used particular emission factors for several source sub-categories (see Table 4.37).

Table 4.37 Approaches and emission factors for Solvent Use sector

Subcategories	NRF	EF	Tier	Unit
Cosmetics and toiletries (all)	2D3a	0.83	2	t/t solvent
Household products (all)	2D3a	0.65	2	t/t solvent
DIY/buildings (all), Adhesives, Paint/varnish removers and solvents	2D3a	0.95	2	t/t solvent
Car care products (all)	2D3a	0.94	2	t/t solvent
Pesticides	2D3a	0.865	2	t/t solvent
Domestic use of pharmaceutical products	2D3a	0.606	2	t/t product
Paint application: construction and buildings	2D3d	0.23	2	t/t paint applied
Paint application: domestic use	2D3d	0.23	2	t/t paint applied
Coating applications: manufacture of automobiles	2D3d	0.4	1	t/t paint applied
Paint application: car repairing	2D3d	0.72	2	t/t paint applied
Paint application: coil coating	2D3d	0.8	2	t/t paint applied
Coating applications: Boat building	2D3d	0.4	1	t/t paint applied
Paint application: wood	2D3d	0.8	2	t/t paint applied
Coating applications: Other industrial paint application	2D3d	0.2	1	t/t paint applied
Other non industrial paint application	2D3d	0.74	2	t/t paint applied
Degreasing	2D3e	0.46	1	t/t cleaning products
Chemical products, manufacture and processing	2D3g	0.01	1	t/t product
Polystyrene foam processing	2D3g	0.06	2	t/t polystyrene
Rubber processing	2D3g	0.008	2	t/t rubber produced
Tyre production	2D3g	0.01	2	t/t tyres
Paints manufacturing	2D3g	0.011	2	t/t product

Subcategories	NRF	EF	Tier	Unit
Polyurethane processing	2D3g	0.12	2	g/kg foam processed
Printing	2D3h	0.5	1	t/t ink
Glass Wool Enduction	2D3i	0.25	2	t/t solvent
Glass Wool Enduction	2D3g	0.25	2	t/t solvent
Printing	2D3h	0.5	1	t/t ink
Fat, edible and non-edible oil extraction	2D3i	0.002	1	t/t product used
Application of glues and adhesives	2D3i			
Preservation of wood	2D3i	0.945	2	t/t preservative (organic solvent-borne preservative)
Preservation of wood	2D3i	0.005	2	t/t preservative (waterborne preservative)
Other solvent and product use	2D3i	0.002	2	t/t product

From the 1990s till 2005 statistics for Solvent Use was not well kept due to the country-wide changes in the governmental system and national economy. For 2006-2015 activity data for Paint application, Degreasing, Chemical Products (partly), Printing industry, Domestic solvent use and Other solvent use was obtained from the Register of Chemical Substances and Chemical Mixtures (CR) at Ltd. Latvian Environment, Geology and Meteorology Centre. In the 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 the 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 %), as well as type of product group (subcategories of Solvent Use sector) is provided.

NMVOC emissions (kt) from Solvent Use sector (except 2D3f and partly 2D3g) were calculated for the time series 2006-2015 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 (kt)*
EF_{NMVOC} *– emission factor from EMEP/EEA 2013*
AD – activity data from the Chemical Register (kt)

To obtain a comparable data in time series for years where statistics was not well kept NMVOC emissions were extrapolated taking into account number of inhabitants taken from CSB database.

NMVOC emissions data from Dry cleaning and Chemical products subsectors is obtained directly from database "2-Air" at Ltd. Latvian Environment, Geology and Meteorology Centre for 2006-2015. From the 1990s till 2005 statistics for NMVOC emissions data also was not well kept. "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 2016. The enterprises have been reporting their produced NMVOC emissions dividing in a particular NMVOC.

Activity data from Dry cleaning and Chemical products subsectors reported by enterprises is not available as these data is not required to be reported and could be assumed as confidential.

Indirect CO_2 emissions from Solvent Use sector was estimated using methodology from the 2006 IPCC Guidelines:

$$Emissions_{CO2} = Emissions_{NMVOC} \times Percent\ carbon\ in\ NMVOCs\ by\ mass \times 44.0098/12.011$$

It was assumed that the average carbon content of NMVOC is 60% by mass for all categories under the sector of Solvent Use in accordance with the 2006 IPCC Guidelines.

This leads to an emission factor for indirect CO_2 release of 2.198474731 kg CO_2/kg NMVOC.

Road paving with asphalt (2.D.3.b) and Asphalt roofing (2.D.3.c)

EMEP/EEA 2016 Tier1 was used to estimate NMVOC emissions from the 2.D.3.b Road paving with asphalt and 2.D.3.c Asphalt roofing. According to CSB data the biggest part of bitumen mixtures amount is used for road paving (90%). Only small part is used for roofing activities (10%) (Table 4.38).

NMVOC emissions are estimated using simpler default methodology:

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

where:
E_{NMVOC} *– NMVOC emissions (kt)*
$AD_{bitumen}$ *– bitumen and bitumen mixtures used in CRF 2.D.3.b and 2.D.3.c activities (kt)*
EF_{NMVOC} *–NMVOC emission factor (kt/kt)*

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

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 (kt)*
EF_{CO2} *– estimated CO_2 emission factor*
NMVOC – NMVOC emissions (kt)

Emission factors

For CO_2 emission estimation 80% of carbon content conversion factor are used. According to 2006 IPCC Guidelines [61] indirect emissions of CO_2 from atmospheric oxidation of emitted NMVOC are included in the national emission inventory. The average amount of carbon in NMVOC is assumed as 80%[62].

Therefore the CO_2 emission factor from 2006 IPCC Guidelines was estimated using following equation:

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

where
EF_{CO2} – CO_2 emission factor (kt/kt)
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.[63,64] Due to lack of the technology use information Tier1 EFs were used (Table 4.38).

Table 4.38 Emission factors for asphalt roofing and Road paving in 1990–2015

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

Urea use

Description of methodology to calculate CO_2 emissions from Urea use is reported under sector 1.A.3 Transport.

4.5.3.3 Uncertainties and time series consistency

Uncertainty analysis for 2016 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Solvent use

Latvia has developed a detailed inventory for the Solvent Use sector thereby the uncertainty of activity data is estimated to be the default value of 25 percent according to the IPCC 2006 Guidelines. Uncertainties if indirect CO_2 from Solvent Use sector were estimated on the bases on uncertainties of respective NMVOC emissions. Uncertainty of emission factor is assumed to be default value of 10 percent. The uncertainty of emission factor took into account the fact that the default fossil carbon content fraction of NMVOC is 60 % by mass, and can vary between 50-70%.

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[61] *http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_7_Ch7_Precursors_Indirect.pdf (page 7.6)*
[62] *Based of the most often used average carbon conversion factor*
[63] *http://www.eea.europa.eu/publications/emep-eea-guidebook-2013, 2.D.3.b Road paving with atsphalt pdf (page8)*
[64] *http://www.eea.europa.eu/publications/emep-eea-guidebook-2013 2.D.3.c Asphalt roofing pdf (page 9)*

Road paving with asphalt (2.D.3.b) and Asphalt roofing (2.D.3.c)

Uncertainty of activity data for estimations of CO_2 emissions from 2.D.3.c Asphalt roofing sector and 2.D.3.b Road paving with asphalt sector is assumed rather low as CSB data of used bitumen mixtures are used and the percentage of 2006 IPCC Guidelines 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 at least 20%.

The CO_2 emission factors for 2.D.3.b and 2.D.3.c sectors are assumed as high as 50% 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 2016 as Tier 1 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, AD and emission changes and attention was paid to important increase/decrease that are explained in NIR.

4.5.3.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

Solvent use

All estimations of the emissions done in the LEGMC 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 the national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived in centralized archiving system.

Road paving with asphalt (2.D.3.b) and Asphalt roofing (2.D.3.c).

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.

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

4.5.3.5 Category-specific recalculations

Solvent use

Recalculations have been done for the all time series taking into account that previous reporting system for Register of Chemical Substances and Chemical Mixtures has improved. For instance, from this year electronic reporting system has implemented for the chemicals importers and producers (previous the annual reports by enterprises were submitted in paper form). In particular, now it is necessary to specify product group (request for allocation of subcategories under Solvent Use sector) for produced or imported chemical mixtures placed in territory of Latvia (previously this was done by expert judgment). The implementation of this electronic reporting system has led to an increase in the availability of information on the solvent sector as well as an improvement on data quality, in particular more accurate division by subcategories. Based on the submitted information by enterprises for the previous calendar year all historical data were reviewed and recalculated.

Road paving with asphalt (2.D.3.b) and Asphalt roofing (2.D.3.c)

No recalculations were done in this sector.

4.5.3.6 Category-specific improvements

Solvent use

It is planned to more detailed analysing activity data obtained from the Chemical Register and database "2-Air" for all time series, as well as to improve NMVOC emission calculation for historical years where statistics was not well kept.

Road paving with asphalt (2.D.3.b) and Asphalt roofing (2.D.3.c)

No improvements are planned for this sector.

4.6 ELECTRONICS INDUSTRY (CRF 2.E)

HFC, PFC, SF_6 and NF_3 emissions from manufacturing of integrated circuit of semiconductors, TFT flat panel displays, photovoltaics and heat transfer fluids are not occurring in Latvia.

There is one company in Latvia which manufactures liquid crystal displays (LCDs) and 3D products for industrial, professional, medical and defence applications. Directly contacting with the company they confirmed that NF_3 is not used in technology as well as company has no plans to use it in the future.

Other types of equipment listed in 2006 IPCC Guidelines, Volume 3, Chapter 6 under this sector are not manufactured in Latvia. Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells although CRF Reporter User manual says that if disaggregated data is not available for certain categories, the CRF

Reporter allows users to report information in the parent category. This can be done by directly entering data in the green cells (i.e. overwriting formulas).

Under Electronics industry subcategories Latvia doesn`t report emissions so child nodes (gases) are not added according to CRF User manual however it is not currently possible to enter data in green cells so some information in the parent category (green cells) in corresponding CRF tables are missing. It was confirmed by CRF Reporter help desk that this is an CRF internal issue which will be improved in the future releases of the software. But for the moment it was suggested to leave cells blank.

4.7 PRODUCT USES AS SUBSTITUTES FOR OZONE DEPLETING SUBSTANCES (CRF 2.F)

Under 2.F Latvia reports emissions from usage of hydrofluorocarbons (HFCs) occurring in following sectors:

- Refrigeration and air-conditioning equipment (CRF 2.F.1);
- Foam blowing products (CRF 2.F.2);
- Fire Protection (CRF 2.F.3);
- Aerosols (CRF 2.F.4).

In 2015 GHG emissions from Product uses as substitutes for ODS substances amounted 227.06 kt CO_2 eq (2.0%) from total CO_2 equivalent emissions with indirect CO_2, without LULUCF. Compared to 2014 F-gases emissions have increased by 10%, but compared to 1995 emissions have increased by even 8984.8%.

There is no production of HFCs in Latvia. Emissions of the perfluorocarbons (PFCs) and nitrogern trifluoride (NF_3) do not occur in Latvia for all time series. HFC and PFC emissions from Solvents (CRF 2.F.5) and Other Applications (CRF 2.F.6) are not occurring in Latvia (reported as "NO" in CRF Reporter). Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells therefore some information in the parent category (green cells) in corresponding CRF tables are missing.

The calculation of emissions under 2.F was carried out for following gases:

- HFC–23
- HFC–32
- HFC–125
- HFC–134a
- HFC–143a
- HFC–152a
- HFC-245fa
- HFC-365mfc
- HFC–227ea

The biggest part of 2F emissions constitutes 2.F.1 Refrigeration and Air Conditioning (96.0%) which is also a key category of Latvia`s GHG inventory. Additionally 2.1% from 2F emissions comes from 2.F.4. Aerosols (metered dose inhalers), but 1.9% comes from 2.F.2 Foam blowing agents. Less than 1% comes from 2.F.3 Fire protection in 2015 (Figure 4.15).

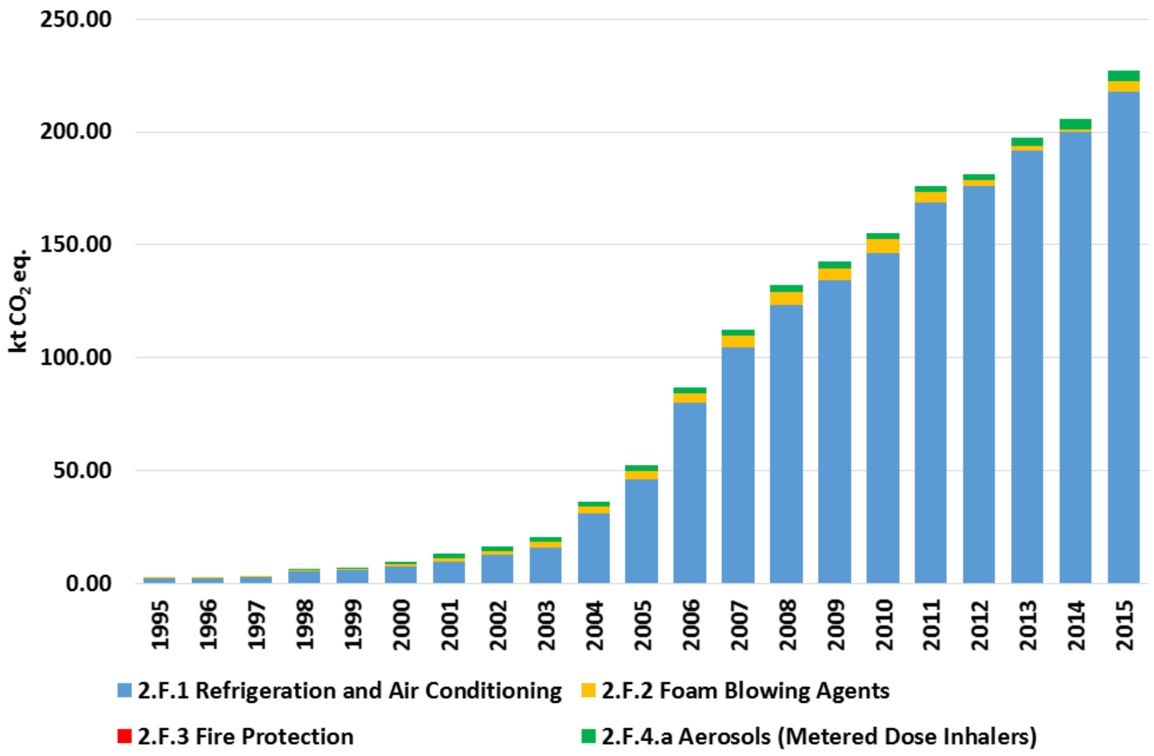

Figure 4.15 HFC emissions from 2.F Product Uses as ODS Substitutes 1995-2015 (kt CO_2 eq.)

The total emissions from 2.F have increased significantly since 1995 (see Table 4.39 and Figure 4.15). The main reason which caused emission growth was substitution of ODS with nature friendlier alternatives commonly named F-gases in refrigeration and air conditioning appliances. The usage of products which substitute ODSs in Latvia mainly depends on import. The imported amounts could be associated with economic situation in the country consequently this led to F-gases emission growth. As the significant part of total 2.F emissions (31.4% in 2015) results from use of mobile air conditioning systems in road transport, the emission growth is also a result of increase of car population under this sector.

Table 4.39 HFC emissions from 2.F Product Uses as Substitutes for ODS, 1995-2015 (kt CO_2 eq.)

Year	2.F	2.F.1	2.F.2	2.F.3	2.F.4
	Product Uses as Substitutes for ODS	Refrigeration and Air Conditioning	Foam blowing agents/ foaming of polyether (for shoe soles)	Fire Protection	Aerosols (Metered dose inhalers)
1995	2.50	2.10	0.40	NO,NE	NO,NE
1996	2.76	2.34	0.42	NO,NE	NO,NE
1997	3.35	2.90	0.45	NO,NE	NO,NE
1998	5.75	5.07	0.50	NO,NE	0.17
1999	6.96	6.04	0.23	NO,NE	0.70
2000	9.59	7.58	0.78	NO,NE	1.24
2001	12.92	9.66	1.52	0.02	1.73
2002	16.44	12.42	1.97	0.02	2.03
2003	20.27	15.93	2.38	0.04	1.93
2004	36.06	30.87	3.21	0.08	1.91

Year	2.F	2.F.1	2.F.2	2.F.3	2.F.4
	Product Uses as Substitutes for ODS	Refrigeration and Air Conditioning	Foam blowing agents/ foaming of polyether (for shoe soles)	Fire Protection	Aerosols (Metered dose inhalers)
2005	52.06	46.24	3.64	0.05	2.13
2006	86.61	79.98	4.22	0.02	2.39
2007	112.51	104.56	5.18	0.01	2.77
2008	132.10	123.28	5.81	0.01	3.00
2009	142.38	134.14	5.41	0.01	2.82
2010	155.01	146.09	6.19	0.02	2.72
2011	175.99	168.75	4.51	0.02	2.71
2012	181.18	175.95	2.63	0.06	2.55
2013	197.21	191.79	1.84	0.06	3.52
2014	205.63	199.94	0.96	0.03	4.70
2015	227.06	217.87	4.38	0.00	4.80
Share of total IPPU emissions in 2015 (%)	29.85%	28.65%	0.58%	0.0004%	0.63%
2015 versus 2014	+10.41%	+8.97%	+354.16%	-89.76%	+2.23%
2015 versus 1995	+8985%	+10281%	+991%	-82%	+2698%

In 2004 the first investigation of F-gases sources and emissions in Latvia was carried out. Within the project "SF_6, HFC and PFC emission inventory in Latvia 1995-2003" [65] (hereinafter F-gases research (2004)) the areas and users of F-gases in Latvia were identified for the first time. The result of this project was initial activity and consumption data for F-gases emission estimation (in accordance with IPCC 1996 methodology). Activity data and assumptions derived during this project and shortly after were used for F-gases emission calculations.

In 2015 and 2016 the F-gases research within the EEA Financial Mechanism 2009-2014 Programme "National Climate Policy (hereinafter F-gases research (2016)) was carried out. The aim of this research was to improve activity data obtaining process and emission factors in 2.F.1 Refrigeration and Air conditioning sector as well as to split the activity data for years 2004-2014 between the 2.F.1 subcategories according to 2006 IPCC Gudelines.

The research has been bottom-up orientated. F-gases importers, suppliers, users and service companies were asked to supplement the information reported under EU Regulation (EU) No 517/2014[66] and national Regulations No.563[67] with the information regarding the sector and purpose of the substances they import, use or refill in equipment in the country. Data base containing information regarding amounts of ODS and F-gases imported, refilled and held in stocks is maintained by LEGMC according to previous mentioned regulations. As a result data from the particular database was divided by categories relevant to 2006 IPCC Gudelines 2.F.1 sector subcategories. Emission factors and assumptions were discussed and

[65] Project report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003", Riga 2004
[66] EU Regulation (EU) No 517/2014 of The European Parliament and the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006
[67] Regulation No.563 of the Cabinet of Ministers of Latvia on special restrictions and prohibitions regarding activities with ozone-depleting substances and fluorinated greenhouse gases

confirmed by Latvian Freezing Equipment Engineers` Association which is the responsible institution in certification of F-gases operators in Latvia.

4.7.1 Refrigeration and Air Conditioning (CRF 2.F.1)

4.7.1.1 Category description

The calculation of actual emissions from Refrigeration and Air Conditioning is done according to the 2006 IPCC Guidelines, Chapter 7 (Emissions of Fluorinated Substitutes for Ozone Depleting Substances) and Chapter 8 (Other Product Manufacture and Use).

Refrigeration and Air Conditioning Systems are responsible for about 96 % of the 2.F Product uses as substitutes for ozone depleting substances sector in 2015. Under 2.F.1 sector HFC emissions are reported covering 6 subcategories according to 2006 IPCC Gudelines:

- Commercial Refrigeration (refrigerators for supermarkets, shops etc.);
- Domestic Refrigeration (fridges and freezers in households);
- Industrial Refrigeration (refrigeration units in food and chemical industries);
- Transport Refrigeration (refrigerated vehicles);
- Mobile Air Conditioning (air conditioning systems in passenger cars, trucks and buses);
- Stationary Air Conditioning (room air-conditioning systems and heat pumps).

In 2015 HFC emissions from 2.F.1 Refrigeration and Air Conditioning totalled 217.87 kt CO_2 equivalent. Compared to 2014 the emissions were increased by 9.0 %. In 2015 the mayority of F-gases emissions under 2.F.1 originates from 2.F.1.a Commercial Refrigeration (40.8 %) 2.F.1.e Mobile air conditioning (32.7 %), and 2.F.1.c Industrial Refrigeration (14.7 %) Other less significant sources are 2.F.1.f Stationary Air Conditioning (9.4 %), 2.F.1.d Transport Refrigeration (2.1%) and 2.F.1.b Domestic Refrigeration (0.3%) (Figure 4.16).

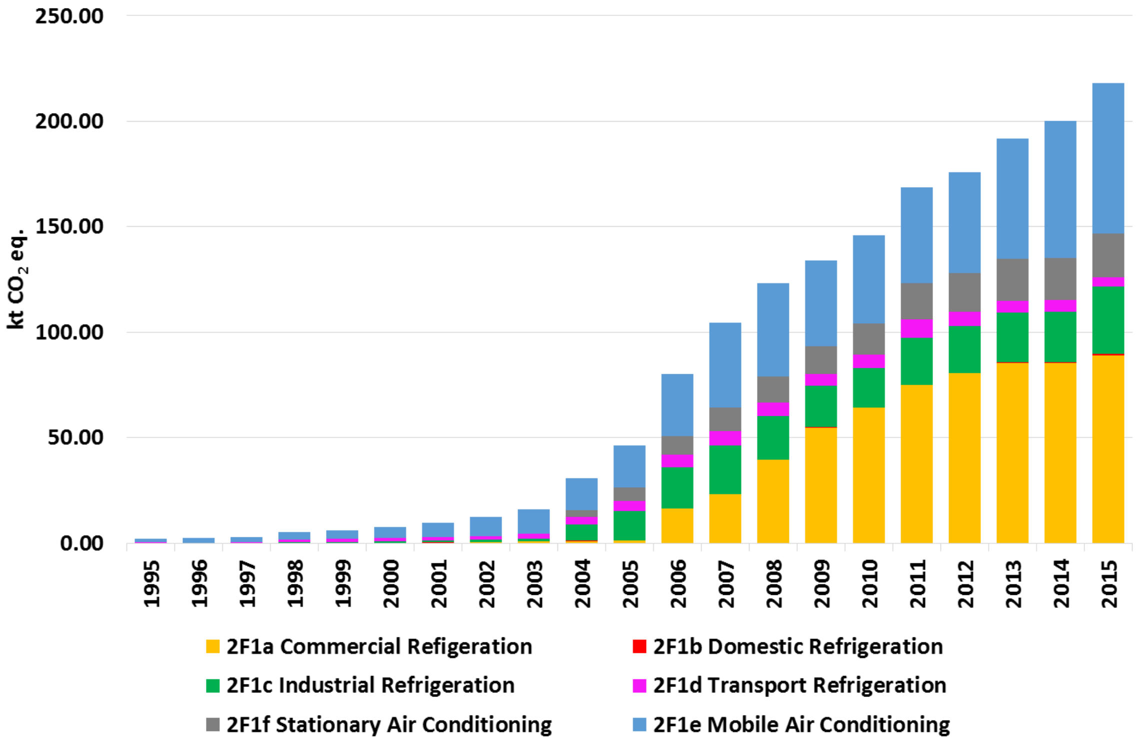

Figure 4.16 F-gases emissions from 2.F.1. Refrigeration and Air Conditioning equipment 1990-2015 (kt CO_2 eq.)

4.7.1.2 Methodological issues

An overview of the methods used and gases reported under 2.F.1 sector is presented in Table 4.40.

Table 4.40 Summary of emission calculation methods and gases in CFR 2.F.1

CRF Category/subcategory	Method used	Gases reported
2.F.1 Refrigeration and Air Conditioning		
2.F.1.a Commercial Refrigeration	Tier 2a	HFC-134a HFC-32 HFC-125 HFC-143a HFC-152a HFC-23
2.F.1.b Domestic Refrigeration	Tier 2a	HFC-134a
2.F.1.c Industrial Refrigeration	Tier 2a	HFC-134a HFC-32 HFC-125 HFC-143a
2.F.1.d Transport Refrigeration	Tier 2a	HFC-134a HFC-32 HFC-125 HFC-143a HFC-23
2.F.1.e Mobile Air Conditioning	Tier 2a	HFC-134a
2.F.1.f Stationary Air Conditioning	Tier 2a	HFC-134a HFC-32 HFC-125 HFC-143a

- *Commercial Refrigeration (CRF 2.F.1.a)*

Activity data

Activity data for emission calculation is taken from annual reports by F-gases operators according to Regulation (EC) No. 517/2014 and national legislation No.563[68] "Regulations of ozone depleting substances and fluorinated greenhouse gases that are freezing agents". According to these regulations operators (merchants and other institutions) which perform activities with ozone depleting substances or F-gases annually shall report to LEGMC the following information:

- Name of the substance;
- Amount of substance at the beginning of the year;
- Imported amount;
- Exported amount;
- Charged amount in freezing equipment units;
- Recycled amount;
- Regenerated amount;
- Disposed amount;
- Amount of substance at the end of the year.

64 operators reported data of their activities with F-gases in commercial refrigeration in 2015. For historical years activity data were obtained from questionnaires within previous F-gases research. For 2004-2005 activity data were obtained from enterprises that responded on data request letters sent by LEGMC. For 2006-2015 data were obtained from reporting within previously mentioned regulation act or extrapolated.

Emission factors and calculations

Tier 2a – emission-factor approach from 2006 IPCC Guidelines was used to estimate emissions from commercial refrigeration. Emissions result from charging, lifetime and end-of-life of equipment and are calculated for each type of HFC separately.

According to the methodology, refrigerant emissions at a reporting year can be calculated separately for each stage of life of the equipment. These emissions come from:

- $E_{charge,\ t}$ – emissions related to the refrigerant charge: connection and disconnection of the refrigerant container and the new equipment to be charged;
- $E_{lifetime,t}$ – annual emissions from the banks of refrigerants during operation (fugitive emissions and ruptures) and servicing;
- $E_{end\text{-}of\text{-}life,}t$ – emissions at system disposal.

Equation 7.10 from 2006 IPCC Guidelines was used to sum up all the emissions occurring during the lifetime of the equipment:

$$E_{total,t} = E_{Charge,t} + E_{Lifetime,t} + E_{End\text{-}of\text{-}life,t}$$

There are no HFC-containing equipment manufacturing companies in Latvia and all appliances used in commercial refrigeration are imported.

[68] *http://likumi.lv/ta/id/233736-noteikumi-par-ipasiem-ierobezojumiem-un-aizliegumiem-attieciba-uz-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumn...*

Emission factors and assumptions used in emission calculation from commercial refrigeration are as follows:

- HFCs mainly charged in Commercial Refrigeration are HFC-134a, HFC-404a, HFC-422d, HFC-407c, HFC-507a and HFC-410a;
- Average emission factor during charging of equipment is 1.8%[69];
- Average emission factor during operation of equipment is 18%[70];
- Average life time of commercial applications assumed 15 years;
- Residual charge of HFC in equipment being disposed 80%[71];
- Recovery efficiency at disposal 70%[72].

Equation from 2006 IPCC Guidelines for charging emissions estimation:

$$E_{Charged,\ t} = M_t \times k/100$$

where:
$E_{charged}$ – emissions during system manufacture/assembly in year (kg)
Mt – amount of HFC charged into a new equipment in year (kg)
k – charging losses (%)

Equation from 2006 IPCC Guidelines for emission estimation stocks:

$$E_{lifetime,\ t} = B_t \times x\ /\ 100$$

where:
$E_{lifetime}$ – amount of emissions during equipment operation (t)
Bt – amount of HFC held in stocks in year t
x – losses during operation period (%)

Equation from 2006 IPCC Guidelines for emission estimation from disposal:

$$E_{end\text{-}of\text{-}life,\ t} = M_{t\text{-}d} \times p/100 \times 1\text{-}(\eta_{rec,\ d}\ /\ 100)$$

where:
$E_{lend\text{-}of\text{-}life}$– amount of HFC emitted at system disposal in year (t)
Mt-d – residual charge of HFC in equipment being disposed of expressed in percentage of full charge (%)
ηrec, d – recovery efficiency at disposal, which is the ration of recovered HFC reffered to the HFC contained in the system (%)

The total amount of HFC charged into commercial refrigeration equipment in 2015 amounts to 29.29 t constituting 0.51 t manufacturing emissions. HFC in stocks amounts to 135.41 t constituting 68.25 t operating emissions. As the HFC amounts filled into refrigeration equipment are available since 1998, the decommissioning emissions according to 15 years lifetime could be estimated starting from 2013. In 2015 the amount of HFCs remained in decommission is amount of refrigerant initially charged into the systems in 2000 (0.29 t) which constitutes 0.07 t disposal emissions.

[69] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for commercial applications.*
[70] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for commercial applications.*
[71] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9*
[72] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9*

- *Domestic Refrigeration (CRF 2.F.1.b)*

Activity data

This category includes all refrigeration units (fridges and freezers) for domestic use. As there is no production of such equipment in Latvia, emissions could be estimated taking into account data on imported units which are charged and used within the country. Prior to 1990 most refrigeration appliances used CFC-12. Since 1993 there was a shift to HFC-134a. Many countries have subsequently moved to systems using hydrocarbon HC-600a which is now the predominant refrigerant for new domestic refrigeration appliances.

HFC emissions in domestic refrigeration are estimated from HFC-134a.

The activity data for HFC-134a emission estimation from domestic refrigerators and freezers are:

- number of inhabitants in Latvia – data taken from CSB database „Resident population at the beginning of the year"[73];
- number of households in Latvia – data taken from CSB database „Total number of households and the average size of a household"[74];
- number of new imported fridges and freezers – data taken from CSB database "Imports by countries 1995-2015"[75];
- share of annually sold new equipment filled with HFC-134a – taken from Finland according to Finnish research[76];
- percentage of households using refrigerators and freezers – for 1996, 2001, 2006, 2010, 2015 years data taken from CSB database „Number of electrical appliances used in dwellings and average age of appliances" [77];
- percentage of refrigerators and freezers charged with HFC-134a from 1995 till 2005 were determined during first F-gases research in 2004. As from 2006 the F-gases regulation entered into force it was assumed that the share of HFC-134a containing domestic refrigerators (stocks) started to decrease since that time. All European manufacturers of household appliances have changed their production from HFC-134a to R600a some time ago and appliances containing HFC-134a have only been imported from outside the EU to a small extent in recent years. No new equipment entered the stock from 2011 onwards. It was confirmed by Latvian Freezing Equipment Engineers` Association that the share of HCF-134a in domestic refrigeration stock is 15%.

[73] *http://data.csb.gov.lv/pxweb/en/Sociala/Sociala__ikgad__iedz__iedzskaits/IS0020.px/table/tableViewLayout1/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8*
[74] *http://data.csb.gov.lv/pxweb/en/Sociala/Sociala__ikgad__iedz__iedzskaits/IS0210.px/?rxid=562c2205-ba57-4130-b63a-6991f49ab6fe*
[75] *http://data.csb.gov.lv/pxweb/en/atirdz/atirdz__detalizeta__8zim/?tablelist=true&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0*
[76] *http://www.vtt.fi/inf/pdf/tiedotteet/2001/T2099.pdf*
[77] *http://data.csb.gov.lv/pxweb/en/vide/vide__energ_pat/0201.px/table/tableViewLayout1/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8*

Emission factors and calculations

HFC-134a emissions from domestic refrigerators and freezers are estimated by using 2006 IPCC Guidelines Guidelines Tier 2a – Emission-factor approach.

Emission factors and assumptions used in emission calculation from domestic refrigeration are as follows:

- Country specific average refrigerant charge per unit: 150 g HFC-134a;
- Default manufacturing emission factor 0.6%[78];
- Default operating emission factor 0.3%[79];
- Default disposal emission factor 80%[80];
- Recovery efficiency at disposal 70%[81].

There are no manufacturing companies in Latvia and all domestic refrigerators and freezers are imported.

That gives approximate annual amount of HFC-134a charged that is estimated with equation from 2006 IPCC Guidelines:

$$HFC_{Charged,t} = R \times n/f$$

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

Equation from 2006 IPCC Guidelines was used for charging emissions estimation:

$$E_{Charged,t} = Mt \times k/100$$

where:
$E_{charged}$ *– emissions during system manufacture/assembly in year (kg)*
Mt – amount of HFC-134a charged into a new equipment in year (kg)
k – charging losses (%)

Amount of HFC-134a in stocks is estimated according to data from CSB. Approximate amount of HFC-134a stored in domestic refrigerators and freezers was estimated based on CSB data on number of households and percentage of households using refrigerators and freezers as well as assumption of share (percentage) of refrigerators and freezers filled with with HFC-134a.

Equation from 2006 IPCC Guidelines for emissions estimation from equipment lifetime:

$$E_{lifetime,t} = B_t \times x/100$$

[78] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9, average value applied for domestic refrigeration*
[79] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9, average value applied for domestic refrigeration*
[80] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9, value applied for domestic refrigeration*
[81] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9*

where:
$E_{lifetime}$ – amount of HFC emitted during system operation in year (kg)
Bt – amount of HFC banked in existing systems in year (kg)
x – annual emission rate (%)

According to 15 years lifetime it is assumed that first disposal emissions from domestic refrigerators and freezers appear in 2010. Equation from 2006 IPCC Guidelines for emission estimation from disposal:

$$E_{end\text{-}of\text{-}life,\ t} = M_{t\text{-}d} \times p/100 \times 1\text{-}(\eta_{rec,\ d} / 100)$$

where:
$E_{lend\text{-}of\text{-}life}$– amount of HFC emitted at system disposal in year t (kg)
Mt-d – residusl charge of HFC in equipment being disposed of expressed in percentage of full charge, (%)
ηrec, d – recovery efficiency at disposal, which is the ration of recovered HFC reffered to the HFC contained in the system (%)

In 2015 the total HFC emissions from HFC-134a used in domestic refrigeration amounts to 0.40 t or 0.58 kt CO_2 equivalent. The majority of HFC emissions from domestic refrigerators occur at end-of-life from 2010 onwords. Charging and stock emission rates are comparably low since HFC-134a in domestic refrigerators and freezers is replaced with R600a.

- *<u>Industrial Refrigeration (CRF 2.F.1.c)</u>*

Activity data

Activity data for emission calculation from Industrial Refrigeration is taken from annual reports by F-gases operators according to Regulation (EC) No. 517/2014 and national legislation No.563[82]. 125 operators reported data of their activities with F-gases in industrial refrigeration in 2015. For historical years activity data were obtained from questionnaires within previous F-gases research. For 2004-2005 activity data were obtained from enterprises that responded on data request letters sent by LEGMC. For 2006-2015 data were obtained from reporting within previously mentioned regulation act or extrapolated.

Emission factors and calculations

Tier 2a – emission-factor approach from 2006 IPCC Guidelines was used to estimate emissions from industrial refrigeration. Emissions result from charging, lifetime and end-of-life of equipment and are calculated for each type of HFC separately.

According to the methodology, refrigerant emissions at a reporting year can be calculated separately for each stage of life of the equipment. These emissions come from:

- $E_{charge,\ t}$ – emissions related to the refrigerant charge: connection and disconnection of the refrigerant container and the new equipment to be charged;
- $E_{lifetime,t}$ – annual emissions from the banks of refrigerants during operation (fugitive emissions and ruptures) and servicing;
- $E_{end\text{-}of\text{-}life,}$t – emissions at system disposal.

[82] http://likumi.lv/ta/id/233736-noteikumi-par-ipasiem-ierobezojumiem-un-aizliegumiem-attieciba-uz-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumn...

Equation 7.10 from 2006 IPCC Guidelines was used to sum up all the emissions occurring during the lifetime of the equipment:

$$E_{total,t} = E_{Charge,t} + E_{Lifetime,t} + E_{End\text{-}of\text{-}life,t}$$

There are no HFC-containing equipment manufacturing companies in Latvia and all appliances used in industrial refrigeration are imported.

Emission factors and assumptions used in emission calculation from industrial refrigeration are as follows:

- HFCs mainly charged in Industrial Refrigeration are HFC-134a, HFC-404a, HFC-422d, HFC-407c, HFC-507a and HFC-410a;
- Average emission factor during charging of equipment is 1.8%[83];
- Average emission factor during operation of equipment is 16%[84];
- Average life time of industrial applications 15 years[85];
- Residual charge of HFC in equipment being disposed 80%[86];
- Recovery efficiency at disposal 90%[87].

Equation from 2006 IPCC Guidelines for charging emissions estimation:

$$E_{Charged,\ t} = M_t \times k/100$$

where:
$E_{charged}$ – emissions during system manufacture/assembly in year (kg)
Mt – amount of HFC-134a charged into a new equipment in year (kg)
k – charging losses (%)

Equation from 2006 IPCC Guidelines for emission estimation stocks:

$$E_{lifetime,\ t} = B_t \times x \ / \ 100$$

where:
$E_{lifetime}$ – amount of emissions during equipment operation (t)
Bt – amount of F-gases held in stocks in year t (tonnes)
x – losses during operation period (%)

Equation from 2006 IPCC Guidelines for emission estimation from disposal:

$$E_{end\text{-}of\text{-}life,\ t} = M_{t\text{-}d} \times p/100 \times 1\text{-}(\eta_{rec,\ d} \ / \ 100)$$

where:
$E_{lend\text{-}of\text{-}life}$– amount of HFC emitted at system disposal in year t (kg)
Mt-d – residusl charge of HFC in equipment being disposed of expressed in percentage of full charge, (%)
ηrec, d – recovery efficiency at disposal, which is the ration of recovered HFC reffered to the HFC contained in the system (%)

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[83] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for industrial applications.
[84] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for industrial applications.
[85] Assumed in accordance with similarities to Estonia and Lithuania
[86] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9
[87] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9

The total amount of HFC filled into industrial refrigeration equipment in 2014 amounts to 10.38 t constituting 8.57 t manufacturing emissions. HFC in stocks amounts to 53.58 t constituting 8.57 t operating emissions. As the HFC amounts filled into refrigeration equipment are available since 1998, the decommissioning emissions according to 15 years lifetime could be estimated starting from 2013. In 2015 the amount of HFCs remained in decommission is amount of refrigerant initially charged into the systems in 2000 (1.14 t) which constitutes 0.09 t disposal emissions.

- *Transport Refrigeration (CRF 2.F.1.d)*

Activity data

According to F-gases research (2004), only negligible amount of HFCs was used in railways and water transport. Small amount of HFC-23 was filled into refrigerating equipment in ships. HFC-134a and HFC-125 was filled into mobile refrigerators used in road transport. For 1995-2004 activity data for emission calculation were taken from responses to questionnaires during first F-gases research (2004).

For 2004-2005 activity data were obtained from enterprises that responded on data request letters sent by LEGMC. For 2006-2015 activity data for emission calculation from Transport Refrigeration is taken from annual reports by F-gases operators according to Regulation (EC) No. 517/2014 and national legislation No.563. 4 operators reported data of their activities with F-gases in transport refrigeration in 2015. Share of substances used in transport refrigeration was obtained according to information provided by transport refrigeration companies.

Emission factors and calculations

Tier 2a – emission-factor approach from 2006 IPCC Guidelines was used to estimate emissions from transport refrigeration. Emissions result from charging, lifetime and end-of-life of equipment and are calculated for each type of HFC separately.

According to the methodology, refrigerant emissions at a reporting year can be calculated separately for each stage of life of the equipment. These emissions come from:

- $E_{charge,\ t}$ – emissions related to the refrigerant charge: connection and disconnection of the refrigerant container and the new equipment to be charged;
- $E_{lifetime,t}$ – annual emissions from the banks of refrigerants during operation (fugitive emissions and ruptures) and servicing;
- $E_{end\text{-}of\text{-}life,}t$ – emissions at system disposal.

Equation 7.10 from 2006 IPCC Guidelines was used to sum up all the emissions occurring during the lifetime of the equipment:

$$E_{total,t} = E_{Charge,t} + E_{Lifetime,t} + E_{End\text{-}of\text{-}life,t}$$

There are no HFC-containing equipment manufacturing companies in Latvia and all appliances used in transport refrigeration are imported therefore HFC emissions are estimated from stocks and from disposal.

Emission factors and assumptions used in emission calculation from transport refrigeration are as follows:

- HFCs mainly charged in Transport Refrigeration are HFC-134a and HFC-404a;
- Average emission factor during charging of equipment is 0.6%[88];
- Country specific emission factor during operation of equipment is 30%[89];
- Average life time of transport applications 8 years[90];
- Residual charge of HFC in equipment being disposed 50%[91];
- Recovery efficiency at disposal 70%[92].

Equation from 2006 IPCC Guidelines for charging emissions estimation:

$$E_{Charged,\ t} = M_t \times k/100$$

where:
$E_{charged}$ – emissions during system manufacture/assembly in year (kg)
Mt – amount of HFC-134a charged into a new equipment in year (kg)
k – charging losses (%)

Equation from 2006 IPCC Guidelines for emission estimation stocks:

$$E_{lifetime,\ t} = B_t \times x\ /\ 100$$

where:
$E_{lifetime}$ – amount of emissions during equipment operation (t)
Bt – amount of F-gases held in stocks in year t (tonnes)
x – losses during operation period (%)

Equation from 2006 IPCC Guidelines for emission estimation from disposal:

$$E_{end\text{-}of\text{-}life,\ t} = M_{t\text{-}d} \times p/100 \times 1\text{-}(\eta_{rec,\ d}\ /\ 100)$$

where:
$E_{lend\text{-}of\text{-}life}$– amount of HFC emitted at system disposal in year t (kg)
Mt-d – residusl charge of HFC in equipment being disposed of expressed in percentage of full charge, (%);
ηrec, d – recovery efficiency at disposal, which is the ration of recovered HFC reffered to the HFC contained in the system (%)

The total amount of HFC filled into transport refrigeration equipment in 2015 amounts to 0.98 t constituting 0.01 t manufacturing emissions. HFC in stocks amounts to 6.24 t constituting 2.56 t operating emissions. As the HFC amounts filled into refrigeration equipment are available since 1998, the decommissioning emissions according to 8 years lifetime could be estimated 2006-2015. In 2015 the amount of HFCs remained in decommission is amount of refrigerant initially charged into the systems in 2007 (3.11 t) which constitutes 0.16 t disposal emissions.

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[88] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for transport applications.
[89] Confirmed by Latvian Freezing Equipment Engineers` Association
[90] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for transport applications
[91] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9
[92] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9

- *Mobile Air Conditioning (CRF 2.F.1.e)*

Activity data

Under 2.F.1.e HFC-134a emissions are estimated for the following road vehicle types which were assessed according to emission control system (EURO classes):

- Passenger cars
- Light Duty Vehicles <3,5t
- Heavy duty vehicles 3,5 -12 t
- Heavy duty vehicles >=12 t
- Buses <=18 t
- Buses >18 t

Average percentage of vehicles equipped with mobile air conditioning (MAC) systems according to technology used in each vehicle type was estimated taking into account the information from Lithuanian NIR 2016[93] according to vehicle suppliers assuming similar conditions with Lithuania`s vehicle fleet (Table 4.41).

Table 4.41 Average percentage of vehicles equipped with MAC systems by vehicle type and technology

Technology	Passenger cars	Light Duty Vehicles <3,5t	Heavy duty vehicles 3,5 -12 t	Heavy duty vehicles >=12 t	Buses <=18 t	Buses >18 t
Convential 1990-1993	0	0	3	0	0	0
EURO 1 1993-1997	16	3	12	4	4	16
EURO 2 1997-2001	41	22	24	22	22	41
EURO 3 2001-2006	66	33	47	38	38	66
EURO 4 2006-2011	80	47	73	55	55	80
EURO 5 2011-2014	89	50	89	60	60	89
EURO 6 Since 2014	92	50	92	60	60	92

Average amounts of HFC-134a in each vehicle type are summarized in Table 4.42.

Table 4.42 HFC-134a average amount by vehicle type

Vehicle type	Average refrigerant amount (kg)
Passenger cars	0.6
Light Duty Vehicles <3,5t	0.7
Heavy duty vehicles 3,5 -12 t	1.2
Heavy duty vehicles >=12 t	1.2
Buses <=18 t	8
Buses >18 t	13

Emission factors and calculations

Tier 2a – emission-factor approach from 2006 IPCC Guidelines for each vehicle type was used to estimate emissions from MACs. As most part of vehicle fleet in Latvia are second hand there are no data available on the original factory charge. HFC emissions from mobile air

[93] *http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php*

conditioning are estimated from stocks and disposal. According to the methodology, refrigerant emissions at a reporting year can be calculated separately for each stage of life of the equipment. HFC-134a emissions from MACs are estimate from following stages:

- $E_{lifetime,t}$ – annual emissions from the banks of refrigerants during operation (fugitive emissions and ruptures) and servicing;
- $E_{end\text{-}of\text{-}life,}$t – emissions at system disposal.

Equation 7.10 from 2006 IPCC Guidelines was used to sum up all the emissions occurring during the lifetime of the equipment:

$$E_{total,t} = E_{Lifetime,t} + E_{End\text{-}of\text{-}life,t}$$

Emission factors and assumptions used in emission calculation from MACs are as follows:

- HFC used in mobile air conditioning is HFC-134a ;
- Average emission factor during operation of equipment is 15%[94];
- 8% of total MACs are disposed every year[95];
- Average life time of transport applications 13 years[96];
- Residual charge of HFC in equipment being disposed 100%[97];
- $\eta_{rec,\ d}$ = 0[98]

Equation from 2006 IPCC Guidelines for emission estimation stocks:

$$E_{lifetime,\ t} = B_t \times x / 100$$

where:
$E_{lifetime}$ – amount of emissions during equipment operation (t)
Bt – amount of F-gases held in stocks in year t (tonnes)
x – losses during operation period (%)

The amount of F-gases remained in MACs after the disposal every year is estimated by multiplying amount of MACs disposed with the approximate amount of F-gases remained in one appliance. It is assumed that 100% of F-gases remained in MACs after their lifetime.

Equation from 2006 IPCC Guidelines for emission estimation from disposal of MACs:

$$E_{end\text{-}of\text{-}life,t} = M_{t\text{-}d} \times p/100 \times (1\text{-}\eta_{rec,d}/100)$$

where:
$E_{end\text{-}of\text{-}life,t}$– amount of emissions from system disposal (t)
Mt-d– amount of HFCs charged into domestic refrigerators and freezers in year (t-n) (tonnes)
P – residual charge of HFC in equipment being disposed of expressed in % of full charge (%)
ηrec,d – recovery efficiency at disposal

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[94] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for mobile air conditioners
[95] Confirmed by Latvian Freezing Equipment Engineers` Association
[96] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for mobile air conditioners
[97] Confirmed by Latvian Freezing Equipment Engineers` Association
[98] Confirmed by Latvian Freezing Equipment Engineers` Association

In 2015 the total HFC-134a stock in all road vehicle types in Latvia amounts to 273.7 t. The HFC-134a emissions from stocks are 41.05 t. In 2015 the amount of HFC in disposed MACs in year was 8.76 t which according to assumption of 100% emission of disposal resulted in 8.76 t of HFC-134a (71.22 kt CO_2 eq.).

- *Stationary Air Conditioning (CRF 2.F.1.f)*

Activity data

Activity data for emission calculation from stationary air conditioning is taken from annual reports by F-gases operators according to Regulation (EC) No. 517/2014 and national legislation No.563[99]. 93 operators reported data of their activities with F-gases in stationary air conditioning in 2015. Activity data for this category is derived during F-gases research (2016) when the proportion of HFCs used in stationary air conditioning were obtained directly contacting with operators who report the F-gases amounts within the legislation mentioned above.

Emission factors and calculations

Tier 2a – emission-factor approach from 2006 IPCC Guidelines was used to estimate emissions from stationary air conditioning. Emissions result from charging, lifetime and end-of-life of equipment and are calculated for each type of HFC separately.

According to the methodology, refrigerant emissions at a reporting year can be calculated separately for each stage of life of the equipment. These emissions come from:

- $E_{charge,\ t}$ – emissions related to the refrigerant charge: connection and disconnection of the refrigerant container and the new equipment to be charged;
- $E_{lifetime,t}$ – annual emissions from the banks of refrigerants during operation (fugitive emissions and ruptures) and servicing;
- $E_{end\text{-}of\text{-}life,}$t – emissions at system disposal.

Equation 7.10 from 2006 IPCC Guidelines was used to sum up all the emissions occurring during the lifetime of the equipment:

$$E_{total,t} = E_{Charge,t} + E_{Lifetime,t} + E_{End\text{-}of\text{-}life,t}$$

There are no HFC-containing equipment manufacturing companies in Latvia and all appliances used in stationary air conditioning are imported.

Emission factors and assumptions used in emission calculation from stationary air conditioners are as follows:

- HFCs mainly charged in Industrial Refrigeration are HFC-407c, HFC-410a, HFC-404a, HFC-134a, HFC-422d and HFC-417a;
- Average emission factor during charging of equipment is 0.6%[100];
- Average emission factor during operation of equipment is 8%[101];

[99] http://likumi.lv/ta/id/233736-noteikumi-par-ipasiem-ierobezojumiem-un-aizliegumiem-attieciba-uz-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumn...
[100] 2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for residental and commercial air conditioners including heat pumps

- Average life time of stationary air conditioning applications 15 years[102];
- Residual charge of HFC in equipment being disposed 80%[103];
- Recovery efficiency at disposal 90%[104].

Equation from 2006 IPCC Guidelines for charging emissions estimation:

$$E_{Charged,\ t} = M_t \times k/100$$

where:
$E_{charged}$ *– emissions during system manufacture/assembly in year (kg)*
Mt – amount of HFC-134a charged into a new equipment in year (kg)
k – charging losses (%)

Equation from 2006 IPCC Guidelines for emission estimation stocks:

$$E_{lifetime,\ t} = B_t \times x / 100$$

where:
$E_{lifetime}$ *– amount of emissions during equipment operation (t)*
Bt – amount of F-gases held in stocks in year t (tonnes)
x – losses during operation period (%)

The total amount of HFC filled into stationary air conditioners in 2014 amounts to 12.74 t constituting 0.08 t manufacturing emissions. HFC in stocks amounts to 102.96 t constituting 8.24 t operating emissions. Emissions from disposal or stationary air conditioners are not estimated due to lifetime of 15 years that has not been reached yet.

4.7.1.3 Uncertainties and time series-consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty for Refrigeration and air conditioning sector could arise to 50% according to expert judgement. Also uncertainty of emission factors for HFCs is assumed as 50%.

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

4.7.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.F. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed according to 2006 IPCC Guidelines. All information on activity data and emission calculations are stored and archived in the common FTP folder. All

[101] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9 – Average value applied for residental and commercial air conditioners including heat pumps*
[102] *Confirmed by Latvian Freezing Equipment Engineers` Association*
[103] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9*
[104] *2006 IPCC Guidelines, Volume 3, Chapter 7, Table 7.9*

findings are documented using check-lists which are archived and documented in centralized archiving system (common FTP folder).

All estimations of the emissions done in the LEGMC 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.

Quality manager from LEGMC has checked the data between CRF and NIR to ensure the consistency as well as QC actions were done in CRF in purpose to double check if all sub-applications are covered.

Checks according to EU MMR Implementing Regulation[105] Article 11 (Reporting on consistency of the data reported on fluorinated greenhouse gases) were done. To compare F-gas data in GHG inventory and the data reported on F-gases by F-gas operators under Regulation No 517/2014 the 2 data sources were used - GHG inventory data on amounts charged in new and operating refrigeration and air conditioning equipment used for emission calculation and LV-specific F-gas data on imported F-gas amounts according to the Article 19 of EU Regulation No 517/2014[106] reported by F-gas operators to European Comission. Pre-filled equipment were not taken into account.
The differences between quantities that were imported in Latvia and quantities filled into new and operating equipment in GHG inventory could have many reasons and cannot be associated with over or underestimation of HFC amounts reported in GHG inventory. Wholesalers and service companies could 1) import refrigerants and sell it to neighboring EU countries (or to ships from other countries) or buy refrigerants from other EU countries 2) buy into stock with intention to sell them in future years. Imported and filled HFC-125, HFC-143a and HFC-32 amounts almost match causing difference little more than 10%. For HFC-134a a situation is more complicated due to mobile air conditioners (MACs) which cause the greatest part of 2.F.1 Refrigeration and Air conditioning emissions (HFC-134a). Activity data for emission calculation from MACs are not taken from F-gas operators data assuming that the data are not complete. Therefore amounts charged in new and operating equipment seems 300% smaller than imported HFC-134a amounts.

Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells for those F-gases where emissions are not occurring in Latvia although CRF Reporter User manual says that if disaggregated data is not available for certain categories, the CRF Reporter allows users to report information in the parent category. This can be done by directly entering data in the green cells (i.e. overwriting formulas).

Under 2.F.1 Refrigeration and Air Conditioning only F-gases which are source of emissions are reported. Remaining F-gases are not added as child nodes according to CRF User manual however it is not currently possible to enter data in green cells for these F-gases therefore some information in the parent category (green cells) in corresponding CRF tables are missing. It was confirmed by CRF Reporter help desk that this is an CRF internal issue which

[105] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0749&from=EN*
[106] *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517&from=EN*

will be improved in the future releases of the software. But for the moment it was suggested to leave cells blank. Due to this reason completeness check in CRF Reporter shows incompleteness (orange light) which could be solved when CRF Reporter will allow to enter notation keys for F-gases directly in green and grey cells.

QA/QC procedures within CRF Reporter were carried out in order to ensure completeness and consistency of reported data.

4.7.1.5 Category-specific recalculations

HFC-134a emissions from 2.F.1.b Domestic refrigeration were recalculated from 2011-2014 due to updated percentage of households using refrigerators and freezers 2010-2015 according to results of the CSB housholds surwey in 2015.

HFCs emissions from 2.F.1.e Mobile Air-Conditioning were recalculated 1995-2014 due to revision of average percentage of vehicles equipped with air conditioning systems by vehicle type and technology according to Lithuania`s NIR 2016[107].

4.7.1.6 Category-specific planned improvements

Evaluation study regarding F-gases in stocks (number of instalations, amount of cooling agents in operating systems and number of companies per F-gas sectors) is planned in 2017. Results are planned to include to the next inventory.

4.7.2 Foam Blowing Agents (CRF 2.F.2)

4.7.2.1 Category description

The category covers HFC emissions from open and closed-cell foams. HFCs from foams are emitted only from the use of imported foams containing F-gases as there is no production of foams in Latvia. In 2015 emissions from the open-cell foams used in furniture and seating production occur for the first time. Emissions from foaming of polyether for shoe soles are not occurring anymore due to prohibitions described in EU regulation No. 517/2014.

The calculation of emissions under 2.F.2 was carried out for following gases:

- HFC-134a
- HFC-227ea
- HFC-245fa
- HFC-152a
- HFC-365mfc

In 2015 emissions from foam blowing agents totalled 4.38 kt CO_2 equivalent (Figure 4.17).

[107] *http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php*

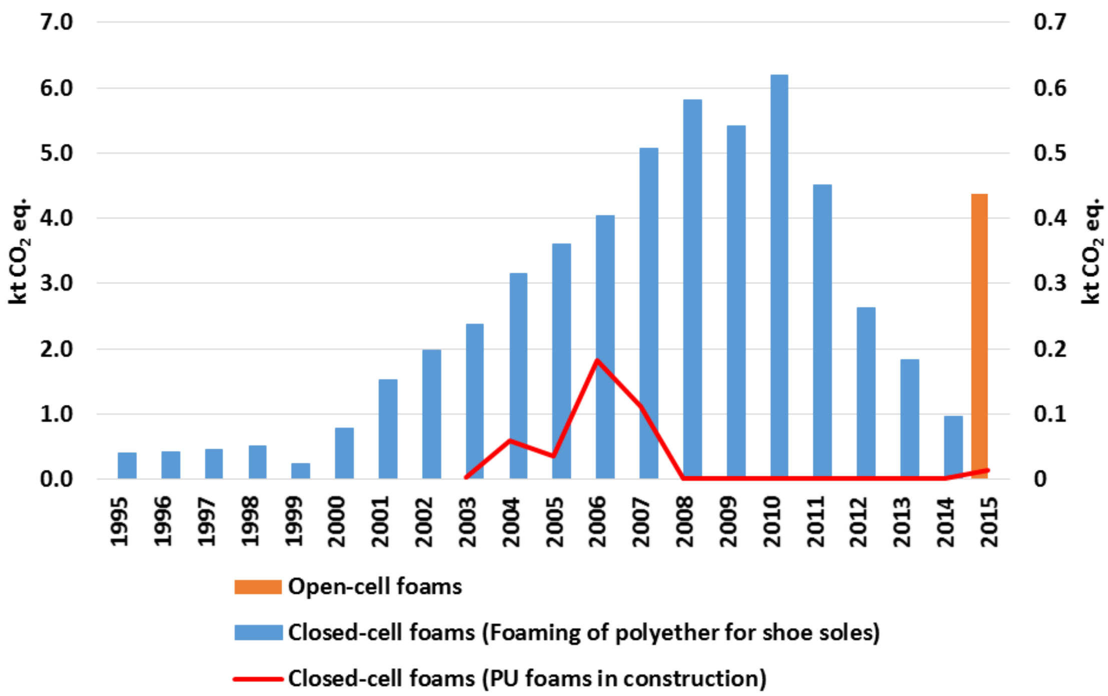

Figure 4.17 HFC emissions from 2.F.2[108] (kt CO_2 eq.)

Manufacturing of shoes (shoe soles) containing HFC-134a occurred in 1995-2002 when comparatively smaller amounts of HFC were emitted. After 2002 emissions from stocks and disposal were estimated and emissions started to increase reaching peak level in 2010. According to F-gases Regulation (EU) No 517/2014 which repeals Regulation (EC) No 842/2006 from 4 July 2006 it is prohibited to place on the EU market footwear containing F-gases. According to prohibitions described in EU regulations it was assumed that amount of shoes containing HFC-134a started to decrease since 2007 however emissions from disposal were still at previous level.

Emissions from closed-cell PU foams used in construction are estimated starting from 2003 when data from Chemicals Register become avalaible. Since then emissions have been increased very rapidly due to economic development and increased activity in building sector reaching the highest level in 2006. Afterwards emissions started to decrease and since 2008 rather small amounts are emitted. Fluctuations between years are mostly related to consumed foam amounts in construction. In 2015 only one enterprise has reported small amount of imported PU foams used in construction.

Emissions from open-cell foams are estimated starting from 2015 therefore rapid emission increase by 356% can be observed in 2015 comparing with 2014.

4.7.2.2 Methodological issues

An overview of the methods used and gases reported under 2.F.2 sector is presented in Table 4.43.

[108] *Closed cell foams (PU foams in construction) on secundary axis*

Table 4.43 Summary of emission calculation methods and gases in CFR 2.F.2

CRF Category/subcategory	Method used	Gases reported
2.F.1 Foam Blowing agents		
2.F.2.a Closed Cells	Tier 1a	HFC-134a HFC-227ea HFC-245fa HFC-152a HFC-365mfc
2.F.2.b Open Cells	Tier 1a	HFC-227ea HFC-245fa HFC-365mfc HFC-134a

- *Closed-cell PU foams*

Activity data

The imported amount of PU construction foams is obtained from Chemicals Register. No export and production data is reported to the Chemicals Register therefore only imported amount can be obtained. So only emissions from use of PU foams (stocks) are calculated.

Although the activity in building sector in previous years has radically increased, emission estimations for PU foams can be done starting from 2003 due to the lack of activity data of imported and used building foams or foams used in windows manufacturing as well as lack of data on foams containing F-gases. It is assumed that all the construction foams imported are closed cells foams (used in insulation applications) according to NACE classification. The data on foams imported as well as the average percentage of F-gases in foams were obtained from Chemicals Register.

Emission factors and calculations

HFC emissions are calculated from foams in stocks. The emission calculations were done according to 2006 IPCC Guidelines Tier 1a method using activity data on imported foams and default emission factor – annual losses 4.5% of the original HFC charge/year[109].

Equation from 2006 IPCC Guidelines for emissions from closed-cell foam in year was used:

$$Emissions_t = Bank_t \times EF_{AL}$$

where:
Emissions $_t$ = emissions from closed-cell foam in year t, tonnes
Bank $_t$ = HFC charge blown into closed-cell foam manufacturing between year t and year t-n, tonnes
EF $_{AL}$ = annual loss emission factor, fraction
t = current year

The product lifetime of foam is 20 years. 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 from foams are not estimated (NE).

[109] 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Emissions of Fluorinated Substitutes for Ozone Depleting Substances (Volume 3) Industrial Processes and Product Use, p.7.35

- *Closed-cell foams from foaming of polyether for shoe soles*

Activity data

Activity data for emission estimation from foaming of polyether for shoe soles is taken from CSB databases about produced imported and exported amount of shoes[110]. Assumptions and default leakage factors are taken from Danish project "The Greenhouse gases: HFCs, PFCs and SF_6" [111].

The manufacturing of shoe soles containing HFC-134a occurred in Latvia in 1995-2002. The amount of produced shoes (shoe soles) is obtained by CSB. According to Danish project[103] it was assumed that 5% of all shoes with plastic, rubber and leather soles contain polyether containing 8 g of HFC-134a per shoe.

Emission factors and calculations

Total amount of HFC-134a used for manufacturing of shoe soles can be estimated by using equation:

$$HFC_{filled} = Sh_{produced} \times d_{HFC} \times HFC_{sh}$$

where:
HFC_{filled} – total amount of HFC-134a used in manufacturing of shoes (t)
$Sh_{produced}$ – amount of produced shoes (pieces)
d_{HFC} – amount of shoes containing HFC-134a (%)
HFC_{sh} – amount of HFC-134a filled in one shoe sole (t)

Danish default leakage factor for HFC-134a emitted during manufacturing is 15%.

The HFC-134a emissions from manufacturing of shoe soles can be estimated by using equation:

$$E_{production} = HFC_{filled} \times k$$

where:
$E_{production}$ – HFC-134a emissions from shoe manufacturing (t)
HFC_{filled} – total amount of HFC used in manufacturing of shoes (t)
k – leakage from shoes production (%)

The amount of imported, exported and produced shoes (shoe soles) is obtained by CSB. According to Danish project it was assumed that 5% of all shoes with plastic, rubber and leather soles contain polyether containing 8 g of HFC-134a per shoe.

Total amount of HFC-134a held in stocks in shoe soles can be estimated by using equation:

$$HFC_{stocks} = HFC_{filled} + HFC_{imported} - HFC_{exported}$$

where:
HFC_{stocks} – total amount of HFC-134 held in stocks in shoe soles and used in country in particular year (t)
HFC_{filled} – total amount of HFC-134a filled in shoes during manufacture of shoes (t)
$HFC_{imported}$ – total amount of HFC-134a imported in shoes (t)
$HFC_{exported}$ – total amount of HFC-134a exported in shoes (t)

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[110] *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*
[111] *http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publications/2009/978-87-7052-962-4/html/bred01_eng.htm*

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 (%)

According to above mentioned Danish project average lifetime of shoes is 3 years. It means that for HFC-134a emission estimation the amount of HFC-134a remained in shoe soles after their lifetime in year^{-3} has to be 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 (%)

- *Open-cell foams*

Activity data

The imported amount of open-cell foams used in furniture and seating is obtained from Chemicals Register. No export and production data is reported to the Chemicals Register therefore only imported amount well as the average percentage of F-gases in foams can be obtained.

According to 2006 IPCC Guidelines open-cell foam upon foaming the blowing agent is released almost completely within one year hence the manufacturing emission factor is assumed as 100%. All the amounts are emitted during manufacturing therefore emissions from stocks are not calculated.

Emission factors and calculations

HFC emissions are calculated from foams in manufacturing. The emission calculations were done according to 2006 IPCC Guidelines Tier 1a method using activity data on imported foams and default emission factor – first year loss factor 100% of the original HFC charge/year .

Equation 7.8 from 2006 IPCC Guidelines for emissions from ope-cell foam in year was used:

$$Emissions_t = M_t$$

where:
$Emissions_t$ = emissions from open-cell foam in year t, tonnes
M_t = total HFC used in manufacturing new open-cell foam in year t, tonnes

The product lifetime according to 2006 IPCC Guidelines is 12 years. Therefore decommissioning losses from open-cell foams are not occurring yet.

4.7.2.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty for Foam Blowing sector could arise to 50% according to expert judgement. Also uncertainty of emission factors for HFCs is assumed as 50%.

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

4.7.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.F. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

More detailed description can be found under chapter 4.7.1.4.

Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells for those F-gases where emissions are not occurring in Latvia although CRF Reporter User manual says that if disaggregated data is not available for certain categories, the CRF Reporter allows users to report information in the parent category. This can be done by directly entering data in the green cells (i.e. overwriting formulas).

It is not currently possible to enter notation keys NO in green cells for these F-gases which are not occurring under this sector therefore some information in the parent category (green cells) in corresponding CRF tables are missing. It was confirmed by CRF Reporter help desk that this is an CRF internal issue which will be improved in the future releases of the software. But for the moment it was suggested to leave cells blank. Due to this reason completeness check in CRF Reporter shows incompleteness (orange light) which could be solved when CRF Reporter will allow to enter notation keys for F-gases directly in green and grey cells.

QA/QC procedures within CRF Reporter were carried out in order to ensure completeness and consistency of reported data.

4.7.2.5 Category-specific recalculations

No recalculations were done for this category.

4.7.2.6 Category-specific planned improvements

No planned improvements of this category.

4.7.3 Fire Protection (CRF 2.F.3)

4.7.3.1 Category description

The category covers HFC emissions from use of fire protecting equipment. In 2015 emissions totalled 0.003 kt CO_2 equivalent giving less than 1% from total HFC emissions in 2.F (Figure 4.18). As the emissions from fire suppression systems occur when the system is discharged in case of fire or accidentally, emissions are estimated only from for operating of fire protection systems using HFC-227ea and HFC-23.

Emission time series started in 2001 when the first data regarding use of Fire protection systems containing HFCs was received during the first F-gases research (2004). Since then strong emission fluctuations have been observed. Compared to 2014 in 2015 the emissions have decreased by 89.8 % mainly due to decrease in activity data in this sector.

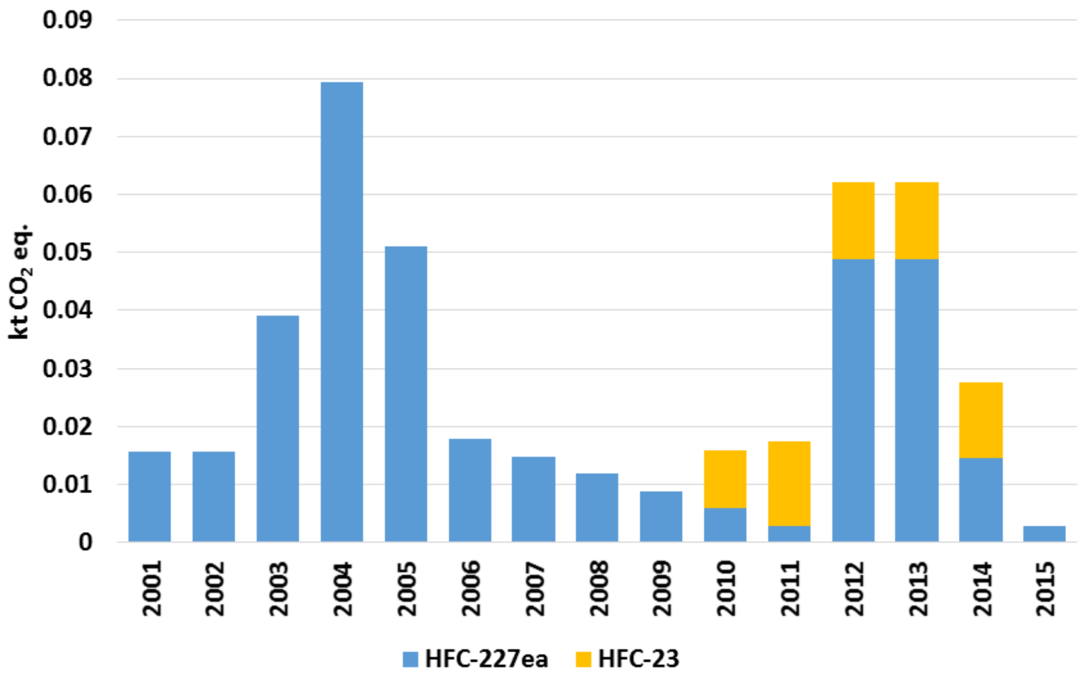

Figure 4.18 HFC emissions from 2.F.3 (kt CO_2 eq.)

Emissions from fire extinguishing are problematic to estimate due to the fact that 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.

According to Regulation No.563 of the Cabinet of Ministers of Latvia companies who use F gases in stationary fire protection equipment shall report amounts used to responsible institution (LEGMC) each year till 31st of March. Information from LEGMC database on ozone depleting substances and F-gases available since 2010. Till then historical data from basic F-gases research (2004) was used and extrapolation was done.

4.7.3.2 Methodological issues

An overview of the methods used and gases reported under 2.F.3 sector is presented in Table 4.44.

Table 4.44 Summary of emission calculation methods in CFR 2.F.3

CRF Category/subcategory	Method used	Gases reported
2.F.3 Fire Protection	Tier 2a	HFC-227ea, HFC-23

Activity data

During the F-gases research (2004) it was found out that there is no manufacturing of fire extinguishers containing F-gases. 19 enterprises were questioned including only manufacturer of fire extinguishers. According to responses received a little amount of fire extinguishers are filled with F-gases. Only 2 enterprises reported the amount of HFC-227ea in their installed equipment in particular year and amount of HFC-227ea held in stocks (containers) of fire extinguishing equipment. 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.

Amount of F-gases in annually installed equipment and amount held in containers is used as activity data for emission estimations from stocks. Activity data for historical years (2001-2006) is taken from the first F gases research done in 2004. Since 2010 data is taken from annual F-gases reports, where operators annually report F-gases amounts used in their equipment.

Emission factors and calculations

It is assumed that 2% from total stocks is emitted during equipment operations annually according to 2006 IPCC Guidelines [112].

Equation from 2006 IPCC Guidelines for emission estimation from stocks:

$$E_{lifetime,\,t} = B_t \times x \,/\, 100$$

where:
$E_{lifetime}$ – amount of emissions during equipment operation (t)
Bt – amount of F-gases held in stocks in year t (tonnes)
x – losses during operation period (%)

The lifetime of the equipment is 20 years therefore emissions at system disposal were not estimated.

[112] *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Emissions of Fluorinated Substitutes for Ozone Depleting Substances (Volume 3) Industrial Processes and Product Use, p.7.63*

4.7.3.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty for Fire Protection sector could arise to 50% according to expert judgement. Also uncertainty of emission factors for HFCs is assumed as 50%.

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

4.7.3.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.F. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

More detailed description can be found under chapter 4.7.1.4.

Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells for those F-gases where emissions are not occurring in Latvia although CRF Reporter User manual says that if disaggregated data is not available for certain categories, the CRF Reporter allows users to report information in the parent category. This can be done by directly entering data in the green cells (i.e. overwriting formulas).

Under 2.F.3 Fire Protection only F-gases which are source of emissions are reported. Remaining F-gases are not occurring and are not added as child nodes according to CRF User manual however it is not currently possible to enter data in green cells for these F-gases therefore some information in the parent category (green cells) in corresponding CRF tables are missing. It was confirmed by CRF Reporter help desk that this is an CRF internal issue which will be improved in the future releases of the software. But for the moment it was suggested to leave cells blank. Due to this reason completeness check in CRF Reporter shows incompleteness (orange light) which could be solved when CRF Reporter will allow to enter notation keys for F-gases directly in green and grey cells.

QA/QC procedures within CRF Reporter were carried out in order to ensure completeness and consistency of reported data.

4.7.3.5 Category-specific recalculations

No recalculations were done for this category.

4.7.3.6 Category-specific planned improvements

No improvements are planned for this category.

4.7.4 Aerosols (Metered Dose Inhalers CRF 2.F.4.a)

4.7.4.1 Category description

This category covers HFC-134a emissions from metered dose inhalers. There are no other HFC containing aerosol types used in Latvia.

In 2015 emissions totalled 4.80 kt CO_2 equivalent giving 2.1% from total HFC emissions in 2.F (Figure 4.19). The 2015 emissions increased 2.2% compared to 2014 due to the increased amount of imported HFC-134a in products. Emissions have increased compared to the base year as well. The fluctuation in the time series is due to observed changes in consumption of HFC containing metered dose inhalers.

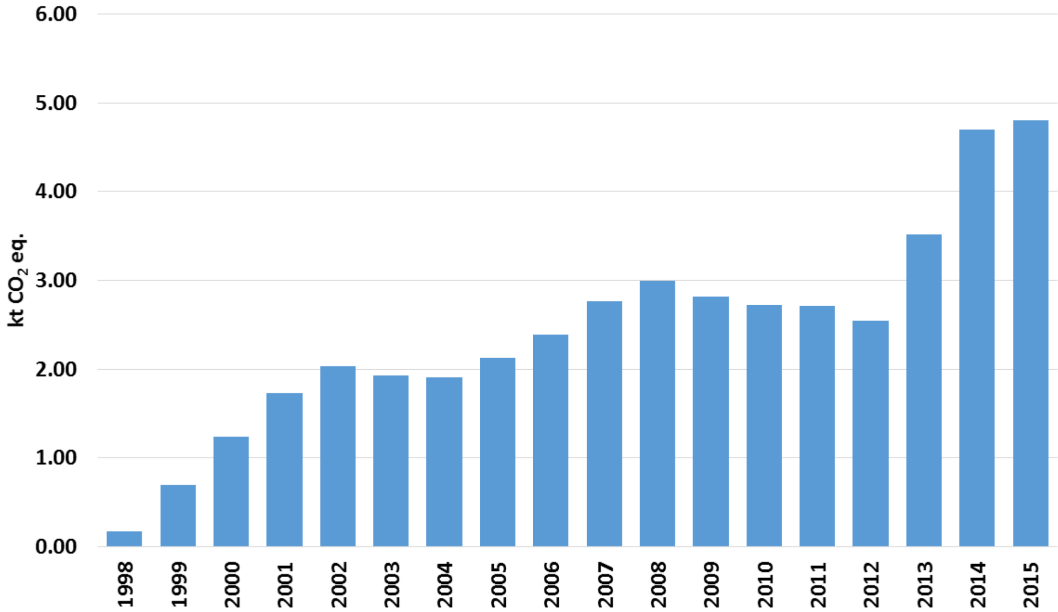

Figure 4.19 HFC emissions from 2.F.4.a (kt CO_2 eq.)

During the first F-gases research (2004) it was found out that there is no production of F-gases containing aerosols in Latvia. All aerosols used in Latvia are imported. It is very difficult to collect the data of imported aerosols as it is necessary to separate HFCs containing aerosols from others. It is almost impossible to get the information from all households and importers of industrial aerosols in Latvia as Central Custom Service registers only 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.

Only the aerosols used in medicine for asthmatics are estimated and reported under this category. During the first F-gases investigation number of inhalers containing HFC–134a was obtained 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.

4.7.4.2 Methodological issues

An overview of the methods used and gases reported under 2.F.4 sector is presented in Table 4.45.

Table 4.45 Summary of emission calculation methods in CFR 2.F.4

CRF Category/subcategory	Method used	Gases reported
2.F.4 Aerosols	Tier 2a	HFC-134a

Activity data

For years 1998-2006 data of imported inhalers reported by importers of medical preparations was used as activity data for emission calculations. From 2007 till 2015 data for emission estimations annually is reported by State Agency of Medicines of Latvia. All importers of the medical preparations shall report the imported and sold amount of medicines so these data are very precise.

Total amount of HFC-134a used in metered dose inhalers in particular year can be estimated as the imported amount of inhalers containing HFC-134a and an average amount of HFC-134a filled in each type of inhalers is known.

Emission factoirs and calculations

Equation for total amount HFC-134a used as medical preparation:

$$HFC_{sold} = \Sigma\, MDI_{sold} \times HFC_{filled}$$

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 2006 IPCC Guidelines 50%[113] leakage from metered dose inhalers sold in particular year and 50% from inhalers sold in year before particular year is assumed.

Equation from 2006 IPCC Guidelines for metered dose inhalers emissions:

$$Emissions_t = S_t \times EF + S_{t-1} \times (1-EF)$$

where:
$Emissions_t$ *= emissions in year t, tonnes*
St – quantity of HFC and PFC contained in aerosol products sold in year t, tonnes
S_{t-1} *– quantity of HFC and PFC contained in aerosol products sold in year t-1, tonnes*
EF = emission factor (=fraction of chemical emitted during the first year), fraction

4.7.4.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty for Aerosol sector could arise to 50% according to expert judgement. Also uncertainty of emission factors for HFCs is assumed as 50%.

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

[113] *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Emissions of Fluorinated Substitutes for Ozone Depleting Substances (Volume 3) Industrial Processes and Product Use, p.7.29*

4.7.4.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.F. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

More detailed description can be found under chapter 4.7.1.4.

Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells for those F-gases where emissions are not occurring in Latvia although CRF Reporter User manual says that if disaggregated data is not available for certain categories, the CRF Reporter allows users to report information in the parent category. This can be done by directly entering data in the green cells (i.e. overwriting formulas). Entering data in green cells is only possible when the parent node to which the grid with green cells belongs does not have any child nodes.

Under 2.F.4 Aerosols only F-gases which are source of emissions are reported. Remaining F-gases are not occurring and are not added as child nodes according to CRF User manual however it is not currently possible to enter data in green cells for these F-gases therefore some information in the parent category (green cells) in corresponding CRF tables are missing. It was confirmed by CRF Reporter help desk that this is an CRF internal issue which will be improved in the future releases of the software. But for the moment it was suggested to leave cells blank. Due to this reason completeness check in CRF Reporter shows incompleteness (orange light) which could be solved when CRF Reporter will allow to enter notation keys for F-gases directly in green and grey cells.

QA/QC procedures within CRF Reporter were carried out in order to ensure completeness and consistency of reported data.

4.7.4.5 Category-specific recalculations

No recalculations are done for this category.

4.7.4.6 Category-specific planned improvements

No improvements are planned for this category.

4.8 OTHER PRODUCT MANUFACTURE AND USE (2.G)

Under 2.G Latvia reports emissions from sulphur hexafluoride (SF_6) and nitrus oxide (N_2O), occurring in following sectors:

- Electrical equipment (CRF 2.G.1);
- N_2O from product uses (CRF 2.G.3);

SF_6 and PFCs emissions from Other product use (2.G.2) and Other (2.G.4) are not occurring in Latvia. Under 2.G only F-gases which are source of emissions are reported. Remaining F-gases are not occurring and are not added as child nodes in CRF Reporter according to CRF User manual however it is not currently possible to enter data in green cells for these F-gases therefore some information in the parent category (green cells) in corresponding CRF tables are missing.

In 2015 GHG emissions from other product manufacture and use amounted 13.69 kt CO_2 eq (0.1%) from Latvia`s total CO_2 equivalent emissions without LULUCF. In 2015 compared to 2014 emissions have increased by 13.6%, but compared to 1990 emissions have increased by 321.2%.

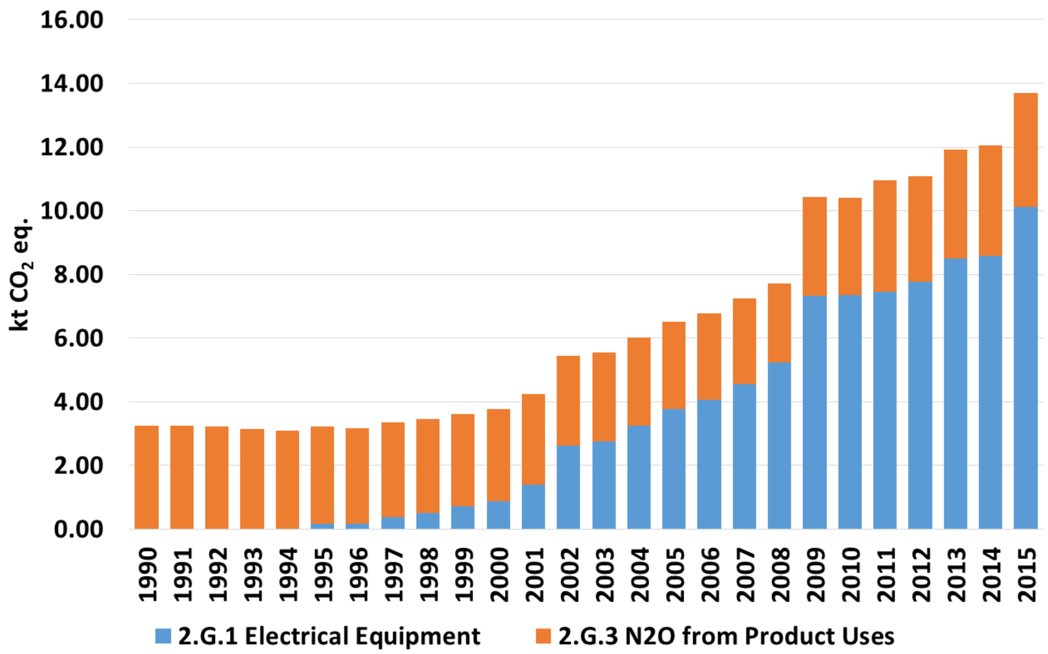

Figure 4.20 Emissions from 2.G Other product manufacture and use (kt CO_2 eq.)

The total emissions from 2.G have increased by 321% since 1990 (see Figure 4.20 and Table 4.47). Emission trend could mainly associated with increase in activity data received from companies. Emission fluctuations in the N_2O From Product Uses sector are linked with the economic situation of the country.

Reported emissions, calculation methods and type of emission factors for the 2.G Other Product Manufacture and Use in the Latvian inventory are summarized in Table 4.46.

Table 4.46 GHG emission categories, methods and gases reported from 2.G Other Product Manufacture and Use

Category	Method used	Gases reported
G. Other Product Manufacture and Use		
1. Electrical Equipment	Tier1	SF_6
3. N_2O from Product Uses (Medical Applications)	CS	N_2O

Table 4.47 Total emissions from 2.G Other Product Manufacture and Use, 1990-2015 (kt CO_2 eq.)

	2.G Other Product manufacture and Use	2.G.1 Electrical Equipment	2.G.3 N_2O from Product Uses
1990	3.25	NE	3.25
1995	3.22	0.17	3.05

	2.G Other Product manufacture and Use	2.G.1 Electrical Equipment	2.G.3 N_2O from Product Uses
2000	3.78	0.88	2.90
2005	6.52	3.78	2.74
2006	6.78	4.07	2.71
2007	7.24	4.55	2.69
2008	7.73	5.23	2.49
2009	10.43	7.33	3.10
2010	10.41	7.35	3.06
2011	10.97	7.47	3.50
2012	11.09	7.78	3.31
2013	11.94	8.50	3.43
2014	12.05	8.58	3.48
2015	13.69	10.12	3.57
Share of total IPPU % in 2015	1.80%	1.33%	0.547%
2015 versus 2014	+13.57%	+17.96%	+2.76%
2015 versus 1990	+321%	+5737%	+10%

4.8.1 Electrical Equipment (CRF 2.G.1)

4.8.1.1 Category description

This category covers emissions of sulphur hexafluoride (SF_6) from electrical equipment used in high and medium voltage commutation and control installations. Equipment is not manufactured in Latvia. SF_6 emissions are estimated from charging and lifetime. There is only 2 enterprises where SF_6 is filled. Installations are not produced in Latvia and the old equipment without fill of the SF_6 was dismantled at the beginning of 1990s. Only starting from 1992 new equipment was gradually installed. Since 1992, it uses small amount of SF_6 in electrical equipment, but since 1995 used amount is increasing.

In 2015 SF_6 emissions from Electrical Equipment constituted 10.12 kt CO_2 eq (73.9% from total 2.G emissions). Emissions have grown since 1995 by 5737 % and by 18% compared to 2014 due to replacement of the old equipment and installation of the new equipment where, until then, SF_6 was not used (Figure 4.21 and Table 4.48).

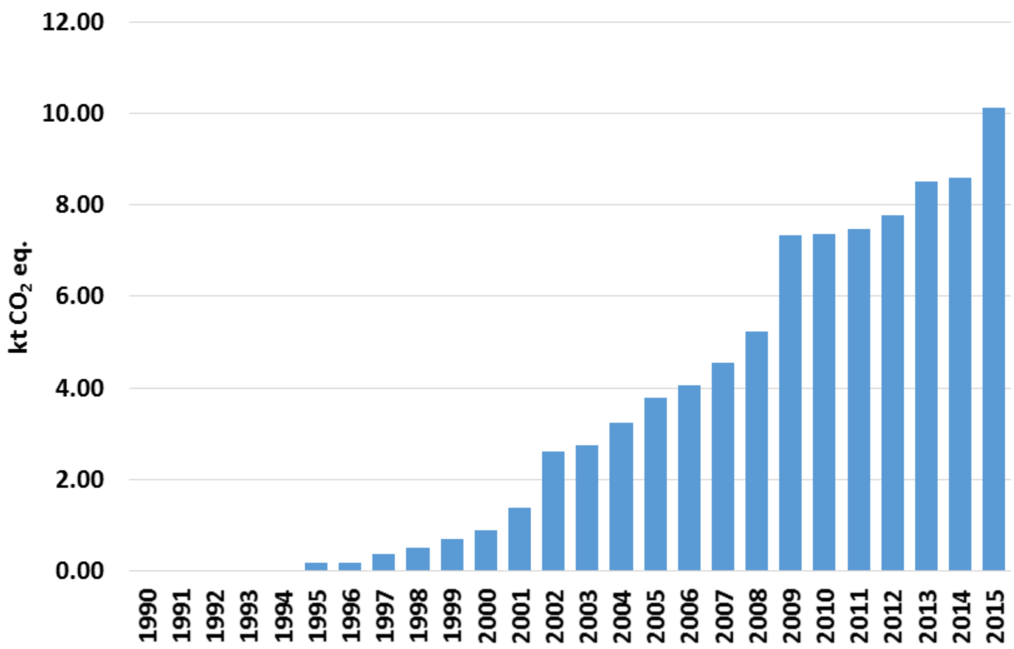

Figure 4.21 SF_6 emissons from 2.G.1 (kt CO_2 eq.)

Table 4.48 SF_6 emissions from 2.G.1 Electrical Equipment, 1995-2015 (kt CO_2 eq.)

	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Electrical equipment	0.17	0.88	1.39	2.62	2.76	3.25	3.78	4.07	4.55	5.23	7.33	7.35	7.47	7.78	8.50	8.58	10.12

4.8.1.2 Methodological issues

An overview of the methods used and gases reported under 2.G.1 sector is presented in Table 4.49.

Table 4.49 Summary of emission calculation methods and gases in CFR 2.G.1

CRF Category/subcategory	Method used	Gases reported
2.F.1 Electrical Equipment	Tier1	SF_6

Activity data

Enterprises imports equipment already filled with SF_6. There is no manufacturing of the electric equipment containing SF_6 in Latvia, therefore only emissions from charging and operating were estimated using amount of SF_6 in newly installed equipment as activity data reported by the company. For years 2003-2015 enterprises reports the emergency leakage from electrical equipment which are also reported as operating emissions.

Emission factors and calculations

For emission estimations the Tier 1 default emission factor method from 2006 IPCC Guidelines was used. Emissions are estimated by multiplying default regional emission factor (for Europe) by amount of SF_6 used in equipment in enterprises. The emissions are estimated by splitting data into the sealed pressure electrical equipment (MV switchgear) and closed pressure electrical equipment (HV switchgear) containing the SF_6 due to the different emission factors for each of these installations in 2006 IPCC Guidelines. For HV switchgears 2.6 %, but for MV switchgears 0.2% emission factor was used.

Equation from 2006 IPCC Guidelines for emission estimation from charging:

$$E_{charged,\ t} = M_t \times k / 100$$

where:
$E_{charged}$ – emissions during system manufacture/assembly in year (kg)
M_t – amount of HFC-134a charged into a new equipment in year (kg)
k – charging losses (%)

Equation from 2006 IPCC Guidelines for emission estimation from stocks:

$$E_{lifetime,\ t} = B_t \times x / 100$$

where:
$E_{lifetime}$ – amount of emissions during equipment operation (t)
B_t – amount of F-gases held in stocks in year t (tonnes)
x – losses during operation period (%)

Lifetime of used equipment is 30 years and no equipment was dismantled yet therefore emissions from disposal are marked "NO" in CRF Reporter.

4.8.1.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

As there are two facilities in the country which uses SF_6 in their technology and report the data on SF_6 usage directly to LEGMC, it is assumed that data used for emission estimation under this subcategory is more precise. Uncertainty of activity data for SF_6 from electrical equipment is assumed as ±2% for AD, but EF uncertainty could arise up to 30% according to the 2006 IPCC Guidelines.

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.

4.8.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.G. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

More detailed description can be found under chapter 4.7.1.4.

Currently using CRF Reporter software version v6.0.1.1 it is not possible to enter NO in green and grey cells for those F-gases where emissions are not occurring in Latvia although CRF Reporter User manual says that if disaggregated data is not available for certain categories, the CRF Reporter allows users to report information in the parent category. This can be done by directly entering data in the green cells (i.e. overwriting formulas).

Under 2.G.1 Electrical equipment only F-gases which are source of emissions are reported. Remaining F-gases are not occurring and are not added as child nodes according to CRF User manual however it is not currently possible to enter data in green cells for these F-gases therefore some information in the parent category (green cells) in corresponding CRF tables are missing. It was confirmed by CRF Reporter help desk that this is an CRF internal issue which will be improved in the future releases of the software. But for the moment it was suggested to leave cells blank. Due to this reason completeness check in CRF Reporter shows incompleteness (orange light) which could be solved when CRF Reporter will allow to enter notation keys for F-gases directly in green and grey cells.

QA/QC procedures within CRF Reporter were carried out in order to ensure completeness and consistency of reported data.

4.8.1.5 Category-specific recalculations

No recalculations were done.

4.8.1.6 Category-specific planned improvements

No improvements planned for this category.

4.8.2 N_2O From Product Uses (CRF 2.G.3)

4.8.2.1 Category description

This chapter describes emissions from from the use of N_2O for anesthesia and N_2O emissions from aerosol cans. N_2O emissions from this sector formed a negligible part of total GHG emissions in Latvia. In 2015 these emissions totalled 3.57 kt CO_2 eq.

4.8.2.2 Methodological issues

N_2O emissions from anesthesia were estimated taking into account the amount of N_2O sold. According to 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 2007. 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 1990-2006 assume that base year for N_2O Emissions is year 2007, N_2O emissions for years 1990-2006 were calculated proportionally, taking into account the number of inhabitants provided by CSB.

At the moment there is no data on N_2O emissions from aerosol cans in Latvia. However, in order to estimate these N_2O emissions from aerosol cans in Latvia, Belgium approach (Belgium greenhouse inventory report, 2014) was used.

According to Belgium inventory report in 2014 the N_2O emissions from aerosol cans was estimated on the basis of the average European consumption (number of food aerosol can/inhab) obtained from DETIC (Belgian-Luxembourg Association of producers and distributors of soaps, cosmetics, detergents, cleaning products, hygiene and toiletries, glues, and related products) for the year 2012. Because of a lack of activity data before 2012, this average consumption is assumed to be constant over time. The activity data (number of aerosol cans) is then calculated for the complete time series on the basis of the number of inhabitant. The emission factor for N_2O is 7.6 g/can (as estimated in the Netherlands on the basis of data provided by one producer) and is assumed to be constant over time.

N_2O emissions from anesthesia and from aerosol cans are shown in Table 4.50.

Table 4.50 Estimated N_2O emissions from anesthesia and from aerosol cans

	N_2O emissions from anesthesia, kt CO_2 eq.	N_2O emissions from aerosol cans, kt CO_2 eq.	Total emissions from N_2O from product Use
1990	1.30	1.95	3.25
1991	1.30	1.94	3.24
1992	1.29	1.93	3.22
1993	1.26	1.89	3.15
1994	1.24	1.85	3.10
1995	1.22	1.83	3.05
1996	1.21	1.80	3.01
1997	1.19	1.78	2.98
1998	1.18	1.77	2.95
1999	1.17	1.75	2.92
2000	1.16	1.74	2.90
2001	1.15	1.72	2.87
2002	1.13	1.69	2.83
2003	1.12	1.68	2.80
2004	1.11	1.66	2.77
2005	1.10	1.64	2.74
2006	1.09	1.63	2.71
2007	1.08	1.61	2.69
2008	0.89	1.60	2.49
2009	1.53	1.58	3.10
2010	1.51	1.55	3.06
2011	1.98	1.51	3.50
2012	1.82	1.49	3.31
2013	1.95	1.48	3.43
2014	2.01	1.46	3.48
2015	2.12	1.45	3.57

4.8.2.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of available activity data for anaesthesia under CRF 2.G.3 sub-sector was ±2% in 2015. Emission factor uncertainty is assumed to be 2%. Time series consistency was ensured by using one method for all time series.

As the activity data (number of cans) is estimated on the basis of the average European consumption, the uncertainty is considered high.

4.8.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the Other product manufacture and use (2.G.3) sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

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 the national legislation. All findings were documented and introduced in GHG inventory. All corrections are archived in centralized archiving system (common FTP folder).

4.8.2.5 Category-specific recalculations

During the 2017 submission, N_2O emissions from aerosol cans were included for the first time for the complete time series.

4.8.2.6 Category-specific planned improvements

No improvements are planned under CRF 2.G.3.

4.9 OTHER PRODUCTION (CRF 2.H)

4.9.1 Category description

Other Production sub-sector includes indirect emissions from:

- Pulp and Paper (2.H.1);
- Food and beverages industry (2.H.2).

NMVOC emissions constitute 1.30 kt in 2015 and increased by 0.5% comparing with 2014 and decreased by 61.5% comparing with 1990.

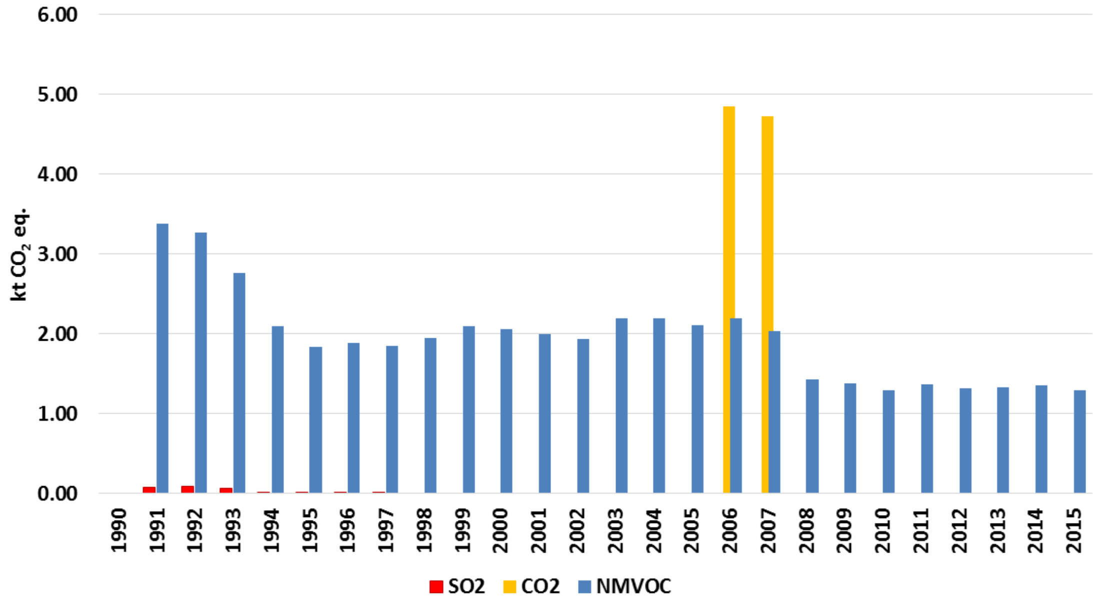

Figure 4.22 Total emissions from 2.H Other Production in 1990–2015 (kt CO_2 eq.)

Considerable fluctuations occurred in time period 1991–1993 due to changes in economic situation in country (Figure 4.22). Decrease of NMVOC emissions in time period 1999 – 2001 is explained with decresing demand of Food and beverages export to Commonwealth of Independent States (CIS). 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. For time period 2005-2006 data of used limestone in sugar production are reported. CO_2 emissions were calculated as two sugar production plants entered into ETS as operators and detailed information became available from annual GHG reports. After these two years sugar production plants stopped their activities and were closed. Since 2007 the total amount of food and beverages industry sector decrease. That could be explained with economic crisis in 2008-2009 as well with rise in prices of national 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. Since 2010 situation are quite stable in food and drink industry.

4.9.2 Methodological issues

Reported emissions, calculation methods and type of emission factors for the 2.H Other in the Latvian inventory are summarized in Table 4.51.

Table 4.51 GHG emission categories, methods and gases reported from 2.H Other

Category	Method used	Gases reported
H. Other		
1.Pulp & Paper	Tier1	SO_2
2.Food and beverages industry	Tier1	NMVOC, CO_2

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 4.52). LEGMC has signed an agreement with CSB to get data of total production of products from sectors where data are confidential.

Still for the 2015 data for the category – wine production, was classified as confidential. That's why for this category 2006 year's data was used also for 2007-2015.

Table 4.52 Activity data of 2.H Other Production sector

	Pulp and Paper	Wine	Beer	Spirits	Meat, fish, poultry	Sugar	Limestone use in sugar production	Cakes, biscuits, breakfast cereals	Bread	Animal forage
	kt	hl	hl	hl	kt	kt	kt	kt	kt	kt
1990	36.60	19880.00	87380.00	324500.00	569.30	31.00	NO	54.80	314.00	200.00
1995	1.50	159190.00	652820.00	341500.00	82.80	29.30	NO	24.40	145.40	214.40
2000	NO	C	945146.59	C	197.30	C	NO	24.30	121.10	173.80
2005	NO	C	1293300.00	C	243.80	C	11.00	53.60	116.30	248.60
2006	NO	C	1383048.62	C	288.40	C	10.70	45.00	107.30	244.20
2007	NO	C	1414258.56	C	286.00	NO	NO	46.50	102.30	336.80
2008	NO	C	1333800.00	C	297.70	NO	NO	38.50	100.70	307.30
2009	NO	C	1292446.65	C	253.50	NO	NO	33.30	95.90	299.30
2010	NO	C	1484924.59	C	252.70	NO	NO	38.00	90.00	409.80
2011	NO	C	1626594.61	C	261.50	NO	NO	39.70	88.60	360.90
2012	NO	C	1488504.18	C	264.30	NO	NO	44.50	91.40	348.20
2013	NO	C	1513696.66	C	286.20	NO	NO	56.40	88.10	380.10
2014	NO	C	967477.92	C	270.70	NO	NO	50.40	84.90	379.50
2015	NO	C	887837.62	C	260.38	NO	NO	31.76	86.95	393.87

Emission factors and calculations

NMVOC emissions from the food and beverages industry as well as SO_2 emissions from pulp and paper are calculated. Emissions are calculated according to 2006 IPCC Guidelines default methodology.

SO_2 emission factor 2 (kg/Mg air dried pulp) is taken from EMEP/EEA 2016[114].

The NMVOC emission factors (Table 4.53) are taken from the EMEP/EEA 2016[115]. CSB provided aggregated statistical data where it can be seen that 95.5% of all spirits produced

[114] *file:///C:/Users/vita.ratniece/Downloads/2.H.1%20Pulp%20and%20paper%20industry%202016.pdf*

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 4.53 NMVOC emission factors for food and beverages 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

4.9.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

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 regarding wine production. SO_2 and NMVOC emission factor uncertainty were assigned as 50% because default emission factors 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.

4.9.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the IPPU sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC check is performed with Tier1 method from 2006 IPCC Guidelines.

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

[115] *file:///C:/Users/vita.ratniece/Downloads/2.H.2%20Food%20and%20beverages%20industry%202016%20-%20Update%20Nov.%202016%20(1).pdf*

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 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.

4.9.5 Category-specific recalculations

No recalculations were done for this sector.

4.9.6 Category-specific planned improvements

No improvements are planned for this sector for nearest submissions.

5 AGRICULTURE (CRF 3)

5.1 OVERVIEW OF SECTOR

Greenhouse gases (GHG) emissions from agriculture sector in Latvia include:

1) methane (CH_4) emissions from enteric fermentation of domestic livestock and manure management;
2) nitrous oxide (N_2O) emissions from manure management and managed soils;
3) carbon dioxide (CO_2) emissions from lime and urea application.

Emissions from managed soils include:

-) direct nitrous oxide emissions from:

1) application of synthetic nitrogen (N) fertilizer;
2) application of animal manure, compost, sewage sludge and other organic fertilizers;
3) urine and dung N deposited by grazing animals on pasture, range and paddock;
4) N in crop residues;
5) cultivation of organic soil in croplands and grasslands;
6) N mineralisation associated with loss of soil organic matter resulting from change of land use or management of mineral soils.

-) indirect nitrous oxide emissions from atmospheric deposition and nitrogen leaching/run-off.

Rice cultivation (3 C) and savannas (3 E) are not typical for Latvia, therefore these categories are reported as "NO" in CRF tables. Legislative measures and agricultural residue management practices prohibit agricultural residues burning on fields, therefore a notation key "NO" is used in CRF tables under the category Field Burning of Agricultural Residues (3 F). The calculation of emissions is based on 2006 IPCC Guidelines and EMEP/EEA 2013 methodology. Detailed information about methods is provided under each subcategory. Overview of GHG emissions sources from Agriculture sector in 2015 is shown in Figure 5.1.

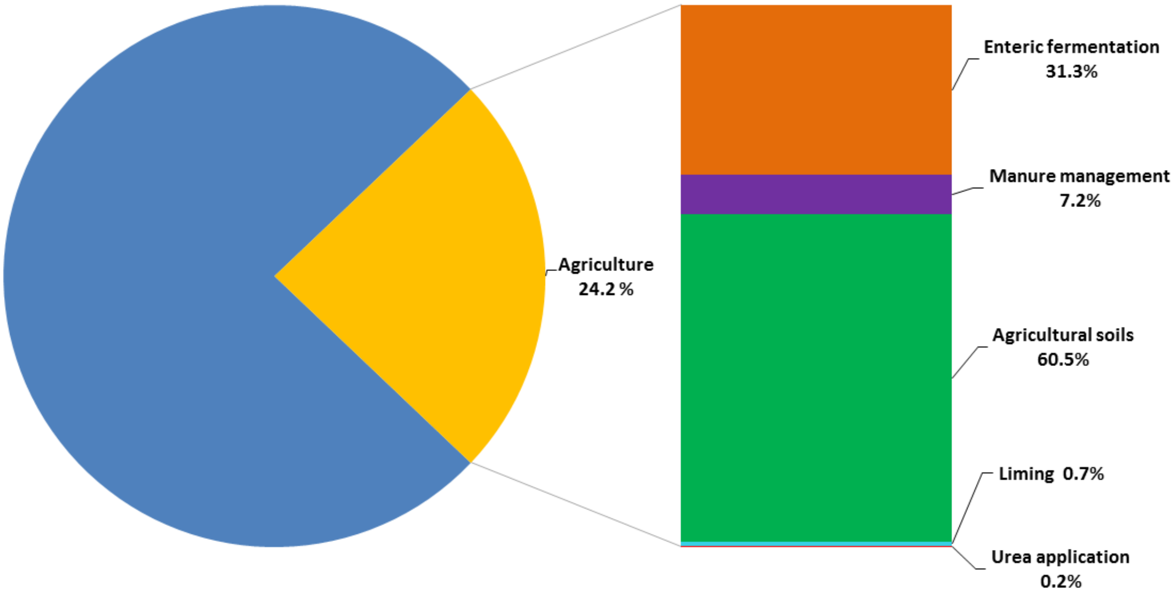

Figure 5.1 Emissions from the agriculture sector compared with the total emissions in 2015

In 2015, agriculture sector contributed 2739.6 kt CO_2 eq. which made up 24.2% of total national GHG emissions in Latvia. Agricultural soils are responsible for 60.5% of total emissions from Agriculture. Second largest emission source is Enteric fermentation contributing with 31.3%. Manure management constituted 7.2% from Agicultural emissions in 2015. Liming and Urea application are less significant emission sources producing less then 1.0% of total Agricultural emissions in 2015 (Figure 5.1).

Nitrous oxide emissions constituted 64.0% (1754.1 kt CO_2 eq.) and methane emissions resulted in 35.0% (959.4 kt CO_2 eq.) of total GHG emissions from agricultural sector. Remaining 1.0% (26.1 kt CO_2) of total GHG emissions from agriculture originated from liming and urea fertilization. 89.5% of total agriculture sector methane emissions resulted from enteric fermentation and 10.5% - from manure management. The largest part (94.5%) of total nitrous oxide emissions resulted from direct-indirect emissions of managed soils, only 5.5% of total nitrous oxide emissions related to manure management.

In 2015, GHG emissions from agriculture sector in Latvia increased by 2.9% comparing with 2014. However, annual emissions have been reduced by 49.1% since 1990 due to decrease mainly in the number of livestock and nitrogen fertilizers (Table 5.1).

Table 5.1 Greenhouse gas emissions in the agricultural sector, 1990–2015 (kt, CO_2 eq.)

Year	CH_4	N_2O	CO_2	Total
1990	2411.2	2594.7	364.8	5370.7
1991	2312.4	2436.0	229.7	4978.1
1992	1912.5	1969.7	36.2	3918.4
1993	1256.1	1581.6	3.9	2841.7
1994	1102.5	1441.5	2.4	2546.4
1995	1074.5	1306.6	1.9	2383.0
1996	1028.4	1325.5	1.5	2355.3
1997	1006.3	1332.7	1.3	2340.3
1998	936.4	1297.1	3.3	2236.8

Year	CH_4	N_2O	CO_2	Total
1999	807.2	1237.0	3.4	2047.5
2000	811.7	1263.7	6.0	2081.4
2001	857.7	1341.9	2.2	2201.8
2002	849.7	1314.3	19.5	2183.6
2003	849.8	1358.9	26.1	2234.8
2004	822.5	1343.0	2.4	2168.0
2005	847.6	1395.2	2.9	2245.8
2006	854.9	1396.0	2.8	2253.7
2007	894.4	1446.8	6.3	2347.5
2008	868.7	1451.1	5.9	2325.8
2009	866.5	1478.9	8.3	2353.8
2010	860.4	1509.6	6.0	2376.0
2011	870.3	1513.4	12.2	2395.9
2012	889.8	1601.0	15.7	2506.5
2013	923.7	1629.3	17.3	2570.3
2014	958.2	1681.5	23.7	2663.3
2015	959.4	1754.1	26.1	2739.6
Share of total % in 2015	35.0%	64.0%	1.0%	100.0%
2015 versus 2014	+0.1%	+4.3%	+10.5%	+2.9%
2015 versus 1990	-60.2%	-32.4%	-92.8%	-49.0%

**In all tables non-rounded values are used to calculate percentage*

Several emission sources in the Agriculture sector are key categories both in level and trend assessment. Information regarding results of key category analysis for the Agriculture sector is presented in Table 5.2**.**

Table 5.2 Identified key categories for the agriculture sector in 2017 submission

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
3.A.1 Enteric Fermentation - Cattle	CH_4	L1,L2,T1,T2	X	X
3.B.1.1 Manure Management - Cattle	CH_4	L1,L2,T1,T2		X
3.B.2.1 Manure Management - Cattle	N_2O	L1,L2		X
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	L1,L2,T2		X
3.D.1. Direct N_2O emissions from managed soils	N_2O	L1,L2,T1,T2	X	X
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	L1,L2,T1,T2	X	X
3.G. Liming	CO_2	T1,T2	X	X

Some interannual variation of emissions, which can be noticed from the time series, was mainly caused by fluctuation in activity data among the years due to changes in the number of animals, which had been significantly affected by economic situation in the country, as well as agricultural policy. Methane and nitrous oxide emissions from manure management were affected by the fluctuation in the number of animals and the proportion of manure managed in different manure management systems which vary depending on animal species. Nitrous oxide emissions from managed soils generally were affected by the numbers describing management of organic soils, amount of synthetic fertilizers consumption, the number of grazing livestock, sown area and crop yields, which have large variation among the years.

Emissions from agriculture noticeably decreased in the beginning of 1990s after the Soviet system and large state or collective farms collapses. However, in the recent years it is possible to observe a slight increase of sown area, consumption of synthetic N-fertilizers, non-dairy, sheep, swine and poultry numbers. State efforts to improve animal manure management systems (MMS) and expansion of anaerobic digestation in the largest farms is the main reason that reduces the increase of emissions from manure management. In the last years, dairy farming in Latvia turns to liquid slurry management system according to closing of small farms and reflection to the trend to this management system in developed countries, however liquid slurry produces more methane and results in increase of this type of emissions.

The number of cattle, sheep, swine, goats, horses, poultry, rabbits and fur-bearing animals' population, as well as data on milk production and fat content in milk are obtained from the Central Statistical Bureau (CSB) of Latvia Database[116] and statistical yearbooks[117] or no open access Database. Similarly to the number of domestic livestock, also statistical information about amounts of synthetic fertilizer N application and crop production is obtained from the CSB Database. The number of deer in Latvia is obtained from available information from informative reports prepared by Ministry of Agriculture[118] and Wild Animal Breeders Association[119]. The distribution of different MMS is adopted from national studies. Calculation of the distribution is done based on research results and developed methodology provided by Latvia University of Agriculture.

Statistical information about livestock number in Latvia is included in Table 5.3. The number of fur-bearing animals is not available for 1990-1992 and 1995, therefore interpolation and extrapolation is used to fill in the gaps of time series.

Table 5.3 Number of livestock, 1990–2015 (thousand heads)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Poultry	Rabbits	Fur-bearing animals	Deer
1990	535.1	904.2	164.6	1401.1	5.4	30.9	10321.1	193.9	260.2	NO
1991	531.4	851.5	183.7	1246.5	6.1	30.0	10395.1	223.3	260.2	NO
1992	481.7	662.6	164.7	866.5	6.4	28.4	5438.3	198.5	260.2	NO
1993	351.0	326.9	114.0	481.8	6.3	26.2	4123.7	162.8	260.2	NO
1994	311.9	238.9	86.3	500.7	7.4	26.8	3699.6	154.5	221.0	NO
1995	291.9	245.2	72.2	552.8	8.9	27.2	4198.3	152.5	213.5	NO
1996	274.6	234.8	55.5	459.6	8.4	25.8	3790.7	134.3	205.9	NO
1997	262.8	214.1	40.7	429.9	8.9	23.3	3550.7	93.4	88.6	NO
1998	242.1	192.3	29.4	421.1	10.5	22.0	3208.8	97.6	55.2	NO
1999	205.6	172.8	27.0	404.9	8.1	19.0	3236.9	72.3	84.0	NO
2000	204.5	162.2	28.6	393.5	10.4	19.9	3104.6	110.9	97.2	NO
2001	209.1	175.6	29.0	428.7	11.5	19.6	3621.2	150.4	117.7	NO
2002	204.6	183.5	31.5	453.2	13.2	18.5	3882.0	141.6	116.3	NO

[116] *Agriculture, Forestry and Fishery. http://data.csb.gov.lv/pxweb/en/lauks/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8*
[117] *Agriculture in Latvia. Collection of Statistical Data. Rīga: 2016. 70 p*
[118] *Ministry of Agriculture. Available at: https://www.zm.gov.lv/lauksaimnieciba/statiskas-lapas/lauksaimniecibas-gada-zinojumi?nid=531#jump*
[119] *Wild Animal Breeders Association. Available at: http://www.losp.lv/sites/default/files/articles/attachments/publications/22.12.2011_-_1500/17_savvalas_dzivnieki.pdf*

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Poultry	Rabbits	Fur-bearing animals	Deer
2003	186.3	192.3	39.2	444.4	15.0	15.4	4002.6	149.2	119.4	NO
2004	186.2	184.9	38.6	435.7	14.7	15.5	4049.5	135.5	143.5	NO
2005	185.2	200.0	41.6	427.9	14.9	13.9	4092.3	97.9	141.7	NO
2006	182.4	194.7	41.3	416.8	14.3	13.6	4488.1	92.9	182.8	3.3
2007	180.4	218.3	53.9	414.4	13.0	13.0	4756.8	96.4	181.4	4.0
2008	170.4	209.8	67.1	383.7	12.9	13.1	4620.5	57.4	197.5	5.3
2009	165.5	212.7	70.7	376.5	13.2	12.6	4828.9	43.9	164.4	7.8
2010	164.1	215.4	76.8	389.7	13.5	12.0	4948.7	33.5	167.0	7.6
2011	164.1	216.5	79.7	375.0	13.4	11.5	4417.9	39.3	183.7	9.6
2012	164.6	228.5	83.6	355.2	13.3	10.9	4910.9	37.3	231.6	9.3
2013	165.0	241.5	84.8	367.5	12.6	10.7	4985.8	38.9	231.6	11.5
2014	165.9	256.1	92.5	349.4	12.3	10.1	4413.9	38.3	313.9	13.2
2015	162.4	256.7	102.3	334.2	12.7	9.6	4532.0	39.8	272.2	12.6
2015 versus 2014*	-2.1%	+0.2%	+10.6%	-4.4%	+3.3%	-5.0%	+2.7%	+3.9%	-13.3%	-4.5%
2015 versus 1990*	-69.7%	-71.6%	-37.8%	-76.1%	+135.2%	-68.9%	-56.1%	-79.5%	+4.6%	NA

Latvian livestock industry has been influenced by historical events and economical 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. Reorientation of livestock product export to Western markets was more difficult in terms of market saturation. Latvian farmers were forced to reduce production levels of milk, meat and crop. Consequently, livestock numbers declined most rapidly in 1990-1994 in all sectors, except for goat farming. All the above-mentioned social and economic changes lead to also eliminating of stud-farms. The horses were sold, only the strongest stud-farms continued to work. Starting from 2004, according to Latvia's accession to the European Union (EU), the number of livestock has stabilized. The increase of production indicators was characteristic for beef cattle, sheep, goat and poultry industries. Dairy farming is one of the most important branches of agriculture in Latvia. The number of dairy cows in Latvia is relatively stable, with a tendency to a slight increase in the last years. In 2015, 162.4 thousand dairy cows were registered and an average milk yield per cow reached 5905 kg, showing the highest average milk yield per dairy cow since 1990.

According to CSB information[120], at the end of 2015, agricultural holdings were breeding 419.1 thousand cattle – or 2.9 thousand less over the year before. Number of dairy cows fell by 3.5 thousand or 2.1 %, but the number of suckling cows rose by 4.6 thousand or 13.6 %, and the share thereof in the total number of cows reached 19.3 %. Partially because of further spread of the African swine fever, the number of pigs decreased by 15.3 thousand or 4.4 % over the year. In 2015, number of sheep and goats continued to grow – by 9.7 thousand or 10.5 % and 0.4 thousand or 3.2 %, respectively, while number of horses reduced by 0.5 thousand or 4.7 %. In 2015, output of milk (incl. goat milk) comprised 978.1 thousand tons – an increase of 0.7 % over 2014. Average milk yield per dairy cow grew by 1.6 %. Rise

[120] *Agriculture in Latvia. Collection of Statistical Data. Rīga: 2016. 70 p*

in the output of eggs was influenced by the increase in average number of laying hens (of 0.2 million or 6.7 %),

Since 2009, the number of large farms has increased, while small farms have been closed, however dairy and other farms in Latvia are characterized by a low herd size in comparison with other European countries. At the end of 2015, there were 83.6 thousand agricultural holdings in Latvia; the average size thereof constituted 34.8 hectares – 5.3 hectares or 18 % more than in 2010. Agricultural area on average per holding has expanded from 19.6 hectares in 2010 to 23.6 hectares in 2015. The total area of utilised agricultural land in the country reached 1884.8 thousand hectares in 2015[121].

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 economic situation in the country. Since 2007, two sugar factories have stopped their activity therefore no data is presented further. Agricultural statistics data fulfil criteria determined by the EU and requirements are determined in the legislative acts. The Project Documentation System (ADS) is established at CSB. It is a quality metadata system for internal and external users. There are methodological descriptions of all statistical surveys and calculations. Annual samples are made up as stratified simple samples. Holdings are selected by economic size (standard output – SO) and type of farming. SO is a 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 the corresponding region and expressed in EUR. A total standard output characterises 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 experts' 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[122;123].

Total sown area in 2015 was 1168.8 thousand ha, the number of total sown area increased by 1.6% compared to 2014. Share of main crops in the total sown area is represented in Figure 5.2. In 2015, harvested production of grain reached 3.0 million tons – 794.3 thousand tons or 35.7 % more than in 2014. The significant growth in the harvested production of grain was affected not only by increase in the cereal cropland (17.2 thousand hectares or 2.6 % more than in 2014), but also by notable rise in average yield per hectare As a result of improved technological crop growing process, selection of highly productive and more qualitative seed sorts, and very favourable climatic conditions, average yield of cereals increased from 34.0 in 2014 to 44.9 quintals in 2015, that is the highest yield recorded in the history of Latvia.

[121] *Agriculture in Latvia. Collection of Statistical Data. Rīga: 2016. 70 p*
[122] *Available at: http://www.csb.gov.lv/sites/default/files/quality_report_on_annual_crop_statistics_2010_0.pdf*
[123] *Available at: http://www.csb.gov.lv/sites/default/files/quality_report_on_livestock_and_meat_statistics_2010_0.pdf*

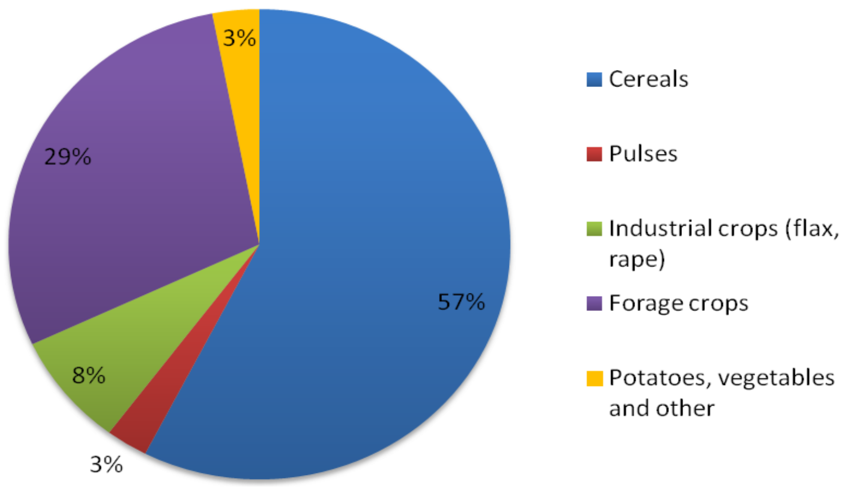

Figure 5.2 Share of the man crops on sown area in Latvia, 2015

As compared to the previous year, in 2015 sown area of rape decreased by 11.1 thousand hectares or 11.1 %. Average yield of rape grew from 18.5 quintals in 2014 to 32.9 quintals in 2015, while total yield of rape seeds grew by 107.2 thousand tons or 57.8 %. The growth was promoted by the increase in harvested yield of winter rape (that occupies 77 % of the total sown area of rape) seeds – from 19.0 quintals in 2014 to 36.5 quintals in 2015. In 2015, the total sown area of pulses increased 2.7 times, of which sown area of field beans – by 17.5 thousand hectares or 3.1 times. The increase was encouraged by the introduction of a new support payment for climate- and environment-friendly farming practices or agricultural greening. Sown area and harvested production of potatoes decreased by 7.3 % and 1.6 %, respectively, whereas average yield thereof per hectare increased by 6.1 %. In 2015, 194.9 thousand tons of vegetables (including vegetables in greenhouses) were grown – 3.5 thousand tons or 1.9 % more than in 2014[124].

Statistical information about crop production in Latvia for calculation of nitrous oxide emissions is included in Table 5.4 and Table 5.5. Data about sown area of oil flax (1990-1999) are not available; therefore data for filling gaps in the time series are extrapolated from the closest numbers. Other statistical data are included in relevant subchapters.

Table 5.4 Sown area of agricultural crops, 1990–2015 (thousand ha)

Year	Wheat	Barley	Triticale	Oats	Rye	Buckwheat	Mixed cereals	Pulses
1990	141.5	306.9	1.1	82.4	130.7	0.1	12.7	10.5
1991	71.5	398.5	2.6	92.7	69.2	0.1	13.7	9.0
1992	128.6	350.4	3.3	69.4	131.4	0.1	13.5	6.7
1993	169.1	275.3	6.8	48.5	187.6	0.1	6.2	2.8
1994	94.6	266.5	3.1	54.0	62.7	0.1	5.3	2.8
1995	109.6	203.3	2.7	45.6	40.4	0.1	6.8	3.0
1996	149.2	178.4	1.7	53.6	56.4	0.1	6.8	3.6
1997	152.3	194.6	2.8	59.1	62.5	0.6	11.0	4.7

[124] *Agriculture in Latvia. Collection of Statistical Data. Rīga: 2016. 70 p*

Year	Wheat	Barley	Triticale	Oats	Rye	Buckwheat	Mixed cereals	Pulses
1998	150.9	173.4	5.3	59.7	57.7	1.7	17.3	6.8
1999	146.0	147.3	5.8	47.2	47.2	2.3	19.8	2.5
2000	158.1	134.9	5.9	45.5	54.8	6.2	14.6	2.1
2001	166.8	130.3	13.0	55.2	55.8	10.6	12.0	3.2
2002	153.5	136.9	15.5	47.1	42.3	10.5	9.2	2.5
2003	167.8	132.6	19.1	49.4	44.2	6.5	8.9	2.9
2004	169.9	127.3	17.1	56.7	45.1	9.7	10.9	2.6
2005	187.4	148.7	13.3	58.0	39.3	10.4	11.8	2.2
2006	215.1	154.2	11.3	62.9	42.8	14.0	11.5	1.4
2007	224.6	145.3	12.4	62.4	57.5	10.7	9.0	1.6
2008	256.6	131.2	13.8	66.2	59.0	10.4	7.0	1.6
2009	285.7	104.6	13.1	60.6	59.0	10.1	7.7	2.5
2010	307.6	106.5	12.1	63.3	34.6	8.2	9.2	2.7
2011	311.3	98.7	9.9	59.3	28.4	9.5	9.5	3.8
2012	354.7	87.9	13.3	62.0	37	11.7	8.0	4.6
2013	371.8	85.4	14.2	62.4	29.1	10.6	10.4	7.0
2014	402.5	119.9	10.7	66.8	32.3	10.2	12.8	11.9
2015	448.2	99.6	10.4	60.3	37.4	10.5	6.0	31.6
2015 versus 2014	+11.4%	-16.9%	-2.8%	-9.7%	+15.8%	+2.9%	-53.1%	+165.5%
2015 versus 1990	+216.7%	-67.5%	+845.5%	-26.8%	-71.4%	+10400.0%	-52.8%	+201.0%

Table 5.5 Sown area of agricultural crops, 1990–2015 (thousand ha)

Year	Sugar beet	Fodder roots	Potatoes	Maize for silage and forage	Crops for green feed and silage	Perennial grass	Fibre flax	Oil flax	Rape
1990	14.7	37.0	80.3	44.8	73.9	664.0	11.9	0.3	1.9
1991	14.6	39.4	82.2	39.5	84.9	679.6	8.8	0.3	0.7
1992	24.8	36.5	96.9	24.8	56.7	598.6	7.6	0.3	1.3
1993	12.1	29.6	87.7	9.2	31.4	536.0	0.6	0.3	1.7
1994	12.0	26.2	80.4	2.7	20.9	540.6	1.5	0.3	2.2
1995	9.5	19.8	75.3	0.6	17.8	374.7	1.4	0.3	1.1
1996	10.0	17.3	78.7	1.2	11.6	398.4	1.3	0.3	0.8
1997	10.9	14.9	69.6	0.5	13.2	389.7	1.6	0.3	0.4
1998	16.3	13.1	58.8	0.5	12.8	392.7	2.2	0.3	1.2
1999	15.5	9.1	50.1	0.7	12.0	383.1	2.0	0.3	6.5
2000	12.7	9.0	51.3	1.2	11.4	347.2	1.6	0.3	6.9
2001	14.1	9.6	55.1	1.0	8.4	304.4	1.4	0.4	8.4
2002	15.9	7.5	53.6	1.2	7.2	335.1	2.1	0.1	18.4
2003	14.4	7.1	54.6	1.7	9.9	282.9	2.1	0.1	25.9
2004	13.8	5.6	48.9	2.9	9.9	302.3	2.7	0.1	54.3
2005	13.5	3.8	45.1	2.9	8.7	360.6	2.2	0.2	71.4
2006	12.7	2.8	45.1	3.5	11.4	425.8	1.5	0.2	83.2
2007	0.3	2.3	40.3	5.1	11.1	427.1	1.4	0.1	99.2
2008	NO	0.9	37.8	5.9	8.2	413.1	0.4	0.2	82.6
2009	NO	0.7	30	9.8	7.2	413.7	0.1	0.2	93.3

Year	Sugar beet	Fodder roots	Potatoes	Maize for silage and forage	Crops for green feed and silage	Perennial grass	Fibre flax	Oil flax	Rape
2010	NO	0.9	30.1	7.1	6.3	387.3	0.0	1.1	110.6
2011	NO	0.8	29.7	11.3	5.7	370.8	0.1	1.4	121.3
2012	NO	0.6	28.2	20.6	10.6	351.4	0.6	0.3	117.5
2013	NO	0.3	27.3	20.4	7.7	356.7	0.2	0.1	128.2
2014	NO	0.2	26.8	21.7	7.3	312.4	0.1	0.5	100.1
2015	NO	0.2	24.8	25.6	8.6	304.3	0.1	0.3	89.0
2015 versus 2014	NO	0.0%	-7.5%	+18.0%	+17.8%	-2.6%	0.0%	-40.0%	-11.1%
2015 versus 1990	NA	-99.5%	-69.1%	-42.9%	-88.4%	-54.2%	-99.2%	0.0%	+4584.2%

5.2 ENTERIC FERMENTATION (CRF 3.A)

5.2.1 Category description

Methane (CH_4) is emitted as a by-product of the normal livestock digestive process, in which microbes resident in the animals' digestive system ferment the feed consumed by the animal. This fermentation process is also known as enteric fermentation[125]. Ruminant livestock (cattle, sheep and goats) are the primary source of methane emissions. The amount of enteric methane emitted is driven primarily by the number and size of domestic animals, the type of digestive system, and the type and amount of feed consumed[126]. Latvia reports emissions from cattle (including dairy cows, other mature non-dairy cattle and growing cattle according to CRF Option B), sheep, swine, goats, horses, rabbits, and fur-bearing animals (Table 5.6). Emission from poultry enteric fermentation has not been estimated. According to 2006 IPCC Guidelines, methodology for enteric fermentation calculation from poultry is not developed. Methane emission from poultry is calculated only in the manure management category.

Table 5.6 Reported emissions under the subcategory enteric fermentation

CRF	Source	Emissions reported	Level
3.A 1	Dairy cattle / Non-dairy cattle (other mature and growing cattle)	CH_4	Tier 2
3.A 2	Sheep	CH_4	Tier 1
3.A 3	Swine	CH_4	Tier 1
3.A 4	Other – Buffalo	NO	Tier 1
3.A 4	Other – Camels	NO	Tier 1
3.A 4	Other – Deer	CH_4	Tier 1
3.A 4	Other – Goats	CH_4	Tier 1
3.A 4	Other – Horses	CH_4	Tier 1
3.A 4	Other – Mules and asses	NO	Tier 1
3.A 4	Other – Poultry	NE	Tier 1
3.A 4	Other – Rabbits	CH_4	Tier 1
3.A 4	Other – Fur-bearing animals	CH_4	Tier 1

[125] *IPCC GPG, 2000*
[126] *2006 IPCC Guidelines*

Cattle are the largest source of enteric fermentation methane emissions (94.6% from total enteric fermentation methane emissions) in Latvia. In 2015, dairy cattle produced 62.7% and non-dairy cattle –31.9% of methane emissions. Emissions from sheep formed 2.4%, from swine – 1.5% and from other livestock – 1.6% of the total emissions from enteric fermentation. In 2015, total methane emissions from enteric fermentation of domestic livestock decreased by 0.13 kt or 0.4%, compared with 2014. This is caused by the decrease of the number of dairy cattle, swine, horses, fur-bearing animals and deer. Also the reason of decreasing enteric fermentation methane emissions from dairy cows is the increase of digestible energy expressed as percentage of gross energy. Since 1990, generally due to the evident fall of the number of livestock, methane emissions decreased by 61.4% (Table 5.7).

Table 5.7 Methane emissions from enteric fermentation by livestock category, 1990–2015 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Rabbits	Fur-bearing animals	Deer	Total, CH_4
1990	55.11	29.61	1.32	2.10	0.03	0.56	0.11	0.03	NO	88.86
1991	53.48	27.70	1.47	1.87	0.03	0.54	0.13	0.03	NO	85.25
1992	46.26	21.06	1.32	1.30	0.03	0.51	0.12	0.03	NO	70.62
1993	33.61	10.36	0.91	0.72	0.03	0.47	0.10	0.03	NO	46.23
1994	30.70	7.64	0.69	0.75	0.04	0.48	0.09	0.02	NO	40.42
1995	29.41	7.69	0.58	0.83	0.04	0.49	0.09	0.02	NO	39.16
1996	28.36	7.57	0.44	0.69	0.04	0.46	0.08	0.02	NO	37.67
1997	28.45	6.89	0.33	0.64	0.04	0.42	0.06	0.01	NO	36.83
1998	26.63	6.18	0.24	0.63	0.05	0.40	0.06	0.01	NO	34.18
1999	22.59	5.40	0.22	0.61	0.04	0.34	0.04	0.01	NO	29.24
2000	23.03	4.99	0.23	0.59	0.05	0.36	0.07	0.01	NO	29.33
2001	23.97	5.34	0.23	0.64	0.06	0.35	0.09	0.01	NO	30.69
2002	23.19	5.65	0.25	0.68	0.07	0.33	0.08	0.01	NO	30.26
2003	22.63	6.17	0.31	0.67	0.08	0.28	0.09	0.01	NO	30.24
2004	21.93	5.87	0.31	0.65	0.07	0.28	0.08	0.01	NO	29.21
2005	22.19	6.54	0.33	0.64	0.07	0.25	0.06	0.01	NO	30.11
2006	22.26	6.61	0.33	0.63	0.07	0.24	0.05	0.02	0.07	30.21
2007	22.42	7.71	0.43	0.62	0.07	0.23	0.06	0.02	0.08	31.56
2008	21.57	7.52	0.54	0.58	0.06	0.24	0.03	0.02	0.11	30.56
2009	21.13	7.81	0.57	0.56	0.07	0.23	0.03	0.02	0.16	30.40
2010	20.70	8.15	0.61	0.58	0.07	0.22	0.02	0.02	0.15	30.37
2011	20.80	8.39	0.64	0.56	0.07	0.21	0.02	0.02	0.19	30.71
2012	21.17	9.04	0.67	0.53	0.07	0.20	0.02	0.02	0.19	31.72
2013	21.65	9.87	0.68	0.55	0.06	0.19	0.02	0.02	0.23	33.05
2014	22.06	10.58	0.74	0.52	0.06	0.18	0.02	0.03	0.26	34.20
2015	21.51	10.96	0.82	0.50	0.06	0.17	0.02	0.03	0.25	34.08
Share of total % in 2015	62.7%	31.9%	2.4%	1.5%	0.2%	0.5%	0.1%	0.1%	0.7%	100.0%
2015 versus 2014	-2.5%	+3.6%	+10.6%	-4.4%	+3.3%	-5.0%	+3.9%	-13.3%	-4.5%	-0.4%
2015 versus 1990	-61.0%	-63.0%	-37.8%	-76.1%	+135.2%	-68.9%	-79.5%	+4.6%	ND	-61.4%

5.2.2 Methodological issues

The Tier 1 approach relies on default emissions factors. For Tier 1 methodology countries are required to collect data on number of animals for each livestock category. The Tier 2 approach is more complex 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 2006 IPCC Guidelines. Methane emissions from enteric fermentation for sheep, swine, goats, horses, rabbits, fur-bearing animals and deer have been calculated with the IPCC Tier 1 methodology by multiplying the number of the animals in each category with the IPCC default emission factor of the respective livestock category as shown in 2006 IPCC Guidelines[127]:

$$Emissions = EF_{(T)} \cdot \left(\frac{N_{(T)}}{10^6}\right)$$

where:
Emissions = methane emissions from Enteric Fermentation, kt CH_4 *yr^{-1}*
$EF_{(T)}$ = emission factor for the defined livestock population, kg CH_4 *$head^{-1}$ yr^{-1}*
$N_{(T)}$ = the number of head of livestock species / category T in the country
T = species/category of livestock

The default emission factors as for developed countries according to 2006 IPCC Guidelines[128] were used to calculate methane emissions from enteric fermentation for sheep, swine, goats, horses and rabbits (Table 5.8). As default IPCC and national emission factors for rabbits and fur-bearing animals are not available, other emission factors as Norwegian[129] emission factor for fur-bearing animals and Russian[130] emission factor for rabbits were used for enteric fermentation emission calculations similarly by experience of the neighbouring countries. For deer the emission factor 20.0 kg $animal^{-1}$ $year^{-1}$ is used that is IPCC default value.

Table 5.8 Default methane emission factors from enteric fermentation

Livestock category	EF (kg CH_4 $head^{-1}$ yr^{-1})
Sheep	8.00
Swine	1.50
Goats	5.00
Horses	18.00
Rabbits	0.59
Fur-bearing animals	0.10
Deer	20.0

The Tier 2 approach to estimate emissions is implemented for cattle, because emissions from cattle make up the biggest part of total agricultural sector methane emissions. With the Tier 2 methodology methane emissions have been calculated as in the Tier 1

[127] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.19, page 10.28
[128] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.10, page 10.28
[129] Greenhouse gas emission in Norway 1990-2011, National inventory report, 2013, p. 238, Table 6.3
[130] Национальный доклад о кадастре антропогенных выбросов из источников и абсорбции поглотителями парниковых газов не регулируемых Монреальским протоколом за 1990-2011 г. Москва, 2013. Часть 1, С. 175, Таблица 6.5

methodology mentioned above, but the emission factors (EF) for dairy cattle and young and mature non-dairy cattle have been calculated according to 2006 IPCC Guidelines methodology represented as[131]:

$$EF = \left[\frac{GE \cdot \left(\frac{Y_m}{100}\right) \cdot 365}{55.65}\right]$$

where:
EF = emission factor, kg CH_4 *head*$^{-1}$ *yr*$^{-1}$
GE = gross energy intake, MJ head^{-1} *day*$^{-1}$
Y_m *= methane conversion factor, per cent of gross energy in feed converted to methane (default values in table 10.12, page 10.30 from 2006 IPCC Guidelines)*
The factor 55.65 (MJ/kg CH_4*) is the energy content of methane*

For cattle, the gross energy intake (GE) has been calculated according to 2006 IPCC Guidelines[132]:

$$GE = \left[\frac{\left(\frac{NE_m + NE_a + NE_1 + NE_{work} + NE_p}{REM}\right) + \left(\frac{NE_g}{REG}\right)}{\frac{DE\%}{100}}\right]$$

where:
GE = gross energy, MJ day^{-1}
NE_m *= net energy required by the animal for maintenance, MJ day*$^{-1}$
NE_a *= net energy for animal activity, MJ day*$^{-1}$
NE_l *= net energy for lactation, MJ day*$^{-1}$
NE_{work} *= net energy for work, MJ day*$^{-1}$
NE_p *= net energy required for pregnancy, MJ day*$^{-1}$
REM = ratio of net energy available in a diet for maintenance to digestible energy consumed
NEg = net energy needed for growth, MJ day^{-1}
REG = 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 NE_m (Equation 10.3, 2006 IPCC Guidelines), NE_a (Equation 10.4, 2006 IPCC Guidelines), NE_l (Equation 10.8, 2006 IPCC Guidelines), NE_p (Equation 10.13, 2006 IPCC Guidelines), NE_g (Equation 10.6, 2006 IPCC Guidelines), REM (Equation 10.14, 2006 IPCC Guidelines) and REG (Equation 10.15, 2006 IPCC Guidelines)[133] are:

$$NE_m = Cf_i \cdot (Weight)^{0.75}$$

$$NE_a = C_a \cdot NE_m$$

$$NE_l = Milk \cdot (1.47 + 0.40 \cdot Fat)$$

$$NE_p = C_{pregnancy} \cdot NE_m$$

$$NE_g = 22.02 \cdot \frac{BW}{C \cdot MW}^{0.75} \cdot WG^{1.097}$$

$$REM = \left[1.123 - (4.092 \cdot 10^{-3} \cdot DE\%) + [1.126 \cdot 10^{-5} \cdot (DE\%)^2] - \left(\frac{25.4}{DE\%}\right)\right]$$

$$REG = \left[1.164 - (5.160 \cdot 10^{-3} \cdot DE\%) + [1.308 \cdot 10^{-5} \cdot (DE\%)^2] - \left(\frac{37.4}{DE\%}\right)\right]$$

where:

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[131] *2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.21, page 10.31*
[132] *2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.16, page 10.21*
[133] *2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.3-10.15, page 10.15-10.21*

Cf_i = maintenance coefficient (default values used[134])
Weight = animal weight, kg
Ca = coefficient corresponding to animals feeding situation (default values used)[135]
Milk = amount of milk produced, kg of milk day^{-1}
Fat = fat content of milk, % by weight
$C_{pregnancy}$ = Pregnancy coefficient (default values used[136])
BW = the average live body weight (BW) of the animals in the population, kg
MW = the mature live body weight of an adult female in moderate body condition, kg
WG = the average daily weight gain of the animals in the population, kg day^{-1}
C = a coefficient with a value of 0.8 for females, 1.0 for castrates and 1.2 for bulls
REM = ratio of net energy available in a diet for maintenance to digestible energy consumed
REG= ratio of net energy available for growth in a diet to digestible energy consumed
DE% = digestible energy, %

When using NEp to calculate GE, the NEp estimate must be weighted by the portion of the mature females that actually go through gestation in a year. According to animal breeding national expert calculations based on data of Agricultural Data Centre Republic of Latvia Register, 83% of the NEp value for dairy cattle is used in the GE equation.

Methane conversion factor (Ym) of zero is assumed for juveniles consuming only milk (2006 IPCC Guidelines, p.10.30). In Latvia, it was supposed that calves feed milk and milk substitute no longer than of age 3 months. Therefore it was assumed that methane conversion rate of young growing cattle group (under 1 year old) is 5.5% in 2015. The rate was estimated from IPCC default Ym 6.5%, based on an assumption that for calves between 0 and 3 months Ym is 0%.

Feed digestibility (DE) cattle 65% for dairy is used in calculations according to the average value represented in Table 10.2 in the 2006 IPCC Guidelines for 1990-2009, because detailed information on feed digestibility are not available in the country for this period. DE 66% is used for 2010-2014 and 67% for 2015 based on national studies. For non-dairy cattle DE 65% is used.

Forage quality, level of concentrates in the diet and feed digestibility directly affect enteric methane production in the rumen, therefore the chemical content of typical forage used for cattle feeding was analysed from all regions of Latvia at the Latvia University of Agriculture Scientific Laboratory of Agronomic Analysis. Research activities were done according to the tasks of the pre-defined project "Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections" under 2009 – 2014 EEA Grants Programme National Climate Policy. The cattle feed samples were collected from January until December in 2015. The chemical analysis of animal feed was made according to generally accepted zootechnical methods of feed analysis: dry matter (DM) %, crude protein (CP) %, insoluble protein, %, soluble protein, %, undegraded intake protein (UIP) %, crude fiber (CF) %, acid detergent fiber (ADF) %, neutral detergent fiber (NDF) %, ash %, Ca and P %, according ISO 5983, ISO 6490/2 and ISO 6491 standards. Digestibility was determined using the cellulase method. Special attention was given to ADF and NDF values, because they could be used also for calculation of feed digestibility. The ADF value refers to the cell wall portions of the forage that are made up of cellulose and lignin and relate to the ability of an

[134] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.4, page 10.16
[135] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.5, page 10.17
[136] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.7, page 10.20

animal to digest the forage. As ADF increases, the ability to digest the forage decreases. The NDF value is the total cell wall which is comprised of the ADF fraction plus hemicellulose. NDF values reflect the amount of forage the animal can consume.

The research results showed that NDF content and digestibility vary significantly for analysed forage samples. Depending on the growth stage of green biomass in the harvesting period, the content of NDF in hay was found within 51-71%, 24-48% in silage, 38-62% in haylage and 30-45 % in total mixed ration (TMR) of DM. The average determined digestibility of forage for natural meadow hay was 52.3±4.3% and 53.8±5.2% for cereal grass hay; for grass silage with preservative 65.2±6.1%, without preservative 62.8±4.9%; and for corn silage, respectively 71.1±0.6%, 68.2±3.1%; for haylage 62.6±4.1%, for TMR 71.7±5.7%. Detailed description of the research results is available in the scientific literature[137].

All forage quality analysis results are summarized and included in the catalogue of forage digestibility and chemical analysis results[138].

The interviews with agricultural and academic experts in the field of animal feeding as additional study were conducted with the main aim to identify the country typical feed rations for dairy cows and other cattle. According to the survey results, the feed ration of dairy cows consists in average of 71% (58.1-84.4%) of grass forage and 29% (15.6-41.9%) of concentrates based on dry matter intake. Other cattle feed ration includes grass forage and concentrates in following proportions: for 1-2 years old cattle – 92% and 8%, for beef cattle over 2 years old – 91% and 9%, and other cattle over 2 years old – 83% and 17% of the dry matter intake, respectively.

Based on detailed calculations of the cattle feed quality parameters and feeding rations in 2015, it was concluded to use in the inventory DE 67% for dairy cows for the same year. Based on historical records of feed quality analysis and feeding rations, it was set to use DE 66% for the time period 2010-2014, taking in to account that since 2010 the number of farms with higher proportion of concentrates in the dairy cow diet showed tendency to increase. Overall analysis of other cattle feeding lead to conclusion that digestibility of feed for other cattle fluctuates around DE 65% in the case of typical conditions for Latvia.

The calculation of GE for dairy cattle 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 5.9. Values of milk fat content for 1990-1997 are derived by extrapolation based on an assumption that fat content in milk was around 3.5% in 1990; all other information comes from CSB of Latvia.

Table 5.9 Average milk yield per cow and fat content

Year	Average milk yield, kg $year^{-1}$	Fat content, %
1990	3437	3.50
1991	3205	3.58

[137] *Degola L. Trupa A., Aplocina E. (2016) Forage quality and digestibility for calculation of enteric methane emission from cattle /15th International scientific conference "Engineering for Rural Development" : proceedings, Jelgava, Latvia, May 25 - 27, 2016 Latvia University of Agriculture. Faculty of Engineering. - Jelgava, 2016. - Vol.15, p. 456-461. Available at SCOPUS: https://www.scopus.com/record/display.uri?eid=2-s2.0-84976575976&origin=inward&txGid=770FDC7EE521DF4413DBC8DAAC7E5702.wsnAw8kcdt7IPYLO0V48gA%3a1*

[138] *http://www.vbf.llu.lv/getfile.php?id=2835*

Year	Average milk yield, kg year^{-1}	Fat content, %
1992	2793	3.67
1993	2741	3.75
1994	2923	3.84
1995	3074	3.92
1996	3237	4.01
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
2013	5508	4.08
2014	5812	3.86
2015	5905	3.99
2015 versus 2014	+1.6%	+3.4%
2015 versus 1990	+71.8%	+14.0%

In Latvian GHG inventory livestock category *Cattle* (CRF 3.A.1) is reported in three sub-categories: mature dairy cattle, other mature cattle and growing cattle. Calculations of methane emission from enteric fermentation for dairy cattle are not divided into smaller sub-groups. Estimation of methane emissions from non-dairy cattle is split in seven age and production type sub-groups according to the records in the database of CSB of Latvia. Growing cattle group is represented by young cattle under 1 year and young cattle aged from 1 to 2 years. These two growing cattle groups are segregated for dairy and beef cattle. Other mature cattle group include bulls, heifers and other cows aged over 2 years old. The numbers of non-dairy cattle by sub-categories are presented in Table 5.10. Activity data and calculations of emmisions for non-dairy are divided in mentioned sub-categories of cattle because:

1) in the inventory are strongly linked to data base of Central Statistical Bureau of Latvia and therefore provide consistency with EUROSTAT and other official statistical data;

2) promote easer reporting of cattle weights and identify feeding situation;

3) facilitating proper estimation of MMS, because MMS significantly differs by defined cattle types in the herd.

Missing data or no available data for 1990-1995 are created by linear extrapolation. Total numbers of young cattle under 1 year and aged 1 to 2 years are provided by CSB. Data of young dairy and beef cattle are calculated by Latvia University of Agriculture experts based on CSB totals of mentioned young cattle groups. All numbers of other mature cattle over 2 years are original data obtained from CSB data base.

Table 5.10 The number of non-dairy cattle by sub-categories in Latvia, 1990-2015 (thousand heads)

Year	Growing cattle						Other mature cattle		
	Young cattle under 1 year			Young cattle aged from 1 to 2 years			Mature non-dairy cattle over 2 years		
	dairy cattle calves	beef cattle calves	total	dairy cattle	beef cattle	total	bulls	heifers	other cows
1990	267.6	257.7	525.2	214.0	88.6	302.6	12.0	54.3	10.1
1991	265.7	228.9	494.6	212.6	72.4	285.0	11.3	51.2	9.6
1992	240.9	144.1	384.9	192.7	29.0	221.7	8.8	39.8	7.4
1993	140.4	49.5	189.9	87.8	21.7	109.4	4.3	19.6	3.7
1994	93.6	45.2	138.8	62.4	17.5	79.9	3.2	14.4	2.7
1995	87.6	47.2	134.8	64.2	17.8	82.0	3.2	14.7	2.8
1996	96.1	38.3	134.4	60.4	18.9	79.3	3.3	15.0	2.8
1997	92.0	31.7	123.7	52.6	18.1	70.7	2.6	13.8	3.3
1998	84.7	24.6	109.3	48.4	17.5	65.9	1.6	12.7	2.8
1999	82.2	18.4	100.6	45.2	14.3	59.5	1.1	9.5	2.1
2000	75.7	22.2	97.9	40.9	10.7	51.6	0.8	9.8	2.1
2001	83.6	28.4	112.0	37.6	11.4	49.0	1.7	10.4	2.5
2002	92.1	18.6	110.7	45.0	15.3	60.3	1.1	8.7	2.7
2003	93.2	16.0	109.1	48.4	18.3	66.7	1.5	11.2	3.8
2004	93.1	17.3	110.4	41.0	15.6	56.6	1.7	11.6	4.6
2005	92.6	26.3	118.9	42.6	17.0	59.6	1.6	11.9	8.0
2006	91.2	16.3	107.5	47.4	15.5	62.9	1.8	13.1	9.5
2007	90.2	24.7	114.9	59.5	13.0	72.5	1.2	14.6	15.2
2008	85.2	23.2	108.4	56.2	10.0	66.2	2.6	20.8	12.7
2009	82.8	24.8	107.4	54.6	12.2	66.8	3.0	19.9	15.5
2010	82.1	23.6	105.6	54.2	13.4	67.6	3.2	20.3	18.7
2011	82.1	21.9	103.9	54.2	12.5	66.7	3.1	20.9	22.0
2012	82.3	26.1	108.4	54.3	15.7	70.0	3.5	21.0	25.6
2013	82.5	26.8	109.3	54.5	20.9	75.3	4.3	23.4	29.2
2014	83.0	35.5	118.4	54.7	20.2	74.9	4.4	24.3	34.2
2015	77.2	36.4	113.6	54.8	21.4	76.2	4.4	23.6	38.9
2015 versus 2014	-	-	-4.1%	-	-	+1.7%	0.0%	-2.9%	+13.7%
2015 versus 1990	-	-	-78.4%	-	-	-74.8%	-63.3%	-56.5%	+285.1%

Results of gross energy intake (GE) calculation for dairy and non-dairy cattle from enteric fermentation are summarized in Table 5.11.

Two breeds prevailing in the herds of dairy cows – Latvian Brown (Red breed group) and Black and White Holstein. The documented weight for Latvian Brown breed is 530-580 kg[139], for Black and White Holstein breed – no less than 680[140] kg. For the period 1990-1999, mostly Latvian Brown breed were observed in the herds, later the number of Black and White Holstein breed showed tendency to increase, therefore the average weight for dairy cows is updated every 5 years, since 2000. The average weight for other cattle is calculated

[139] *Ciltsdarba programma sarkano šķirņu govju selekcijā 2013. - 2017. gadam un tuvākajai perspektīvai. Available at: http://www.ldc.gov.lv/upload/doc/sarkano_skirnu_ciltsdarba_programma_2013_2017.pdf*

[140] *Latvijas Holšteinas šķirnes govju ciltsdarba programma 2013. - 2017. gadam. Available at: http://www.ldc.gov.lv/upload/doc/LHA_programma_2013_1017.pdf*

based on Agricultural Data Center, which operates the national recording scheme, provided information about most important meat cattle breed's standard weights[141].

Table 5.11 Average gross energy (GE) intake (MJ day^{-1}) and methane emission factors (EF) from enteric fermentation (kg CH_4 head^{-1} year^{-1}) and cattle weight (kg head^{-1} year^{-1}), 1990-2015

Year	Dairy cows			Growing cattle			Other mature cattle		
	Weight	GE	EF	Weight	GE	EF	Weight	GE	EF
1990	550.0	241.6	103.0	272.0	80.4	29.8	581.3	152.9	65.2
1991	550.0	236.1	100.6	270.9	79.7	29.5	581.2	152.9	65.2
1992	550.0	225.2	96.0	267.5	77.6	28.7	581.3	152.9	65.2
1993	550.0	224.6	95.8	267.3	77.0	28.6	580.8	152.9	65.2
1994	550.0	230.9	98.4	268.5	77.9	28.9	581.6	153.0	65.2
1995	550.0	236.3	100.8	271.7	78.6	29.3	580.4	152.9	65.2
1996	550.0	242.3	103.3	269.6	77.9	29.0	581.0	152.9	65.2
1997	550.0	253.9	108.3	267.9	77.5	28.8	572.8	153.9	65.6
1998	550.0	258.0	110.0	270.5	77.7	29.0	555.2	150.1	64.0
1999	550.0	257.7	109.9	268.5	76.8	28.6	552.2	149.7	63.8
2000	555.0	264.2	112.6	262.5	76.0	28.1	541.6	147.6	62.9
2001	555.0	268.9	114.6	254.0	74.8	27.3	566.1	152.9	65.2
2002	555.0	265.9	113.3	264.2	76.1	28.2	556.9	154.4	65.8
2003	555.0	285.0	121.5	270.5	77.2	28.9	559.3	155.9	66.5
2004	555.0	276.3	117.8	261.3	75.6	27.9	563.3	158.7	67.7
2005	555.0	281.1	119.8	261.2	76.1	28.0	563.3	167.3	71.3
2006	560.0	286.2	122.0	267.7	76.4	28.5	564.3	168.8	72.0
2007	560.0	291.5	124.3	271.2	77.1	28.8	556.6	174.8	74.5
2008	560.0	296.9	126.6	268.9	76.5	28.5	560.6	165.2	70.4
2009	560.0	299.4	127.7	270.6	77.1	28.8	567.4	170.5	72.7
2010	560.0	295.8	126.1	272.5	77.5	29.0	569.6	173.8	74.1
2011	565.0	297.4	126.8	272.3	77.2	28.9	568.6	176.2	75.1
2012	565.0	301.7	128.6	273.6	77.9	29.2	572.3	179.4	76.5
2013	565.0	307.8	131.2	278.3	79.1	29.8	575.1	180.1	76.8
2014	565.0	311.8	132.9	274.1	78.7	29.4	575.0	182.4	77.8
2015	565.0	310.7	132.5	277.8	79.6	29.9	576.1	185.4	79.0

Results of gross energy intake and emission factors calculation for non-dairy cattle from enteric fermentation are summarized in Table 5.12.

Table 5.12 Gross energy (GE) intake (MJ day^{-1}) and methane emission factors (EF) from enteric fermentation for non-dairy cattle sub-groups (kg CH_4 head^{-1} year^{-1}), 2015

Non-dairy cattle sub-groups		GE	EF
Young cattle under 1 year	dairy cattle calves	58.2	18.6
	beef cattle calves	74.8	23.9
Young cattle aged from 1 to 2 years	dairy cattle	96.0	40.9
	beef cattle	123.2	52.5
Mature non-dairy cattle over 2 years	bulls	215.3	91.8

[141] Gaļas šķirņu govju ciltsdarba programma 2013. – 2017. gadam. Available at: http://www.ldc.gov.lv/upload/doc/citsdarba.programma._2013-2017.pdf

Non-dairy cattle sub-groups		GE	EF
	heifers	127.1	54.2
	other cows	217.4	92.7
IPCC default			57.0

5.2.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The uncertainty associated with livestock population varies widely depending on the source, but according to 2006 IPCC Guidelines should be known within +20%. However, according to received information from CSB of Latvia, uncertainty of activity data describing numbers of livestock could be 2-3%. Generally, the uncertainty of activity data provided by CSB of Latvia is set as 2%. 2006 IPCC Guidelines declare that emission factors estimated using the Tier 1 method are unlikely to be known more accurately than +30% and may be uncertain to +50%. Tier 2 method is likely to be in the order of +20%[142].

According to the assumptions above, emission factors estimated using the Tier 1 method is set to be uncertain of 50%, but uncertainty of emission factors estimated by the Tier 2 is set as 20%.

Inter-annual changes of CH_4 EF values for cattle are primarily a result of changes in the activity data that occur in response to agricultural policy, the economic situation and market demands.

5.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the agriculture sector in order to achieve these quality objectives. Quality control meetings are held annually between experts.

Activity data check. Livestock data were checked by an inventory compiler and CSB specialist. Livestock age sub-groups data that were collected by extrapolating methods are compared with statistical data of CSB to achieve correct total numbers. Data collection methods are documented in agriculture sector inventory compilers data base for GHG inventory purposes.

Review of emission factors. Country-specific emission factors derived with Tier 2 method are cross-checked against the IPCC defaults. Results of comparison of emission factors for methane emission from enteric fermentation of dairy cows and non-dairy cattle are shown below (Table 5.13).

[142] *2006 IPCC Guidelines. Volume 4, Chapter 10, page 10.33*

Table 5.13 Review of emission factors for enteric fermentation methane emissions

Category	Source	EF (kg CH_4 head^{-1}year^{-1})
Dairy cows	Latvia, Tier 2, 2015	132.5
	2006 IPCC Guidelines (Western Europe)[143]	117.0
Non-dairy cattle	Latvia, Tier 2, 2015 (average)	54.5
	2006 IPCC Guidelines (Western Europe)[58]	57.0

Latvia uses higher emission factor for dairy cows based on a different feeding situation that is not totally characterized as stall fed (set for Tier 1). Also digestibility used for calculations of emission coefficient is lower (65%-67% against 70% for Tier 1). In average enteric fermentation methane emission factor for non-dairy cattle is slightly lower than IPCC default, caused mainly by different feeding situation in Latvia. Detailed information is included in chapter 5.2.2.

5.2.5 Category-specific recalculations

For 2017 submission the main recalculations of methane emissions for the period 2010-2014 are done based on the implementation of new methodology to determine manure management (including pasture period) and feeding situation distribution for all livestock. According to national research results digestibility for dairy cows is changed from 65% to 66% for 2010-2014 and 67% for 2015.

5.2.6 Category-specific planned improvements

Updating of digestible energy as percent of gross energy for swine, according to feeding situation research is planned for the next inventory.

5.3 MANURE MANAGEMENT (CRF 3.B)

5.3.1 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 groups represented in the chapter 1.2), sheep, swine (including mature swine as breeding sows and boars, piglets under 50 kg of weight, young breeding sows and fattening pigs), horses, goats and poultry (including layers, broilers, turkeys, ducks, geese and other poultry), as well as rabbits, fur-bearing animals and deer (Table 5.14).

When organic matter in livestock manure decomposes in anaerobic environment, methanogenic bacteria produce methane. The amount 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 nitrous oxide produced during the storage and treatment of manure before it is applied to land. Production of nitrous oxide during storage and treatment of animal waste occurs via combined nitrification-denitrification of nitrogen in animal waste.

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[143] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.11, page 10.29

Table 5.14 Reported emissions under the subcategory manure management

CRF	Source	Emissions reported	Level
3.B 1	Dairy cattle / Non-dairy cattle (other mature and growing cattle)	CH_4, N_2O	Tier 2, Tier 2
3.B 2	Sheep	CH_4, N_2O	Tier 1, Tier 2
3.B 3	Swine	CH_4, N_2O	Tier 2, Tier 2
3.B 4	Other – Buffalo	NO	NA
3.B 4	Other – Camels	NO	NA
3.B 4	Other – Deer	CH_4, N_2O	Tier 1, Tier 2
3.B 4	Other – Goats	CH_4, N_2O	Tier 1, Tier 2
3.B 4	Other – Horses	CH_4, N_2O	Tier 1, Tier 2
3.B 4	Other – Mules and asses	NO	NA
3.B 4	Other – Poultry	CH_4, N_2O	Tier 1, Tier 2
3.B 4	Other – Rabbits	N_2O	Tier 1, Tier 1
3.B 4	Other – Fur-bearing animals	N_2O	Tier 1, Tier 1

Methane emissions from manure management have decreased by 46.7% over the time period of 1990-2015 (Table 5.15). In 2015, methane emissions from manure management of domestic livestock increased by 0.18 kt or 4.7% compared with 2014 due to increase of the liquid manure share.

Table 5.15 Methane emissions from manure management by livestock category, 1990-2015 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Poultry	Rabbits	Fur-bearing animals	Deer	Total CH_4
1990	3.42	1.02	0.03	2.62	0.001	0.05	0.26	0.016	0.18	NO	7.58
1991	3.38	0.97	0.03	2.36	0.001	0.05	0.26	0.018	0.18	NO	7.24
1992	2.98	0.77	0.03	1.73	0.001	0.04	0.14	0.016	0.18	NO	5.88
1993	2.20	0.38	0.02	1.07	0.001	0.04	0.11	0.013	0.18	NO	4.01
1994	2.04	0.28	0.02	1.04	0.001	0.04	0.09	0.012	0.15	NO	3.68
1995	2.00	0.28	0.01	1.23	0.001	0.04	0.10	0.012	0.15	NO	3.82
1996	1.98	0.27	0.01	0.91	0.001	0.04	0.10	0.011	0.14	NO	3.47
1997	2.05	0.25	0.01	0.92	0.001	0.04	0.09	0.007	0.06	NO	3.42
1998	1.97	0.22	0.01	0.91	0.001	0.03	0.08	0.008	0.04	NO	3.28
1999	1.73	0.20	0.01	0.94	0.001	0.03	0.09	0.006	0.06	NO	3.05
2000	1.82	0.19	0.01	0.93	0.001	0.03	0.08	0.009	0.07	NO	3.13
2001	2.13	0.20	0.01	1.07	0.001	0.03	0.09	0.012	0.08	NO	3.62
2002	2.10	0.21	0.01	1.19	0.002	0.03	0.10	0.011	0.08	NO	3.72
2003	2.08	0.23	0.01	1.22	0.002	0.02	0.10	0.012	0.08	NO	3.75
2004	2.06	0.22	0.01	1.17	0.002	0.02	0.10	0.011	0.10	NO	3.69
2005	2.11	0.23	0.01	1.21	0.002	0.02	0.10	0.008	0.10	NO	3.80
2006	2.18	0.24	0.01	1.22	0.002	0.02	0.11	0.007	0.12	0.001	3.92
2007	2.31	0.27	0.01	1.27	0.002	0.02	0.12	0.008	0.12	0.001	4.14
2008	2.34	0.26	0.01	1.20	0.002	0.02	0.11	0.005	0.13	0.001	4.09
2009	2.39	0.27	0.01	1.18	0.002	0.02	0.12	0.004	0.11	0.002	4.10
2010	2.20	0.28	0.01	1.15	0.002	0.02	0.12	0.003	0.11	0.002	3.90
2011	2.27	0.28	0.02	1.09	0.002	0.02	0.10	0.003	0.12	0.002	3.91
2012	2.18	0.30	0.02	0.91	0.002	0.02	0.10	0.003	0.16	0.002	3.68
2013	2.17	0.32	0.02	0.88	0.002	0.02	0.10	0.003	0.16	0.003	3.67
2014	2.37	0.34	0.02	0.83	0.002	0.02	0.08	0.003	0.21	0.003	3.86
2015	2.50	0.35	0.02	0.88	0.002	0.01	0.09	0.003	0.19	0.003	4.05

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Poultry	Rabbits	Fur-bearing animals	Deer	Total CH_4
Share of total % in 2015	61.9%	8.5%	0.5%	21.8%	0.0%	0.4%	2.2%	0.1%	4.6%	0.1%	100.0%
2015 versus 2014	+5.6%	+2.1%	+10.6%	+6.6%	+3.3%	-5.0%	+17.9%	+3.9%	-13.3%	-4.5%	+4.7%
2015 versus 1990	-26.8%	-66.2%	-37.8%	-66.3%	+135.2%	-68.9%	-65.3%	-79.5%	+4.6%	NA	-46.7%

In 2015, direct nitrous oxide emissions reached 0.20 kt, however over the time period of 1990-2015 nitrous oxide emissions decreased by 67.6% due to decrease mainly of the livestock number. In 2015, direct N_2O emissions from manure management decreased by 1% (0.002 kt) compared to 2014. The fluctuation of emissions is related to the variation of animal numbers, as well as changes in the distribution of livestock MMS (Table 5.16).

Table 5.16 Nitrous oxide emissions from manure management by livestock category, 1990-2015* (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Poultry	Rabbits	Fur-bearing animals	Deer	Total direct, N_2O	Total indirect, N_2O
1990	0.32	0.09	0.016	0.135	0.001	0.009	0.035	0.012	0.017	NO	0.63	0.40
1991	0.31	0.08	0.017	0.119	0.001	0.009	0.037	0.014	0.017	NO	0.61	0.38
1992	0.28	0.07	0.016	0.085	0.001	0.009	0.019	0.013	0.017	NO	0.51	0.30
1993	0.20	0.04	0.011	0.051	0.001	0.008	0.015	0.010	0.017	NO	0.35	0.20
1994	0.18	0.03	0.008	0.049	0.001	0.008	0.013	0.010	0.014	NO	0.31	0.18
1995	0.17	0.03	0.007	0.056	0.001	0.008	0.015	0.010	0.014	NO	0.31	0.18
1996	0.18	0.03	0.005	0.040	0.001	0.008	0.014	0.009	0.013	NO	0.29	0.18
1997	0.18	0.02	0.004	0.038	0.001	0.007	0.013	0.006	0.006	NO	0.28	0.17
1998	0.17	0.02	0.003	0.037	0.001	0.007	0.012	0.006	0.004	NO	0.26	0.16
1999	0.14	0.02	0.003	0.037	0.001	0.006	0.012	0.005	0.006	NO	0.23	0.14
2000	0.14	0.02	0.003	0.035	0.001	0.006	0.012	0.007	0.006	NO	0.23	0.14
2001	0.15	0.02	0.003	0.038	0.001	0.006	0.013	0.010	0.008	NO	0.25	0.15
2002	0.14	0.02	0.003	0.040	0.001	0.006	0.015	0.009	0.008	NO	0.25	0.15
2003	0.14	0.02	0.004	0.039	0.002	0.005	0.014	0.009	0.008	NO	0.24	0.15
2004	0.14	0.02	0.004	0.036	0.002	0.005	0.014	0.009	0.009	NO	0.24	0.14
2005	0.14	0.02	0.004	0.036	0.002	0.004	0.015	0.006	0.009	NO	0.23	0.14
2006	0.14	0.02	0.004	0.035	0.002	0.004	0.016	0.006	0.012	0.000	0.24	0.14
2007	0.14	0.03	0.005	0.036	0.001	0.004	0.017	0.006	0.012	0.000	0.24	0.14
2008	0.13	0.02	0.006	0.033	0.001	0.004	0.016	0.004	0.013	0.000	0.23	0.13
2009	0.13	0.02	0.007	0.032	0.001	0.004	0.017	0.003	0.011	0.000	0.23	0.13
2010	0.12	0.02	0.007	0.030	0.001	0.004	0.017	0.002	0.011	0.000	0.22	0.13
2011	0.12	0.02	0.008	0.028	0.001	0.004	0.015	0.003	0.012	0.000	0.21	0.12
2012	0.11	0.02	0.008	0.022	0.001	0.003	0.015	0.002	0.015	0.000	0.21	0.12
2013	0.11	0.02	0.008	0.021	0.001	0.003	0.014	0.002	0.015	0.000	0.20	0.12
2014	0.12	0.03	0.009	0.019	0.001	0.003	0.011	0.002	0.021	0.000	0.21	0.12

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Goats	Horses	Poultry	Rabbits	Fur-bearing animals	Deer	Total direct, N_2O	Total indirect, N_2O
2015	0.11	0.03	0.009	0.020	0.001	0.003	0.013	0.003	0.018	0.000	0.20	0.12
Share of total % in 2015	54.9%	12.6%	4.6%	9.7%	0.7%	1.4%	6.1%	1.2%	8.7%	0.0%	100.0%	
2015 versus 2014	-2.5%	+0.3%	+7.2%	+5.3%	+3.4%	-8.4%	+18.5%	+3.9%	-+13.3%	0.0%	-1.0%	-3.5%
2015 versus 1990	-64.9%	-70.0%	-39.7%	-85.4%	+135.4%	-70.1%	-64.4%	-79.5%	+4.6%	NA	-67.6%	-70.2%

**emissions from pasture not included, they are reported under 3.D Managed soils*

5.3.2 Methodological issues

The 2006 IPCC Guidelines include two tiers to estimate 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 m^3 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.

Methane emissions from manure management for sheep, goats, horses, poultry (divided as layers broilers, turkeys, ducks, geese and others), rabbits, fur-bearing animals and deer were calculated by using Tier 1 methodology by multiplying the number of the animals with the default emission factor for each animal category according to the 2006 IPCC Guidelines[144]:

$$CH_4\ manure = \sum_{(T)} \frac{\left(EF_{(T)} \cdot N_{(T)}\right)}{10^6}$$

where:
$CH_{4\ Manure}$ = CH_4 emissions from manure management, for a defined population, kt CH_4 yr^{-1}
$EF_{(T)}$ = emission factor for the defined livestock population, kg CH_4 $head^{-1}$ yr^{-1}
$N_{(T)}$ = the number of head of livestock species / category T in the country
T = species/category of livestock

Emission factors for Tier 1 methodology calculations were chosen as for *cool* climate region and are represented in Table 5.17. The original source of default emission factors is 2006 IPCC Guidelines[145]. Emission factor for deer is derived based on average value represented in IPCC Guidelines[146].

[144] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.22, page 10.37
[145] 2006 IPCC Guidelines. Volume 4, Chapter 10, Tables 10.15 and 10.16, page 10.40-10.41
[146] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.16, page 10.41

Table 5.17 Methane emission factors from manure management

Animal category	Emission factor (kg head^{-1} year^{-1})
Sheep	0.19
Goats	0.13
Horses	1.56
Layers	0.03
Broilers and others	0.02
Turkeys	0.09
Ducks	0.02
Geese	0.02
Rabbits	0.08
Fur-bearing animals	0.68
Deer	0.22

For dairy cattle, non-dairy cattle and swine the Tier 2 approach was used for estimating methane emissions from manure management systems as dairy cattle and swine represent a significant share of total emissions from agriculture sector. This method requires detailed information on animal characteristics and the manner in which manure is managed. Methane emission factors for cattle and swine were derived from the 2006 IPCC Guidelines[147]:

$$EF_T = (VS_T \cdot 365) \cdot \left[B_{O(T)} \cdot 0.67 \frac{kg}{m^3} \cdot \sum_{S,k} \frac{MCF_{S,k}}{100} \cdot MS_{T,S,k} \right]$$

where:

$EF_{(T)}$ = annual CH_4 emission factor for livestock category T, kg CH_4 animal^{-1} yr^{-1}

$VS_{(T)}$ = daily volatile solid excreted for livestock category T, kg dry matter animal^{-1} day^{-1}

$Bo_{(T)}$ = maximum methane producing capacity for manure produced by livestock category T, m^3 CH_4 kg^{-1}of VS excreted

$MCF_{(S,k)}$ = methane conversion factors for each manure management system by climate region k, % (Solid Storage – 2%, Liquid Storage (with crust) – 10%, Pasture/Range/Paddock – 1%;Anaerobic Digester – 2% as represented in table 10.17, page 10.44, 2006 IPCC)

$MS_{(T,S,k)}$ = fraction of livestock category manure handled using manure management system in climate region k, dimensionless

0.67 = conversion factor of m^3 CH_4 to kilograms CH_4

365 = basis for calculating annual VS production, days yr^{-1}

The manure management systems (S) reported in the inventory are:

- liquid system;
- solid storage;
- pasture/range/paddock;
- anaerobic digester.

The manure management systems used in practice have changed in Latvia over the time. In the last decade of the 20th century, milk cows were mainly stanchioned, producing farmyard manure, whereas now there is a gradual transition producing liquid manure. Another novelty being observed in Latvia since 2007 is the production of biogas by partially using the manure of agricultural animals for this purpose. Detailed description of methodology of calculation of manure

[147] *2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.23, page 10.41*

management systems distributions is available at scientific publication *Calculation Methodology for Cattle Manure Management Systems Based on the 2006 IPCC Guidelines*[148].

Default methane conversion factor[149] MCF values for manure management systems: solid storage – 2%, liquid storage (with crust) – 10%, pasture/range/paddock – 1%; as well as methane producing capacities[150] B_0 (0.24 for dairy cows, 0.17 for other cattle and 0.45 for swine) are used in Latvia's National Greenhouse Gas Inventory 2017. In response to question raised by Technical expert review team (TERT) during European Union Effort sharing decision (EU ESD) voluntary review in 2015, the estimation of methane emissions from anaerobic digesters now consider MCF value 2%. For anaerobic digester 2006 IPCC Guidelines recommends MCF in the range from 0 to 100%. Based on available information and expert judgement from Latvian Biogas Association, it is assumed that anaerobic digestation completely is referred to energy production and storage of manure for a given period before transfer to the digester is not typical for Latvia. While national study proceeded, that was required from TERT, methane leakage around 2% from biogas production was implemented in the national inventory based on Swedish experience[151], however national studies approved Swedish research results. Currently, the publication of the national study is prepared and will be ready for the next submission.

In 2015, significant part of laying hens manure is used for biogas production. According to information provided above, methane emissions form laying hens estimated by Tier 1 are corrected by fallowing assumption:

$$CH_{4\ layer\ manure} = N_{(L)} \bullet EF_{(L)} \bullet \left(1 - MMS(anaerobic\ digester)\right) + N_{(L)} \bullet EF_{(L)} \bullet MMS(anaerobic\ digester) \bullet 2\%$$

where:
CH_4 layer manure = CH_4 emissions from manure management, for laying hens, kt CH_4 yr^{-1}
$N_{(L)}$ = the number of laying hens
$EF_{(L)}$ = emission factor for the laying hens population, kg CH_4 $head^{-1}$ yr^{-1}, Table 5.17
MMS (anaerobic digester) = share of manure digested

Daily volatile solid (VS) excretion rate (per day on a dry-matter weight basis) was estimated as represented in the 2006 IPCC Guidelines[152]:

$$VS = \left[GE \cdot \left(1 - \frac{DE\%}{100}\right) + (UE \cdot GE)\right] \cdot \left[\left(\frac{1 - ASH}{18.45}\right)\right]$$

where:
VS = volatile solid excretion per day on a dry-organic matter basis, kg VS day^{-1}
GE = gross energy intake, MJ day^{-1}
DE% = digestibility of the feed in percent (67% for dairy cows, 65% for other cattle, 80% for breeding swine and fattening pigs, 85% for piglets under 50 kg)
(UE • GE) = urinary energy expressed as fraction of GE (0.04•GE are considered as urinary energy)

[148] *http://www.vbf.llu.lv/getfile.php?id=2836*
[149] *2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.17, page 10.44*
[150] *2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10A-4, 10A-5, 10A-7, page 10.77-10.80*
[151] *Jonerholm K., Lundborg H. (2012) Methane losses in the biogas system. Available at http://www.balticbiogasbus.eu/web/Upload/Supply_of_biogas/Act_4_6/Annex/Methane%20losses.pdf*
[152] *2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 20.24, page 10.42*

ASH = the ash content of manure calculated as a fraction of the dry matter feed intake (0.08 for cattle and 0.02 for swine)
18.45 = conversion factor for dietary GE per kg of dry matter (MJ kg^{-1})

Results of calculation of the country specific methane emissions factors from manure management are included in Table 5.18.

Table 5.18 Daily volatile solid (VS) values and methane emission factors (EF) of manure management for cattle, 1990-2015

Year	Dairy cows		Growing cattle		Other mature cattle	
	VS (kg day^{-1})	EF (kg CH_4 $head^{-1}$ $year^{-1}$)	VS (kg day^{-1})	EF (kg CH_4 $head^{-1}$ $year^{-1}$)	VS (kg day^{-1})	EF (kg CH_4 $head^{-1}$ $year^{-1}$)
1990	4.70	6.39	1.56	1.09	2.97	1.59
1991	4.59	6.35	1.55	1.09	2.97	1.59
1992	4.38	6.19	1.51	1.12	2.97	1.59
1993	4.37	6.27	1.50	1.12	2.97	1.59
1994	4.49	6.55	1.52	1.11	2.98	1.59
1995	4.60	6.84	1.53	1.12	2.97	1.59
1996	4.71	7.21	1.51	1.12	2.97	1.59
1997	4.94	7.80	1.51	1.12	2.99	1.60
1998	5.02	8.14	1.51	1.13	2.92	1.56
1999	5.01	8.39	1.49	1.13	2.91	1.55
2000	5.14	8.90	1.48	1.11	2.87	1.53
2001	5.23	10.18	1.46	1.09	2.97	1.59
2002	5.17	10.26	1.48	1.12	3.00	1.60
2003	5.54	11.18	1.50	1.14	3.03	1.62
2004	5.37	11.04	1.47	1.11	3.09	1.65
2005	5.47	11.42	1.48	1.10	3.25	1.74
2006	5.57	11.95	1.49	1.14	3.28	1.75
2007	5.67	12.82	1.50	1.15	3.40	1.82
2008	5.77	13.72	1.49	1.15	3.21	1.72
2009	5.82	14.44	1.50	1.15	3.31	1.77
2010	5.61	13.44	1.51	1.15	3.38	1.80
2011	5.63	13.86	1.50	1.15	3.43	1.83
2012	5.72	13.21	1.52	1.15	3.49	1.86
2013	5.83	13.16	1.54	1.15	3.50	1.87
2014	5.91	14.29	1.53	1.13	3.55	1.89
2015	5.73	15.42	1.55	1.14	3.61	1.93

Country specific methane emissions factors for non-dairy cattle groups are lower than IPCC default emission factor, because the amount of manure stored in liquid/ slurry based systems for non-dairy cattle in Latvia is assumed to be zero, that is lower than IPCC default share (Table 5.18, Table 5.19).

Table 5.19 Daily volatile solid (VS) values and methane emission factors (EF) of manure management for non-dairy cattle sub-groups, 2015

Non-dairy cattle sub-groups		VS (kg day^{-1})	EF (kg CH_4 $head^{-1}$ $year^{-1}$)
Young cattle under 1 year	dairy cattle calves	1.13	0.96
	beef cattle calves	1.46	0.78
Young cattle aged from 1 to 2 years	dairy cattle	1.87	1.58
	beef cattle	2.40	1.28
Mature non-dairy cattle over 2 years	bulls	4.19	2.24

Non-dairy cattle sub-groups		VS (kg day^{-1})	EF (kg CH_4 head^{-1} year^{-1})
	heifers	2.47	1.32
	other cows	4.23	2.26
IPCC default[153]			6

As Tier 2 methodology to estimate methane emissions from manure management requires information of gross energy intake by swine, but enteric fermentation emission for swine was derived by Tier 1 methodology, the Estonian inventory[154] approach to calculate gross energy intake based on swine live weight and digestible energy was adopted:

$$GE = \frac{ME}{DE\%}$$

where:
GE = gross energy intake, MJ day^{-1}
DE% = digestible energy as percentage of gross energy, %
ME =2.0 x W = energy intake for maintenance and growth MJ day^{-1}
W = live weight of swine, kg

Feed digestibility data for swine are taken from 2006 IPCC Guidelines: 80% for breeding sows, boars, young breeding sows and fattening pigs (IPCC suggested range 70-80% for confinement mature swine) and 85% for piglets (IPCC suggested range 80-90% for confinement growing swine[155]).

Results of the calculation of methane emission from manure management for swine are presented in Table 5.20.

Table 5.20 Estimation parameters and emission factors (EF) of methane emission from manure management for swine, 1990-2015

Year	Weight (head^{-1} year^{-1})	GE (MJ day^{-1})	VS (kg day^{-1})	EF(kg CH_4 head^{-1} year^{-1})
1990	74.6	35.4	0.40	1.87
1991	73.6	35.1	0.39	1.89
1992	76.8	36.0	0.40	2.00
1993	85.7	38.6	0.44	2.22
1994	75.1	35.5	0.40	2.08
1995	80.2	36.8	0.41	2.23
1996	66.6	32.5	0.35	1.99
1997	70.6	33.5	0.37	2.13
1998	68.9	32.9	0.36	2.16
1999	70.1	33.7	0.37	2.32
2000	69.0	33.5	0.37	2.37
2001	68.6	33.2	0.37	2.49
2002	67.9	33.1	0.37	2.61
2003	67.9	33.1	0.36	2.74
2004	64.3	31.7	0.34	2.69
2005	65.0	31.9	0.35	2.83
2006	65.8	32.2	0.35	2.94
2007	66.9	32.5	0.36	3.06

[153] *2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.14, page 10.38*
[154] *Estonian NIR (2015). Available at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php*
[155] *2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.2, page 10.14*

Year	Weight ($head^{-1}$ $year^{-1}$)	GE (MJ day^{-1})	VS (kg day^{-1})	EF(kg CH_4 $head^{-1}$ $year^{-1}$)
2008	66.3	32.4	0.35	3.13
2009	65.0	31.8	0.35	3.13
2010	65.4	32.0	0.35	2.95
2011	64.5	31.6	0.34	2.91
2012	62.9	31.2	0.34	2.56
2013	62.5	31.1	0.34	2.40
2014	64.3	31.8	0.35	2.36
2015	64.9	32.2	0.35	2.63

Table 5.21 shows main methane emission calculation results for all swine sub-groups and default manure management methane emission coefficients recommended by IPCC for Western Europe. Swine weight data are based on the judgement of Latvia University of Agriculture and Latvian Pig Breeding Association experts. Estimated emission coefficients are lower than IPCC default mainly explained by different distribution of manure management systems.

Table 5.21 Typical animal weight, average gross energy (GE) intake, volatile solid (VS) values and emission factors (EF) for estimation of methane emission from manure management for swine sub-groups, 2015

Swine sub-groups	Number, (thousand heads)	Weight, ($head^{-1}$ $year^{-1}$)	GE, (MJ day^{-1})	VS, (kg day^{-1})	EF, (kg CH_4 $head^{-1}$ $year^{-1}$)
Piglets under 50 kg of weight (under 4 months)	153.9	27.5	19.0	0.17	1.27
Young breeding sows and fattening pigs	155.4	75.0	38.0	0.44	3.32
Mature breeding sows and boars	25.0	232	77.3	0.90	6.72
IPCC default[156]					6-9

2006 IPCC Guidelines methodology was used for estimating nitrous oxide emission 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. Direct nitrous oxide emissions (kg N_2O yr^{-1}) from manure management have been calculated by using 2006 IPCC Guidelines[157]:

$$N_2O_{D(mm)} = \left[\sum_S \left[\sum_T \left(N_{(T)} \cdot Nex_{(T)} \cdot MS_{(T,S)}\right)\right] \cdot EF_{3(S)}\right] \cdot \frac{44}{28}$$

where:

$N_2O_{D(mm)}$ = direct N_2O emissions from Manure Management in the country, kg N_2O yr^{-1}

$N_{(T)}$ = number of head of livestock species/category T in the country

$Nex_{(T)}$ = annual average N excretion per head of species/category T in the country, kg N $animal^{-1}$ yr^{-1}

$MS_{(T,S)}$ = fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system in the country, dimensionless

$EF_{3(S)}$ = emission factor for direct N_2O emissions from manure management system S in the country, kg N_2O-N kg^{-1} N in manure management system

S = manure management system

T = species/category of livestock

[156] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.14, page 10.38 (Western Europe)
[157] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 20.25, page 10.54

The amount of nitrogen excreted annually per animal has been divided among different manure management systems and multiplied with the IPCC default emission factor for each manure management system.

Following emission factors for direct nitrous oxide emissions from manure management were implemented: EF_3 = 0.005 for liquid manure/slurry with natural crust cover; EF_3 = 0.005 for solid storage; EF_3 = 0 for pasture/range/paddock; EF_3 = 0 for digester (2006 IPCC Guidelines[158]). Data about the distribution of MMS according to the national studies are available in Annex A.3.7 Agriculture. Nitrous oxide emissions from pasture are calculated under manure management, but are reported under category *Urine and dung deposited by grazing animals* in CRF 3.D.

Data of N excretion during the year per each livestock category used for the inventory are country specific and are obtained from national studies[159] or calculated fallowing by 2006 IPCC Guidelines. IPCC default annual average nitrogen excretion rate was used for rabbits and fur-bearing animals[160]. EMEP/EEA recommended N excretion value is used for turkeys[161]. N excretion rate for deer is adopted from Norwegian inventory[162] as average value represented for deer and reindeer. All N excretion values used in the inventory are represented in Table 5.22.

Table 5.22 Average N excretions per head of animal (N, kg year^{-1})

Livestock category	1990-2015	Source
Sheep	15.30	National studies
Goats	15.80	National studies
Horses	44.00	National studies
Layers	0.55	National studies
Broilers and others	0.35	National studies
Turkeys	1.64	EMEP/EEA 2013
Ducks	0.58	National studies
Geese	1.12	National studies
Rabbit	8.10	IPCC default
Fur – bearing animals	8.34	IPCC default
Deer	9.00	Norwegian NIR

Values about annual N excretion ($Nex_{(T)}$) per animal for dairy cattle and non-dairy cattle were calculated according to IPCC Tier 2 methodology[163]:

$$Nex_{(T)} = N_{intake} \cdot (1 - N_{retention})$$

where:

$Nex_{(T)}$ = annual N excretion rates, kg N animal^{-1} yr^{-1}

$N_{intake (T)}$ = the annual N intake per head of animal of species/category T, kg N animal^{-1} yr^{-1}

$N_{retention (T)}$ = fraction of annual N intake that is retained by animal of species/category T, dimensionless

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[158] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.21, page 10.62

[159] Fertiliser Recommendations for Agricultural Crops (2013) Ed.A. Karklins and A.Ruza. Jelgava: LLU, 55 p.

[160] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.19, page 10.59

[161] EMEP/EEA Air pollutant emission inventory guidebook (2013) 3.B Manure management. European Environment Agency. Table 3.7, page 27

[162] Norwegian NIR (2015) Available at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php

[163] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.31, page 10.58

The daily N intake per head of each cattle category is calculated as[164]:

$$N_{intake\,(T)} = \frac{GE}{18.45} \cdot \left(\frac{\frac{CP\%}{100}}{6.25} \right)$$

where:
$N_{intake\,(T)}$ = daily N consumed per animal of category T, kg N animal^{-1} day^{-1}
GE = gross energy intake of the animal, MJ animal^{-1} day^{1}
18.45 = conversion factor for dietary GE per kg of dry matter, MJ kg^{-1}
CP% = percent crude protein in diet, input
6.25 = conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg N^{-1})

The daily N retention per animal head of species/category is estimated as[165]:

$$N_{retention\,(T)} = \left[\frac{Milk \cdot \frac{(Milk\ PR\%)}{100}}{6.38} \right] + \left[\frac{WG \cdot \left[268 - \left(\frac{7.03\ NE_g}{WG} \right) \right]}{\frac{1000}{6.25}} \right]$$

where:
N retention(T) = daily N retained per animal of category T, kg N animal^{-1} day^{-1}
Milk = milk production, kg animal^{-1} day^{-1} (dairy cows only)
Milk PR% = percent of protein in milk, calculated as [1.9 + 0.4 • %Fat]
6.38 = conversion from milk protein to milk N, kg Protein (kg N)$^{-1}$
WG = weight gain, input for each livestock category, kg day^{-1}
268 and 7.03 = constants
Neg = net energy for growth, MJ day^{-1}
6.25 = conversion from kg dietary protein to kg dietary N, kgProtein (kg N)$^{-1}$

Crude protein (CP) values are adopted from national studies regarding to feeding requirements for cattle[166] based on milk yield and milk fat content data, CP=14% (1990-1995) and CP=15% is set for dairy cows. For other cattle CP values ranging from 9% to 14%.

Annual N excretion rate for swine is derived from the 2006 IPCC Guidelines methodology[167] by using typical animal mass (TAM) data:

$$Nex_{(T)} = N_{rate} \cdot \frac{TAM}{1000} \cdot 365$$

where:
$N_{ex\,(T)}$ = annual N excretion rates, kg N animal^{-1} yr^{-1}
$N_{rate\,(T)}$ = default N excretion rate, kg N (1000 kg mass)$^{-1}$ day^{-1}(Market swine=0.52, Breeding swine=0.42[168])
TAM = typical anima mass, kg livestock^{-1}

Calculated values of N excretion ($N_{ex(T)}$) per animal for dairy cattle, non-dairy cattle and swine for reporting in CRF are represented in Table 5.23.

[164] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.32, page 10.58
[165] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.33, page 10.60
[166] Latvietis J. (1994) Govju ēdināšanas normas. Jelgava: LLU, p.102
[167] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.30, page 10.57
[168] 2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.19, page 10.59

Table 5.23 N excretion rates for dairy, non-dairy cattle and swine, 1990-2015 (kg N animal^{-1} yr^{-1})

Year	Dairy cattle	Growing cattle	Other mature cattle	Swine
1990	85.8	20.1	58.6	12.3
1991	84.6	20.1	58.6	12.2
1992	82.2	19.9	58.6	12.5
1993	82.1	19.7	58.6	13.6
1994	83.5	19.8	58.6	12.3
1995	84.7	20.0	58.5	12.8
1996	93.8	19.8	58.6	11.0
1997	96.8	19.7	58.1	11.3
1998	97.8	19.8	56.3	11.1
1999	97.7	19.6	56.0	11.5
2000	99.6	19.5	55.0	11.5
2001	100.8	19.2	57.4	11.3
2002	100.0	19.5	56.9	11.3
2003	105.2	19.7	57.3	11.3
2004	102.7	19.3	57.9	10.6
2005	104.0	19.4	58.9	10.7
2006	105.5	19.5	59.1	10.8
2007	106.9	19.8	59.2	11.0
2008	108.3	19.7	58.4	11.0
2009	108.9	19.7	59.6	10.7
2010	106.6	19.8	60.1	10.7
2011	107.1	19.7	60.3	10.6
2012	108.2	19.8	61.0	10.5
2013	109.6	20.0	61.3	10.4
2014	110.5	19.9	61.5	10.7
2015	108.8	20.0	61.9	10.9

In the last submission, calculations of N excretion for cattle have been based on 2006 IPCC Guidelines methodology. Detailed information of estimated N excretion for cattle and swine sub-groups by IPCC methodology is represented in Table 5.24. During 2014-2017 Latvia made efforts to update country-specific N excretion values based on national research data, therefore in the 2017 inventory Latvia used country-specific data for nitrogen excretion from sheep, swine, horses, goats and poultry.

Table 5.24 N excretion rates (Nex) for nitrous oxide emissions estimation of non-dairy cattle and swine subgroups, 2015

Non-dairy cattle sub-groups		**Nex** (kg N animal^{-1} yr^{-1})
Young cattle under 1 year	dairy cattle calves	15.7
	beef cattle calves	18.5
Young cattle aged from 1 to 2 years	dairy cattle	24.7
	beef cattle	26.4
Mature non-dairy cattle over 2 years	bulls	93.9
	heifers	49.4
	other cows	65.9
Swine sub-groups		
Piglets under 50 kg of weight (under 4 months)		5.1
Young breeding sows and fattening pigs		14.0
Mature breeding sows and boars		27.6

The total quantity of excreted N by livestock among MMS implemented in Latvia and estimation results of managed manure N available for application to managed soils is summarized in Table 5.25.

Table 5.25 N excretion rates (Nex) per manure management system (MMS) and manure N available for application (N_{MMS_Avb}) to managed soils (kg N animal^{-1} yr^{-1})

Year	Solid storage	Liquid systems	Pasture range and paddock	Anaerobic digester	Toal Nex per MMS	N_{MMS_Avb}
1990	72829888	7404768	16360390	0	96595046	51980557
1991	70335581	7193480	15338287	0	92867348	50596449
1992	58350416	5968905	11555000	0	75874321	42731407
1993	40320049	4161823	6778612	0	51260485	29873877
1994	35352280	4084470	5731499	0	45168248	26352741
1995	34570841	4571694	5559145	0	44701680	25890389
1996	33191378	4265988	5501223	0	42958589	24859457
1997	30548472	4541011	5163737	0	40253220	22954130
1998	27934264	4606255	4614157	0	37154676	21201337
1999	24508754	4542169	3792926	0	32843849	18847726
2000	24590127	4848148	3761259	0	33199534	19189377
2001	25078359	6266392	3917741	0	35262491	20397752
2002	24720549	6675388	3718861	0	35114798	20368501
2003	23946899	6786124	3855478	0	34588501	19913099
2004	23088739	6782945	3801169	0	33672853	19436930
2005	22712181	7087773	4139005	0	33938959	19303728
2006	22875579	7381551	4092392	0	34349522	19618775
2007	22978459	8004449	4474793	0	35457701	20058775
2008	21593004	8088914	4496826	0	34178745	19232771
2009	20541078	8332127	4649446	20687	33543337	18609152
2010	19735947	7729066	4768306	1299746	33533066	17741801
2011	19265250	7823793	4877670	1610653	33577367	17595798
2012	19325346	6745609	5192530	3332466	34595950	17120691
2013	19072011	6476007	5648802	4435129	35631950	16810619
2014	19241354	6986285	6056884	4657942	36942464	17468320
2015	17926062	8032716	6192699	4068834	36220312	17123454
Share of total % in 2015	49.5%	22.2%	17.1%	11.2%	100.0%	
2015 versus 2014	-6.8%	+15.0%	+2.2%	-12.6%	-2.0%	-2.0%
2015 versus 1990	-75.4%	+8.5%	-62.1%	NA	-62.5%	-67.1%

As explained in 2006 IPCC Guidelines, nitrous oxide emissions calculation should be referred to Tier 2 methodology; if country specific data is included in the estimation (country specific N excretion rates constitute Tier 2 methodology)[169].

The indirect nitrous oxide emissions from volatilisation of N in forms of NH_3 and NOx from manure management are estimated as:

$$N_2O_{G(mm)} = (N_{volatilization-MMS} \bullet EF_4)$$

where:

$N_2O_{G(mm)}$ = indirect N_2O emissions due to volatilization of N from Manure Management in the country, kg N_2O yr^{-1}

$N_{volatilization-MMS}$ = amount of manure nitrogen that is lost due to volatilisation of NH_3 and NOx, kg N yr^{-1}

[169] 2006 IPCC Guidelines. Volume 4, Chapter 10, page 10.53

EF_4 = emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N_2O-N (kg NH_3-N + NOx-N volatilised)$^{-1}$; default value 0.01 kg N_2O-N (kg NH_3-N +NOx-N volatilised)$^{-1}$ is used

The indirect nitrous oxide emissions from leaching and runoff of N from manure management systems are estimated as:

$$N_2O_{L(mm)} = (N_{leaching-MMS} \bullet EF_5)$$

where:

$N_2O_{L(mm)}$ = indirect $_{N2O}$ emissions due to leaching and runoff from Manure Management in the country, kg N_2O yr^{-1}
$N_{leaching-MMS}$ = amount of manure nitrogen that leached from manure management systems, kg N yr^{-1}
EF_5 = emission factor for N_2O emissions from nitrogen leaching and runoff, kg N_2O-N/kg N leached and runoff (default value 0.0075 kg N_2O-N (kg N leaching/runoff)$^{-1}$

The amount of manure nitrogen that is lost due to volatilisation of NH_3 and NOx is assigned to Tier 2 approach to calculate N that is lost due to volatilisation of NH_3 and NOx from the livestock buildings and manure storage facilities is adopted from EMEP/EEA 2016[170].

Risks related to the agricultural point source pollution of surface waters by N leaching and run-off from manure storages can be consider as significant, because the number of farms with high livestock number (more than 250 animal units), especially from pig-breeding and poultry farming branches, increasing in last years; besides many of them are located in the Nitrate Vulnerable Zone with short distance to the water bodies of national importance. Results of long-term agricultural runoff monitoring show that in the catchment basin where the large livestock farms as potential point source pollution are located, the concentrations of nitrogenous compounds are characterized by large dispersion and high maximum concentrations. Based on the measures taken at the national level in order to reduce the pollution of surface waters caused by agricultural production, the long-term agricultural point source pollution monitoring observations indicate that concentrations of pollutants show negative trends, but are still should be taken into account[171]. Values of $Frac_{Leach}$ is based on expert judgment who are involved in national agricultural point source monitoring activities under Agricultural Runoff programme. In 1990-2004, $Frac_{Leach}$ is set to 10% by reducing the value to 1% for slurry storages and 5% to solid storages till 2015. The amount of manure N that is leached from manure management systems is derived from 2006 IPCC Guidelin*es*, Equation 10.28[172].

5.3.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The uncertainty of the manure management system usage data depends on the characteristics of each country's livestock industry and how information on manure management is collected. 2006 IPCC Guidelines show that for one type of management

[170] EMEP/EEA Air pollutant emission inventory guidebook. (2016) 3.B Manure management. European Environment Agency, page 18
[171] Berzina L. (2014) Analysis of Point Source Pollution from Agricultural Production Influence on Surface Water Quality in Highly Vulnerable Zones. Summary of the Thesis for Doctoral Degree in Engineering Sciences, Environmental Science branch, Environmental Engineering subbranch. 91 p.
[172] 2006 IPCC Guidelines. Volume 4, Chapter 10, Equation 10.28, page, 10.56

system, the uncertainty associated with management system usage data can be 10% or less. However, for countries where there is a wide variety of management systems, the uncertainty range in management system usage data can be much higher, in the range of 25% to 50%, depending on the availability of reliable and representative survey data that differentiates animal populations by system usage[173]. For Latvia uncertainty of 25% is set. The uncertainty range for the default emission factors is estimated to be 30%. Improvements achieved by Tier 2 methodologies are evaluated to reduce uncertainty ranges in the emission factors to +20%. IPCC expert judgment shows that uncertainty ranges for the default N excretion rates are estimated at about +50%[174]. Latvia uses country specific values, therefore uncertainty for N excretion rates are reduced to 25%.

5.3.4 Category-specific QA/QC and verification

Activity data check. The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. General QC procedures including quality checks related to calculations, data processing, completeness, and documentation were used during the inventory. Defined manure management systems in the inventory is consistent with definitions that are presented in 2006 IPCC Guidelines Table 10.18[175]. Latvia uses country specific methodology to determine distribution of manure management systems that is available in scientific literature[176].

Review of emission factors. Country-specific emission factors were compared with 2006 IPCC Gudelines defaults. Emission factors were chosen as for cool climate region by average annual temperature ≤10°C. Review results are presented in the chapter above.

Latvia uses country specific nitrogen excretion rates[177], according to the latest research results. Calculated and measured nitrogen excretion rates are compared with other countries inventory data and default factors. No significant differences were found for rates used for inventory that are within the range of values reported in other EU countries.

5.3.5 Category-specific recalculations

For 2017 submission, recalculations of emissions from manure management for period 1990-2015 are done based on implementation of revised approach to calculate manure management system distribution. Most of nitrogen excretion values are changed due to availability of national research results.

Recalculations of MMS are done according to outcomes of pre-defined project "Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections" under 2009 – 2014 EEA Grants Programme National Climate Policy. Main differences caused by implementation of new methodology to determine MMS should be tended to liquid manure system, which was found as no typical

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[173] *2006 IPCC Guidelines. Volume 4, Chapter 10, page 10.50*
[174] *2006 IPCC Guidelines.Volume 4, Chapter 10, page 10.66*
[175] *2006 IPCC Guidelines. Volume 4, Chapter 10, Table 10.18, page 10.49*
[176] *Priekulis J., Āboltiņš A. (2015) Calculation Methodology for Cattle Manure Management Systems Based on the 2006 IPCC Guidelines. Proceedings of the 25th NJF Congress Nordic View to Sustainable Rural Development. Riga, pp.274-280*
[177] *Fertiliser Recommendations for Agricultural Crops (2013) Ed.A. Karklins and A.Ruza. Jelgava:LLU, 55 p.*

for cattle in Latvia. Significantly, the share of pasture, range and paddock was reduced for all livestock groups, except beef cattle. Most of the large livestock farms refuse grazing to keep high productivity of animals and arrange resources in economically feasible way.

5.3.6 Category-specific planned improvements

Revision of MCF value for anaerobic digester.

5.4 AGRICULTURAL SOILS (CRF 3.D)

5.4.1 Category description

In the 2006 IPCC Guidelines, direct and indirect emissions of nitrous oxide from managed soils are estimated separately. The following N sources are included in the inventory for estimating direct nitrous oxide emissions from managed soils:

- synthetic N fertilizers (F_{SN});
- organic N fertilizers (e.g., animal manure, compost, sewage sludge, digestate) (F_{ON});
- urine and dung N deposited on pasture, range and paddock by grazing animals (F_{PRP});
- N in crop residues (above-ground and below-ground), including from N-fixing crops and from forages during pasture renewal (F_{CR});
- drainage/management of organic soils (F_{OS}).

Indirect nitrous oxide emissions from managed soils are determined for volatilization and leaching processes. Indirect nitrous oxide emissions included in the inventory are reported in Table 5.26.

Table 5.26 Reported emissions under the subcategory agricultural soils

CRF	Source	Emissions reported	Level
3.D 1.1	Inorganic N fertilizers	N_2O	Tier 1
3.D 1.2.a	Animal manure applied to soils	N_2O	Tier 1
3.D 1.2.b	Sewage sludge applied to soils	N_2O	Tier 1
3.D 1.2.c	Other organic fertilizer applied to soils	N_2O	Tier 1
3.D 1.3	Urine and dung deposited on soils	N_2O	Tier 1
3.D 1.4	Crop residues	N_2O	Tier 1
3.D 1.5	Mineralization/immobilization associated with loss/gain of soil organic matter	NO	NA
3.D 1.6	Cultivation of organic soils	N_2O	Tier 1
3.D 1.7	Other	NO	NA
3.D 2.1	Atmospheric deposition	N_2O	Tier 1
3.D 2.2	Nitrogen leaching and run-off	N_2O	Tier 1

The total nitrous oxide emission from managed soils reached 5.56 kt in 2015; which is 4.7% more than in 2014. In general, emission has decreased in 2015 by 27.5% comparing with 1990. The main reason for that was decreasing of all livestock numbers that affected the amount of nitrogen excreted annually to soil and low consumption of fertilizers. However, in 2015 nitrous oxide emission increased by 0.25 kt compared with 2014 (Table 5.27). The main reason of the increase of emission absolute number is the growing demand of synthetic fertilizers in the latest years.

In 2015, the total nitrous oxide emission from managed soils originated as 89.3% from direct sources. Indirect nitrous oxide emission from volatilization formed 3.6% and from leaching – 7.1% of the nitrous oxide total emission (Table 5.27).

Table 5.27 Nitrous oxide emissions from managed soils, 1990-2015 (kt)

Year	N_2O direct emission	N_2O indirect emission from atmospheric deposition	N_2O indirect emission from leaching and run-off	Total
1990	6.60	0.42	0.65	7.68
1991	6.21	0.38	0.59	7.18
1992	5.12	0.27	0.41	5.80
1993	4.30	0.18	0.28	4.76
1994	3.97	0.15	0.23	4.34
1995	3.61	0.12	0.17	3.89
1996	3.68	0.12	0.18	3.97
1997	3.72	0.12	0.19	4.03
1998	3.65	0.11	0.18	3.94
1999	3.52	0.10	0.16	3.78
2000	3.59	0.11	0.17	3.87
2001	3.77	0.13	0.21	4.11
2002	3.69	0.12	0.20	4.01
2003	3.82	0.14	0.22	4.17
2004	3.78	0.13	0.21	4.13
2005	3.93	0.14	0.24	4.30
2006	3.92	0.14	0.24	4.30
2007	4.05	0.15	0.26	4.47
2008	4.08	0.15	0.27	4.50
2009	4.17	0.16	0.28	4.61
2010	4.26	0.17	0.29	4.72
2011	4.28	0.17	0.29	4.74
2012	4.54	0.18	0.33	5.05
2013	4.61	0.19	0.34	5.14
2014	4.75	0.20	0.36	5.31
2015	4.97	0.20	0.40	5.56
Share of total % in 2015	89.3%	3.6%	7.1%	100.0%
2015 versus 2014	+4.5%	+1.4%	+9.3%	+4.7%
2015 versus 1990	-24.8%	-53.0%	-39.1%	-27.5%

In 2015, managed organic soils formed the major part of total direct emissions (51.8%), following by emission from synthetic fertilizers (24.0%), crop residues (14.5%), animal manure applied to soils (5.4%), urine and dung deposited on pasture (3.7%), and other organic N additions applied to soils (0.6%) (Table 5.28). Overall, nitrous oxide emissions from application of other organic fertilizer (except manure), pastures, crop residues and synthetic N fertilizer increasing most rapidly in last years. This could be explained by the fact of increased number of beef cattle grazing on pastures and expanding of sown area. The significant growth in harvested production was mainly affected by increase of the cereal crop area. According to CSB information, in 2015 the area of cereal cropland increase by 3% compared to 2014. Use of mineral fertilizer N per one ha of sown area still incresed from 63 kg in 2014 to 65 kg in 2015 and comprised in 49.8% of straight nitrogen mineral fertilizer amount applied to soils[178]. Increasing use of other organic fertilizers could be linked to expansion of anaerobic digestion of biomass and applying digestate to soil.

Table 5.28 Nitrous oxide emissions from N inputs to managed soils, 1990-2015 (kt)

Year	F_{SN}	F_{ON} (animal manure)	F_{ON} (sludge)	F_{ON} (other)	F_{PRP}	F_{CR}	F_{OS}
1990	2.06	0.82	NA	NA	0.50	0.64	2.57
1991	1.77	0.80	NA	NA	0.47	0.60	2.58
1992	1.04	0.67	NA	NA	0.35	0.48	2.58
1993	0.62	0.47	NA	NA	0.21	0.43	2.57
1994	0.46	0.41	NA	NA	0.17	0.35	2.57
1995	0.18	0.41	NA	NA	0.17	0.28	2.57
1996	0.23	0.39	NA	NA	0.17	0.33	2.56
1997	0.30	0.36	NA	NA	0.16	0.34	2.55
1998	0.31	0.33	NA	NA	0.14	0.32	2.54
1999	0.30	0.30	NA	NA	0.12	0.27	2.53
2000	0.36	0.30	NA	NA	0.11	0.28	2.52
2001	0.50	0.32	0.025	NA	0.12	0.29	2.51
2002	0.43	0.32	0.018	NA	0.11	0.30	2.50
2003	0.59	0.31	0.008	NA	0.12	0.29	2.50
2004	0.55	0.31	0.006	NA	0.12	0.32	2.49
2005	0.64	0.30	0.005	NA	0.13	0.37	2.48
2006	0.67	0.31	0.007	NA	0.12	0.34	2.47
2007	0.72	0.32	0.007	NA	0.14	0.41	2.46
2008	0.75	0.30	0.004	NA	0.14	0.44	2.45
2009	0.82	0.29	0.005	NA	0.14	0.44	2.47
2010	0.94	0.28	0.008	0.008	0.14	0.40	2.49
2011	0.94	0.28	0.007	0.004	0.15	0.40	2.51
2012	1.02	0.27	0.006	0.010	0.16	0.55	2.52
2013	1.10	0.26	0.006	0.022	0.17	0.52	2.54
2014	1.15	0.27	0.006	0.029	0.18	0.56	2.56
2015	1.19	0.27	0.004	0.025	0.19	0.72	2.57
Share of total % in 2015	24.0%	5.4%	0.1%	0.5%	3.7%	14.5%	51.8%
2015 versus 2014	+4.0%	-2.0%	-31.4%	-15.3%	+1.7%	+28.6%	+0.65%
2015 versus 1990	-42.3%	-67.1%	NA	NA	-63.1%	+11.7%	-0.01%

F_{SN} = synthetic N fertilizer, F_{ON} = organic N additions, F_{PRP} = urine and dang N deposited on pasture, F_{CR} = N in crop residues, F_{OS} = managed organic soil in grassland and cropland.

5.4.2 Methodological issues

For estimation of nitrous oxide emissions from managed soils the Tier 1 methodology was used. Direct nitrous oxide emissions from agricultural soils have been calculated using the following equation according to 2006 IPCC Guidelines[179] :

$$N_2O_{Direct} - N = N_2O - N_{N\,inputs} + N_2O - N_{OS} + N_2O - N_{PRP}$$

[178] *Agriculture in Latvia. Collection of statistical data. Central Statistical Bureau of Latvia, 2015*

[179] *2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.1, page 11.7*

where:

$$N_2O - N_{N\,inputs} = (F_{SN} + F_{ON} + F_{CR} + F_{SOM}) \cdot EF_1$$

$$N_2O - N_{OS} = (F_{OS,CG,Temp} \cdot EF_{2G,Temp})$$

$$N_2O - N_{PRP} = [(F_{PRP,CPP} \cdot EF_{3PRP,CPP}) + (F_{PRP,SO} \cdot EF_{3PRP,SO})]$$

where:
N_2O_{Direct} –N = annual direct N_2O–N emissions produced from managed soils, kg N_2O–N yr^{-1}
N_2O–$N_{N\,inputs}$ = annual direct N_2O–N emissions from N inputs to managed soils, kg N_2O–N yr^{-1}
N_2O–N_{OS} = annual direct N_2O–N emissions from managed organic soils, kg N_2O–N yr^{-1}
N_2O–N_{PRP} = annual direct N_2O–N emissions from urine and dung inputs to grazed soils, kg N_2O–N yr^{-1}
F_{SN} = annual amount of synthetic fertilizer N applied to soils, kg N yr^{-1}
F_{ON} = annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils, kg N yr^{-1}
F_{CR} = annual amount of N in crop residues (above-ground and below-ground), including N-fixing crops, and from forage/pasture renewal, returned to soils, kg N yr^{-1}
F_{SOM} = annual amount of N in mineral soils that is mineralised, in association with loss of soils C from soils organic matter as a result of changes to land use or management, kg N yr^{-1}
F_{OS} = annual area of managed/drained organic soils in grasslands and croplands, ha
F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock, kg N yr^{-1}
EF_1 = emission factor for N_2O emissions from N inputs, kg N_2O–N kg^{-1} N input
EF_2 = emission factor for N_2O emissions from drained/managed organic soils, kg N_2O–N ha^{-1} yr^{-1}
EF_{3PRP} = emission factor for N_2O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals, kg N_2O–N/kg N input

Inorganic N fertilizers: CRF 3.D 1.1

Annual amount of the synthetic fertilizer N is one of the parameters to estimate direct nitrous oxide emission from N inputs to managed soils. Data of inorganic fertilizer N applied to soils are provided by CSB of Latvia. Input values for direct nitrous oxide emission calculation from inorganic N fertilizers are represented in Table 5.34.

Organic N fertilizers: CRF 3.D 1.2

Amount of the organic N fertilizer (F_{ON}) applied to soils is calculated using methodology represented in 2006 IPCC Guidelines[180]. This includes applied to soils animal manure, sewage, compost, as well as other organic amendments of regional importance to agriculture:

$$F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}$$

where:
F_{ON} = total annual amount of organic N fertilizer applied to soils other than by grazing animals, kg N yr^{-1}
F_{AM} = annual amount of animal manure N applied to soils, kg N yr^{-1}
F_{SEW} = annual amount of total sewage N that is applied to soils, kg N yr^{-1}
F_{COMP} = annual amount of total compost N applied to soils, kg N yr^{-1}
F_{OOA} = annual amount of other organic amendments used as fertilizer, kg N yr^{-1}

Data on the amount of sewage sludge applied to managed soils are provided by LEGMC, other data of organic N fertilizer applied to soils are obtained from CSB. Application of sewage sludge as fertilizer is relatively small in Latvia. Amounts of sewage composts are not included in the calculations. Other organic amendments used as fertilizer mainly refer to

[180] 2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.3, page 11.12

digestate. Amount of nitrogen in sewage sludge, digestate and composts are calculated based on agriculture research results done by Latvia University of Agriculture scientists,[181] other research projects [182] and Latvia University of Agriculture expert judgement. Statistics of different types of organic N fertilizers applied to soils are limited in Latvia. Available data are represented in Table 5.29.

Table 5.29 Statistics of organic N fertilizers applied to soils, 2001-2015

Year	Sewage sludge applied to managed soils, t dry matter	Composts applied to managed soils, thousand t	Other organic N (digestate) applied to managed soils, thousand t
2001	30946.7	NA	NA
2002	22513.9	NA	NA
2003	9230.89	NA	NA
2004	7683.7	NA	NA
2005	6545.5	NA	NA
2006	8936.4	NA	NA
2007	8131.6	NA	NA
2008	5255.2	NA	NA
2009	6686.9	NA	NA
2010	9306.5	95.5	3.7
2011	8759.5	39.9	6.1
2012	7472.6	62.2	82.5
2013	7479.2	40.4	289.9
2014	6861.2	36.2	413.9
2015	4706	15.3	369.5
2015 versus 2014	-31.4%	-57.7%	-10.7%

Animal manure N (F_{AM}) emits from agricultural soil through manure application to fields as an organic fertilizer. Calculation of emissions from nitrogen input through application of animal manure is done according to 2006 IPCC Guidelines[183]:

$$F_{AM} = N_{MMS\,Avb} \cdot [1 - (Frac_{FEED} + Frac_{FUEL} + Frac_{CNST})]$$

where:

F_{AM} = annual amount of animal manure N applied to soils, kg N yr^{-1}

$N_{MMS\,Avb}$ = amount of managed manure N available for soil application, feed, fuel or construction, kg Nyr^{-1}

$Frac_{FEED}$ = fraction of managed manure used for feed

$Frac_{FUEL}$ = fraction of managed manure used for fuel

$Frac_{CNST}$ = fraction of managed manure used for construction

Total annual amount of the managed manure N available for soil application (F_{MMS_Avb}) is determined by 2006 IPCC Guidelines (Chapter 10.5.4) according to the directions of estimation of N lost from manure management systems to final application on managed soils. Calculation of F_{MMS_Avb} is done by fully adopted IPCC methodology (2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.34, p.10.65; fallowing by default values for total N loss from manure management represented in Table 10.23, p.10.67). There is no data available on the fraction of manure being used as feed, fuel or material of construction

[181] *Gemste I., Vucāns A. (2010) Notekūdeņu dūņas. Jelgava, LLU, 276 lpp.*

[182] *Litiņa I. (2013) Digestāta kā mēslošanas līdzekļa efektivitātes novērtējums kukurūzas sējumā. Zinātniski praktiskā konference LAUKSAIMNIECĪBAS ZINĀTNE VEIKSMĪGAI SAIMNIEKOŠANAI. Jelgava, LLU, 206-209 lpp.*

[183] *2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.4, page 11.13*

therefore F_{AM} is considered to be equal to N_{MMSAbv}. Total annual amount of managed manure N available for soil application is determined under CRF category 3B Manure management and is represented in Table 5.25.

Urine and dung deposited by grazing animals: CRF 3.D 1.3

The term F_{PRP} refers to the annual amount of N deposited on pasture, range and paddock soils by grazing animals. F_{PRP} is estimated using 2006 IPCC Guidelines from the number of animals in each livestock species/category $T(N_{(T)})$, the annual average amount of N excreted by each livestock species/category T ($Nex_{(T)}$), and the fraction of this N deposited on pasture, range and paddock soils by each livestock species/category T ($MS_{(T,PRP)}$)[184]:

$$F_{PRP} = \sum_{T} \left[\left(N_{(T)} \cdot Nex_{(T)} \right) \cdot MS_{(T,PRP)} \right]$$

Total annual amount of N deposited on pasture, range and paddock soils by grazing animals is determined under CRF category 3B Manure management and is represented in Table 5.25.

Total annual amount of N deposited on pasture, range and paddock soils separately for two groups: $F_{PRP,\ CPP}$ (cattle, poultry and swine) and $F_{PRP,\ SO}$ (other livestock), according to directions of nitrous oxide emissions estimation by IPCC is summarized in Table 5.34.

Crop residues: CRF 3.D 1.4

The annual production of the amount of crop residue N (F_{CR}) is estimated based on 2006 IPCC Guidelines Tier 1 methodology[185]:

$$F_{CR} = \sum_{T} \left\{ \begin{array}{c} Crop_{(T)} \cdot Frac_{Renew\,(T)} \cdot \\ \left[\left(Area_{(T)} - Area\ burnt_{(T)} \cdot C_f \right) \cdot R_{AG\,(T)} \cdot N_{AG(T)} \cdot \left(1 - Frac_{Remove\,(T)} \right) + Area_{(T)} \cdot R_{BG(T)} \cdot N_{BG(T)} \right] \end{array} \right\}$$

where:
F_{CR} = annual amount of N in crop residues (above and below ground), including N-fixing crops, and from forage/pasture renewal, returned to soils annually, kg N yr^{-1}
$Crop_{(T)}$ = harvested annual dry matter yield for crop T, kg d.m. ha^{-1}
$Area_{(T)}$ = total annual area harvested of crop T, ha yr^{-1}
Area burnt $_{(T)}$ = annual area of crop T burnt, ha yr^{-1}
C_f = combustion factor
$Frac_{Renew\,(T)}$ = fraction of total area under crop T
$R_{AG(T)}$ = ratio of above-ground residues dry matter to harvested yield for crop T
$N_{AG(T)}$ = N content of above-ground residues for crop T, kg N $(kg\ d.m.)^{-1}$
$Frac_{Remove(T)}$ = fraction of above-ground residues of crop T removed annually for purposes such as feed, bedding and construction, kg N $(kg\ crop\text{-}N)^{-1}$
$R_{BG(T)}$ = ratio of below-ground residues to harvested yield for crop T, kg d.m. $(kg\ d.m.)^{-1}$
$N_{BG(T)}$ = N content of below-ground residues for crop T, kg N $(kg\ d.m.)^{-1}$
T = crop or forage type.

Correction factor to estimate dry matter yields ($Crop_{(T)}$) is determined as[186]:

$$Crop_{(T)} = Yield\ Fresh_{(T)} \cdot DRY$$

[184] 2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.5, page 11.13
[185] 2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.6, page 11.14
[186] 2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.7, page 11.15

where:
$Crop_{(T)}$ = harvested dry matter yield for crop T, kg d.m. ha^{-1}
Yield $Fresh_{(T)}$ = harvested fresh yield for crop T, kg fresh weight ha^{-1}
DRY = dry matter fraction of harvested crop T, kg d.m. (kg fresh weight)$^{-1}$

Mainly default and international input data were used to estimate N that is returned to soils by crop residues, except data of crop production (area and yield) that originates from CSB Database. Dry matter fractions of harvested crop are collected as combination of IPCC default and national values, corrected by expert judgement (Table 5.30).

Table 5.30 Dry matter fraction (DRY) of harvested crop (kg fresh weight^{-1})

Crop	DRY
Wheat	0.86
Barley,	0.86
Triticale	0.86
Oats	0.86
Rye	0.86
Buckwheat	0.86
Pulses	0.91
Fodder roots	0.20
Potatoes	0.22
Vegetable	0.22
Maize for silage and forage	0.30
Crops for green feed and silage	0.17
Perennial grass	0.90
Rape	0.91
Flax	0.91

Calculations on annual amount of N in crop residues are done based on default factors represented in 2006 IPCC Guidelines[187].All data sources to calculate N that is returned to soil by crop residues are represented in Table 5.31.

Table 5.31 Data sources for estimation of N in crop residues

Input parameter	Data source
Crop harvested yield	Central Statistical Bureau
Crop harvested area	Central Statistical Bureau
Burnt crop area	NO
$Frac_{Renew}$	Expert judgement, IPCC default
$Frac_{Remove}$	Expert judgement, IPCC default
AG_{DM}	2006 IPCC, Table 11.2
N_{AG}	2006 IPCC, Table 11.2
R_{BG-BIO}	2006 IPCC, Table 11.2
N_{BG}	2006 IPCC, Table 11.2
R_{AG}	2006 IPCC, Page 11.4
R_{GB}	2006 IPCC, Page 11.4

There is no field burning of agricultural residues observed in Latvia and area burnt is set to zero. It is estimated by Latvia University of Agriculture expert that approximately 20% of above-ground residues of all main crops (wheat, outs, barley and rye) and 80% of rape are

[187] 2006 IPCC Guidelines. Volume 4, Chapter 11, Table 11.2, page 11.17

removed annually for purposes such as feeding, bedding and construction (Frac $_{Remove}$). No other data to estimate the fraction of above-ground residues of crop removed for purposes such as feed, bedding and construction is available. According to expert judgment, perennial grass is renewed on average every 4 years. For annual crops Frac $_{Renew}$ 1 was set, as also proposed in the 2006 IPCC Guidelines. Final results of estimation of annual amount of N in crop residues are available in Table 5.34.

Mineralization/immobilization associated with loss/gain of soil organic matter: CRF 3.D 1.5

Average annual loss of soils carbon due to land use or management systems change was obtained from LULUCF sector. The net annual amount of N mineralised in mineral soils as a result of loss soil carbon stock change due land use change is accounted under LULUCF sector and reported under activities listed in paragraph 3.3 of the Kyoto protocol (deforestation). The net annual amount of N mineralised in mineral soils as a result of loss soil carbon stock change due to management activities, including conversion of cropland to grassland, is assumed to be NO, because of the net removals of CO_2 in soil in cropland and grassland due to management activities.

Cultivation of organic soils: CRF 3.D 1.6

Data on annual area of managed organic soils are adopted from LULUCF sector and prepared by Latvian State Forest Research Institute *Silava.* Nitrous oxide emissions from cultivated organic soils have been calculated with the IPCC methodology by dividing the area into grassland and cropland and using emission factors from IPCC Wetlands Supplement[188] to reach consistent reporting of emissions with LULUCF sector. Tier 1 methodology[189] for calculations is used and emission coefficients are summarized in Table 5.33. The area of cultivated organic soils is shown in (Table 5.32).

Table 5.32 Area of cultivated organic soil, 1990-2015 (ha)

Year	Organic soil in cropland	Organic soil in grassland	Total
1990	95759.1	41348.7	137107.8
1991	95833.3	41350.0	137183.3
1992	95993.8	41141.7	137135.6
1993	96063.6	40947.5	137011.1
1994	96113.5	40877.8	136991.3
1995	96151.9	40591.2	136743.1
1996	95903.3	40274.9	136178.1
1997	95658.1	40020.5	135678.6
1998	95495.8	39639.5	135135.2
1999	95220.8	39446.7	134667.5
2000	95011.0	39100.9	134111.9
2001	94658.9	38778.8	133437.6
2002	94438.0	38452.3	132890.3
2003	94193.1	38300.5	132493.5
2004	93880.0	38016.1	131896.2
2005	93553.4	37856.4	131409.8

[188] *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Chapter 2, Table 2.5, page 2.33*

[189] *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Chapter 2, , page 2.31*

Year	Organic soil in cropland	Organic soil in grassland	Total
2006	93213.3	37870.3	131083.6
2007	92859.6	37907.8	130767.4
2008	92492.4	37846.0	130338.4
2009	92571.1	38881.0	131452.1
2010	92649.9	39920.5	132570.4
2011	92718.6	40964.5	133683.1
2012	92787.4	42013.1	134800.5
2013	92846.1	43066.4	135912.5
2014	92904.9	44119.5	137024.4
2015	92963.6	45158.9	138122.5
Share of total % in 2015	67.3%	32.7%	100.0%
2015 versus 2014	+0.1%	+2.4%	+0.8%
2015 versus 1990	-2.9%	+9.2%	+0.7%

Atmospheric deposition: CRF 3.D 2.1

The nitrous oxide emission from atmospheric deposition of N volatilised from managed soil is estimated using 2006 IPCC Guidelines[190]:

$$N_2O_{(ATD)} - N = \left[(F_{SN} \cdot Frac_{GASF}) + \left((F_{ON} + F_{PRP}) \cdot Frac_{GASM} \right) \right] \cdot EF_4$$

where:

$N_2O_{(ATD)}$-N = annual amount of N_2O–N produced from atmospheric deposition of N volatilised from managed soils, kg N_2O–N yr^{-1}

F_{SN} = annual amount of synthetic fertilizer N applied to soils, kg N yr^{-1}

$Frac_{GASF}$ = fraction of synthetic fertilizer N that volatilises as NH_3 and NOx, kg N volatilised (kg of N applied)$^{-1}$

F_{ON} = annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils, kg N yr^{-1}

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock, kg N yr^{-1}

$Frac_{GASM}$ = fraction of applied organic N fertilizer materials (F_{ON}) and of urine and dung N deposited by grazing animals (F_{PRP}) that volatilises as NH_3 and NOx, kg N volatilised (kg of N applied or deposited)$^{-1}$

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

Results of estimation are available in Table 5.27.

Nitrogen leaching and run-off: CRF 3.D 2.2

The nitrous oxide emission from nitrogen loss from agricultural soils through leaching and runoff is estimated as shown in 2006 IPCC Guidelines[191]:

$$N_2O_{(L)} - N = (F_{SN} + F_{ON} + F_{PRP} + F_{CR} + F_{SOM}) \cdot Frac_{LEACH-(H)} \cdot EF_5$$

where:

$N_2O_{(L)}$–N = annual amount of N_2O–N produced from leaching and runoff, kg N_2O–N yr^{-1}

F_{CR} = amount of N in crop residues (above- and below-ground), including N-fixing crops, and from forage/pasture renewal, kg N yr^{-1}

F_{SOM} = annual amount of N mineralised in mineral soils, kg N yr^{-1}

$Frac_{LEACH-(H)}$ = Fraction of N input that is lost through leaching and runoff, kg N (kg of N additions)$^{-1}$

EF_5 = emission factor for N_2O emissions from N leaching and runoff, kg N_2O–N (kg N leached and runoff)$^{-1}$

[190] *2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.9, page 11.21*

[191] *2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.10, page 11.2*

The results of estimation of nitrous oxide emission from nitrogen loss from agricultural soils through leaching and runoff are available in Table 5.27. All emission coefficients and fractions for direct and indirect emissions estimation from managed soils are summarized in Table 5.33.

Table 5.33 Default emission, volatilization and leaching factors for direct and indirect nitrous oxide emissions calculation

Factor	Value	Uncertainty range
EF_1 for N additions from mineral fertilizers, organic amendments and crop residues [kg N_2O–N (kg N)$^{-1}$]	0.01	0.003 – 0.03
$EF_{2\ C}$, for boreal and temperate drained organic cropland soil (kgN_2O–N ha^{-1}) $EF_{2\ G}$, for boreal drained organic grassland soils (kgN_2O–N ha^{-1})	13 9.5	8.2 – 18 4.6 – 14
$EF_{3PRP,\ CPP}$ for cattle (dairy, non dairy), poultry and pigs [kg N_2O–N (kg N)$^{-1}$]	0.02	0.007 – 0.06
$EF_{3PRP,\ SO}$ for cattle (dairy, non dairy), poultry and pigs [kg N_2O–N (kg N)$^{-1}$]	0.01	0.003 – 0.03
EF_4 [N volatilization and re-deposition], kg N_2O–N [kg NH_3–N + NO_X–volatilized]	0.010	0.002 – 0.05
EF_5 (leaching/runoff), kg N_2O–N [kg N leaching/runoff]	0.0075	0.0005 -0.025
$Frac_{GASF}$ (Volatilization from synthetic fertilizer), (kg NH_3–N + NOx–N) [kg N applied]$^{-1}$	0.10	0.03 – 0.3
$Frac_{GASM}$ (Volatilization from all organic N fertilizers applied , and dung and urine deposited by grazing animals), [kg NH_3–N + NOx–N] [kg N applied or deposited]$^{-1}$	0.20	0.05 – 0.5
$Frac_{LEACH-(H)}$, N losses by leaching/runoff [kg N]	0.23	0.18 – 0.27

Summary of input variables for direct nitrous oxide emission estimation according to methodology explained above are provided in Table 5.34.

Table 5.34 Input values for direct nitrous oxide emission calculations from managed soils, 1990-2015

Year	F_{SN}	F_{ON}	$F_{PRP,\ CPP}$	$F_{PRP,\ SO}$	F_{CR}
1990	131400	51980.6	15669.1	691.3	40928.7
1991	112400	50596.4	14588.5	749.8	38433.1
1992	66000	42731.4	10873.9	681.1	30645.6
1993	39700	29873.9	6272.1	506.5	27199.7
1994	29000	26352.7	5309.6	421.9	22507.7
1995	11500	25890.4	5178.3	380.8	18105.4
1996	14500	24859.5	5182.0	319.2	21044.7
1997	19400	22954.1	4903.6	260.1	21951.3
1998	19600	21201.3	4394.2	219.9	20557.9
1999	19000	18847.7	3599.4	193.5	17491.1
2000	23000	19189.4	3554.3	206.9	18015.4
2001	31600	22007.0	3709.1	208.6	18684.3
2002	27600	21539.2	3504.7	214.2	19368.7
2003	37500	20393.1	3628.6	226.9	18710.2
2004	35200	19836.5	3576.2	224.9	20167.8
2005	40900	19644.1	3911.9	227.1	23642.9
2006	42700	20083.5	3838.6	253.8	21656.5
2007	46100	20481.6	4179.9	294.9	26062.2

Year	F_{SN}	F_{ON}	$F_{PRP, CPP}$	$F_{PRP, SO}$	F_{CR}
2008	47500	19506.0	4146.8	350.0	27935.5
2009	51900	18956.9	4267.5	382.0	28268.4
2010	59500	18718.4	4370.7	397.6	25496.2
2011	59800	18275.8	4455.4	422.3	25610.2
2012	65200	18158.1	4763.2	429.4	34762.9
2013	69700	18588.7	5198.0	450.8	32927.3
2014	72900	19701.0	5570.0	486.9	35545.9
2015	75800	18957.8	5630.4	562.3	45729.5
2015 versus 2014	+4.0%	-3.8%	+1.1%	+15.5%	+28.6%
2015 versus 1990	-42.3%	-63.5%	-64.1%	-18.7%	11.7%

F_{SN} = annual amount of synthetic fertilizer N applied to soils, t N yr^{-1}
F_{ON} = annual amount of organic N fertilizer applied to soils, t N yr^{-1}
$F_{PRP\ CPP}$ = annual amount of urine and dung N deposited by grazing cattle, swine and poultry on pasture, t N yr^{-1}
$F_{PRP\ SO}$ = annual amount of urine and dung N deposited by grazing other animals on pasture, t N yr^{-1}
F_{CR} = annual amount of N in crop residues (above and below ground), including N-fixing crops, t N yr^{-1}

5.4.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The uncertainty of activity data is set to 2%. The uncertainty of the default emission factors reaches +50% according to 2006 IPCC Guidelines.

5.4.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the agriculture sector in order to achieve quality objectives. Quality meetings are held annually between experts. A complete coverage of the direct and indirect nitrous oxide emissions from managed land requires estimation of emissions for all anthropogenic inputs and activities (F_{SN}, F_{ON}, F_{CR}, F_{PRP}, F_{SOM} and F_{OS}), that is done in the inventory. N excretion data are consistent with those used for the manure management systems source category. National crop production and synthetic fertilizer consumption statistics is compared with FAO. CSB of Latvia shows efforts to reduce differences between national statistics and FAO data. All calculations mostly are done according to Tier 1. Fluctuations in time series should be explained by fluctuations of statistical data, showing that agricultural production numbers in Latvia are highly variable. As production levels are strongly associated with support of famers from state, situation on agriculture products market, agricultural products price changes, local demand of agricultural products and other.

5.4.5 Category-specific recalculations

Recalculations are done due to the implementation of new emission coefficient for nitrous oxide emission estimation from organic soils and including updated information about organic soil areas (2009-2015) in the inventory.

Recalculations included in the inventory for submission 2017:

1) implementation of new methodology to determine the share of grazing animals;
2) implementation of country specific value of $Frac_{LEACH-(H)}$ or N losses by leaching/runoff;
3) updated values of N in sewage sludge, digestate and animal manure applied to soils.

5.4.6 Category-specific planned improvements

Future development of the country specific value for $FRAC_{GASM}$ is planned to estimate N losses by volatilization.

5.5 FIELD BURNING OF AGRICULTURAL RESIDUES (CRF 3.F)

Notation key – NO is used for reporting field burning of agricultural residues in Latvia. 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.

5.6 LIMING (CRF 3.G)

Liming is used to reduce soil acidity and improve plant growth in managed systems, particularly agricultural lands and managed forests. Adding carbonates to soils in the form of lime (e.g., calcic limestone ($CaCO_3$), or dolomite (CA $Mg(CO_3)_2$) leads to CO_2 emissions as the carbonate limes dissolve and release bicarbonate ($2HCO_3^-$), which evolves into CO_2 and water (H_2O). CO_2 emission from additions of carbonate limes to soils are estimated using Tier 1 methodology with the formula from 2006 IPCC Guidelines[192]:

$$CO_2 - C\ Emission = (M_{Limestone} \cdot EF_{Limestone}) + (M_{Dolomite} \cdot EF_{Dolomite})$$

where:
CO_2–C Emission = annual C emissions from lime application, tonnes C yr^{-1}
M = annual amount of calcic limestone ($CaCO_3$) or dolomite (CA $Mg(CO_3)_2$), tonnes yr^{-1}
EF = emission factor, tonne of C (tonne of limestone or dolomite) $^{-1}$

IPCC default emission factors EF=0.12 for limestone and EF=0.13 for dolomite are used for inventory purposes. The uncertainty of them is 50%. Statistical data in Latvia provides information on overall consumption of liming material. Amount of used lime and dolomite is estimate based on expert judgement, based on assumption that both liming materials limestone and dolomite are intensively used in Latvia create share of consumption 50:50. Activity data and calculated emissions are represented in Table 5.35.

Table 5.35 Consumed lime and calculated CO_2 emissions, 1990-2015

Year	Annual amount of consumed liming material (t $year^{-1}$)	CO_2 emissions (kt)
1990	779200	357.1
1991	486700	223.1
1992	70600	32.4
1993	3500	1.6
1994	1600	0.7
1995	2700	1.2

[192] 2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.12, page 11.27

Year	Annual amount of consumed liming material (t year^{-1})	CO_2 emissions (kt)
1996	1400	0.6
1997	400	0.2
1998	4700	2.2
1999	4900	2.2
2000	10200	4.7
2001	700	0.3
2002	32900	15.1
2003	53800	24.7
2004	2200	1.0
2005	3300	1.5
2006	3000	1.4
2007	10700	4.9
2008	6000	2.8
2009	8700	4.0
2010	4300	2.0
2011	17400	8.0
2012	21600	9.9
2013	28900	13.2
2014	41300	18.9
2015	43500	19.9
2015 versus 2014	+5.3%	+5.3%
2015 versus 1990	-94.4%	-94.4%

Latvian agricultural land has a tendency to acidification of soil**.** According to information provided by State Plant Protection Service, 53.5% of agricultural land required for liming to neutralize the soil acidity. Since 1992, soil liming has to be characterized as insufficient. However, liming activities rapidly increase in the last 5 years.

5.7 UREA APPLICATION (CRF 3.H)

CO_2 emission from urea fertilization is estimated with the following equation from 2006 IPCC Guidelines[193]:

$$CO_2 - C\ Emission = M \cdot EF$$

where:
CO_2–C Emission = annual C emissions from urea application, tonnes C yr^{-1}
M = annual amount of urea fertilization, tonnes urea yr^{-1}
EF = emission factor, tonne of C (tonnes of urea)$^{-1}$

Emission factor (EF) of 0.20 for urea application emissions is used for calculations. The default 50% of uncertainty is applied, activity data uncertainty is evaluated as 2%. CSB of Latvia data of urea application is available from 2007. FAO data for 2002 and 2003 is also available. Data for all other years are derived by extrapolation of available statistical values. Table 5.36 represents activity data and estimated CO_2 emissions from urea fertilization.

[193] *2006 IPCC Guidelines. Volume 4, Chapter 11, Equation 11.13, page 11.32*

Table 5.36 Urea statistics and calculated CO_2 emissions, 1990-2015

Year	Annual amount of urea fertilization (tonnes yr^{-1})	CO_2 emissions (kt)
1990	10512	7.71
1991	8992	6.59
1992	5280	3.87
1993	3176	2.33
1994	2320	1.70
1995	920	0.67
1996	1160	0.85
1997	1552	1.14
1998	1568	1.15
1999	1520	1.11
2000	1840	1.35
2001	2528	1.85
2002	6078	4.46
2003	1942	1.42
2004	1943	1.42
2005	1944	1.43
2006	1945	1.43
2007	1946	1.43
2008	4323	3.17
2009	5930	4.35
2010	5459	4.00
2011	5798	4.25
2012	7901	5.79
2013	5558	4.08
2014	6445	4.73
2015	8468	6.21
2015 versus 2014	+31.4%	+31.4%
2015 versus 1990	-19.4%	-19.4%

5.8 OTHER CARBON-CONTAINING FERTILIZERS (CRF 3.I)

There is no data on other carbon-containing fertilizers use in Latvia. Notation key – NO is used.

5.9 OTHER (CRF 3J)

There is no information on other sources in Latvia. Notation key – NO is used.

6 LAND-USE, LAND-USE CHANGE AND FORESTRY (CRF 4)

6.1 OVERVIEW OF SECTOR

Since 2010 Land Use, Land Use Change and Forestry (LULUCF) sector is a net source of GHG emissions due to continuously high GHG emissions from organic soils in cropland, forest land and grassland and due to decrease of the net CO_2 removals in living biomass in forest land. In 2015 total emissions of aggregated GHG (CO_2, CH_4 and N_2O) in LULUCF sector were 1377.15 kt CO_2 eq (Figure 6.1, Table 6.1, Table 6.2). Aggregated net removals of the GHG reduced by 116 % in 2015 in comparison to 1990 mostly due to increase of harvest rate in mature forests, however considerable role in the increase of the GHG emissions has conversion of forest land to settlements, as well as conversion of recently afforested lands to cropland and grassland.

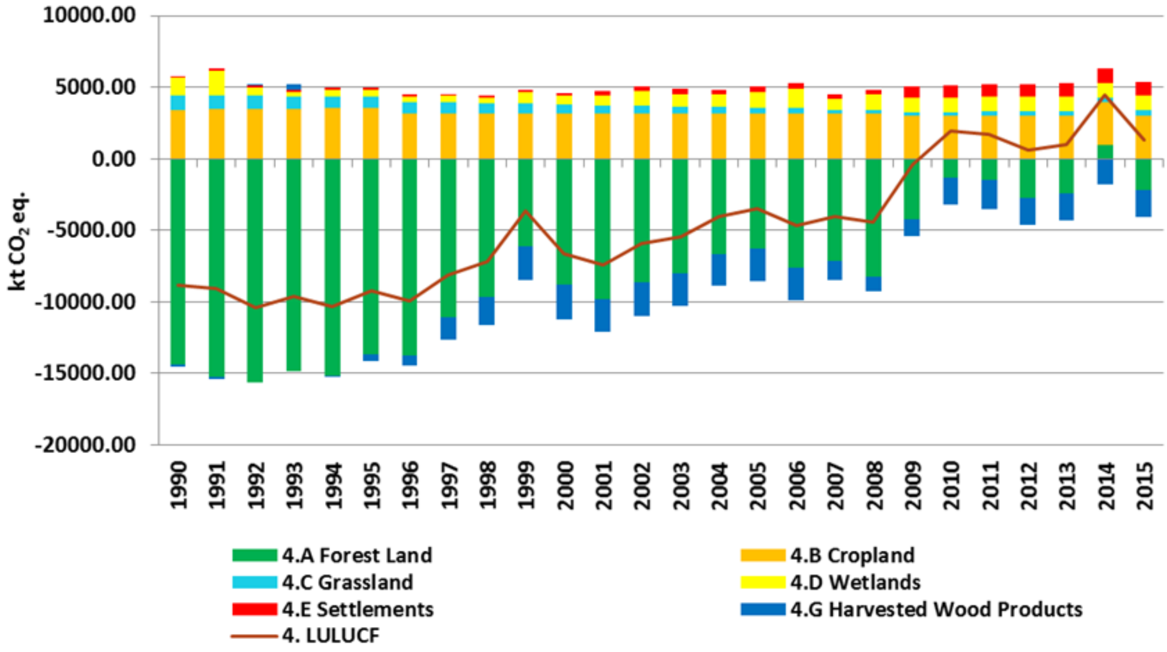

Figure 6.1 Summary of net emissions (positive sign) and removals (negative sign) in the LULUCF sector by land-use category and harvested wood products (kt CO_2 eq.)

According to the 2006 IPCC Guidelines land area is divided into six land-use categories (Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land). In Latvia, LULUCF sector comprises emissions and removals arising from Forest Land, Cropland, Grassland, Wetlands and Settlements divided into the subcategories "lands remaining in the same land-use category for the last 20 years" and "lands converted to present land use during the past 20 years". Other land is considered as unmanaged land and does not contain considerable amount of organic carbon and the emissions and removals are not reported. Emissions and removals from harvested wood products (HWP) are included in the LULUCF estimates.

Summary of net emissions and removals in the LULUCF sector by land-use category and harvested wood products is shown in Table 6.1. Decrease of CO_2 removals in living biomass in forest land and cropland is associated with increase of the harvesting rate, increase of mortality and reduction of increment of living biomass in forest land.

Table 6.1 Summary of net emissions and removals in the LULUCF sector by land-use category and harvested wood products (positive figures indicate emissions, negative removals) (kt CO_2 eq.)

Category	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
4. LULUCF	-8787.09	-9179.82	-6695.18	-3472.09	2018.88	1782.15	639.83	1091.99	4343.32	1377.15
4.A Forest Land	-14391.49	-13711.60	-8811.04	-6299.67	-1362.05	-1448.23	-2757.23	-2429.86	929.94	-2229.64
living biomass	-19460.67	-17269.11	-10885.95	-8280.24	-3704.01	-4354.55	-6911.86	-5006.83	-1252.98	-5354.31
dead wood	76.58	-1514.17	-3232.80	-2859.26	-2709.06	-2270.92	-1144.21	-2853.35	-3273.18	-2321.54
litter	-1.38	-15.78	-36.01	-56.07	-67.25	-68.40	-69.55	-70.70	-71.84	-73.07
organic soils	4749.10	4747.47	4772.36	4775.73	5038.67	5169.48	5300.30	5431.12	5441.74	5434.34
biomass burning	244.88	339.99	571.35	120.16	79.60	76.15	68.10	69.90	86.20	84.94
4.B Cropland	3424.28	3540.20	3197.23	3150.99	3030.02	3028.93	3027.90	3026.06	3023.48	3020.71
living biomass	376.20	439.05	195.81	182.93	108.13	108.60	109.33	110.24	109.50	108.03
dead organic matter	141.63	147.22	67.37	65.39	40.71	41.45	41.99	41.79	42.50	43.75
mineral soils	6.94	41.61	55.91	68.35	73.97	69.62	65.27	60.97	56.67	52.37
organic soils	2898.92	2908.78	2873.38	2828.50	2800.92	2803.33	2805.75	2807.87	2809.99	2812.10
4(III) N mineralization	0.59	3.54	4.76	5.82	6.30	5.93	5.56	5.19	4.83	4.46
4.C Grassland	970.88	812.18	613.81	405.83	240.70	265.20	290.14	313.32	339.31	364.37
living biomass	-19.65	-21.15	-22.64	-22.21	-50.46	-50.46	-44.91	-42.53	-43.69	-48.37
dead organic matter	-4.39	-3.70	-2.84	-1.82	-7.77	-7.25	-5.17	-8.87	-8.71	-4.94
mineral soils	0.00	-139.67	-301.88	-481.31	-603.80	-575.52	-554.10	-525.47	-495.26	-464.13
organic soils	994.82	976.60	940.74	910.80	902.26	898.12	893.97	889.83	885.69	881.21
biomass burning	0.10	0.10	0.42	0.38	0.47	0.30	0.35	0.35	1.27	0.61
4.D Wetlands	1245.40	424.83	582.67	1118.05	1017.71	1019.52	987.53	1031.89	1010.93	1012.05
living biomass	-66.91	-93.59	-101.64	-100.07	-185.21	-185.21	-173.36	-164.56	-168.37	-185.15
dead organic matter	-14.14	-16.03	-12.57	-8.29	-23.74	-21.98	-17.16	-30.49	-29.97	-16.32
organic soils	1326.46	534.45	696.88	1226.41	1226.66	1226.71	1178.04	1226.94	1209.27	1213.52
4.E Settlements	113.51	157.03	157.10	372.13	818.03	856.26	904.30	936.67	966.04	994.71
living biomass	69.62	80.61	59.18	182.26	430.02	432.25	444.16	447.74	442.55	431.68
dead organic matter	37.81	39.96	36.22	81.81	184.69	188.47	192.70	189.92	192.90	200.84
mineral soils	1.40	8.40	13.90	24.32	51.64	61.55	71.49	81.46	91.44	101.41
organic soils	3.77	22.59	38.53	67.49	119.84	136.64	153.16	169.38	185.61	201.84
4(III) N mineralization	0.91	5.46	9.28	16.25	31.84	37.34	42.78	48.17	53.55	58.94
4.G Harvested Wood Products	-149.83	-403.42	-2436.27	-2221.21	-1728.84	-1942.23	-1815.68	-1789.15	-1929.40	-1788.02

Table 6.2 Summary of net emissions and removals in the LULUCF sector by different gases (positive figures indicate emissions, negative removals)

Emissions, unit	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Total emissions, kt CO_2 eq.	-8787.09	-9179.82	-6695.18	-3472.09	2018.88	1782.15	639.83	1091.99	4343.32	1377.15
CO_2 kt	-9666.63	-1077.51	-7630.18	-4351.83	1066.72	798.57	-377.18	38.41	3262.45	295.98
CH_4 kt	12.15	12.50	13.51	11.20	12.34	12.86	13.45	14.16	15.04	14.91
N_2O kt	1.93	1.96	2.00	2.01	2.16	2.22	2.28	2.35	2.37	2.38
NO_x kt	0.18	0.26	0.48	0.10	0.09	0.07	0.06	0.08	0.16	0.11
CO kt	12.33	18.22	33.58	6.38	5.91	4.41	3.87	4.78	8.86	7.06

The definitions of carbon pools are as follows:

- Living biomass consist of above-ground biomass (all biomass of living vegetation, both woody and herbaceous, above the soil including stems, stumps, branches, bark, seeds, and foliage and below-ground biomass (all biomass of live roots and stump, fine roots of less than 2 mm diameter are excluded because these often cannot be distinguished empirically from soil organic matter or litter). Forest understory is a relatively small component of the above-ground biomass carbon pool and it is excluded from calculation in the inventory time series.
- Dead wood consists of all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots down to a diameter of 2 mm, and stumps. Litter includes all non-living biomass with a size greater than the limit for soil organic matter (2 mm) and less than the minimum diameter chosen for dead wood (bottom diameter above 6 cm), lying dead, in various states of decomposition above or within the mineral or organic soil. This includes the litter layer as usually defined in soil typologies. Live fine roots above the mineral or organic soil (wit diameter less than 2 mm) are included in litter where they cannot be distinguished from it empirically.
- Soil carbon is organic carbon in mineral and organic soils (including peat) to a 30 cm depth. Live fine roots of less than 2 mm are included with soil organic matter.

The LULUCF 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 continuous increase of growing stock in forests since beginning of 20th century (from 101 m^3 ha^{-1} in 1935 to 172 m^3 ha^{-1} in 2010 and 209 m^3 ha^{-1} in 2014)[194]. According to data provided by NFI total forest area (including afforested lands) in 2015 was 3298.36 kha (51 % of total country area). Total area of land converted to forest from 1990 to 2015 is 174.15 kha. Twenty years transition period is considered for land use changes, therefore area of forest land remaining forest land is increasing during recent years, but area of lands converted to forest is decreasing, because area converted to forest until 1995 (including) is now accounted as 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 2015 is calculated using the extrapolation method, assuming that conversion of forest land to cropland and to settlements, as well as conversion of other land use categories follows to a linear regression based on data from 1990 to 2009.

Overview of calculation methods and types of emission factors for the LULUCF sector is shown in Table 6.3. 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, biomass expansion factors (BEFs), carbon stock in biomass, as well as the land use information. Calculations were done by Latvian State Forest Research Institute "Silava" (LSFRI Silava) with support of Ministry of Agriculture of Republic of Latvia (MoA).

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[194] *https://www.zm.gov.lv/public/ck/files/ZM/mezhi/buklets/MN_20_EN.pdf and NFI data (http://www.silava.lv/userfiles/file/Meza%20statistiska%20inventarizacija/Kopsavilkumi%202014%20II%20cikls%204gadi.xlsx)*

Emissions from organic soil (cropland, grassland, forest land), controlled burning (forest land) and wildfires (forest land and grassland) were estimated using Tier 1 and Tier 2 methods and country specific activity data.

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[195].

Table 6.3 Overview of methods and emission factors used in calculations of GHG emissions from the LULUCF sector

CRF	Source	CO_2		CH_4		N_2O	
		Methods	EF	Methods	EF	Methods	EF
4.A	**Forest land**						
4.A.1	Forest Land Remaining Forest Land	Tier 1, Tier 2	CS, D	Tier 1, Tier 2	D	Tier 1, Tier 2	D
4.A.2	Land Converted to Forest Land	Tier 2	CS	-	-	-	-
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	Tier 1	D	Tier 1	D	Tier 1	D
4.B	**Cropland**						
4.B.1	Cropland Remaining Cropland	Tier 1, Tier 2	CS, D	-	-	-	-
4.B.2	Land Converted to Cropland	Tier 2	CS	-	-	Tier 1	D
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	-	-	Tier 1	D	-	-
4.C	**Grassland**						
4.C.1	Grassland Remaining Grassland	Tier 2	CS	Tier 1	D	Tier 1	D
4.C.2	Land Converted to Grassland	Tier 1, Tier 2	CS, D	-	-	-	-
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	-	-	Tier 1	D	-	-
4.D	**Wetland**						
4.D.1	Wetlands Remaining Wetlands	Tier 1, Tier 2	CS, D	-	-	-	-
4.D.2	4.D.2 Land Converted to Wetlands	-	-	-	-	-	-
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	Tier 2	CS	Tier 1	D	Tier 1	D
4.E	**Settlements**						
4.E.1	Settlements Remaining Settlements	Tier 2	CS	-	-	Tier 1	D
4.E.2	Land Converted to Settlements	Tier 2	CS	-	-	Tier 1	D
4.G	**Harvested Wood Products**	Tier 2	CS	-	-	-	-

Emissions of GHG due to forest fires in LULUCF sector are calculated using data about areas of forest fires provided by the State forest service (SFS).

[195] *Lazdiņš A., Climate research program, middle-term report, 2012.*

This is the 4th year when Latvia reported HWP pool using methods which were obtained during elaboration of the Forest management reference level (FMRL) for 2013-2020.

Emissions from drained organic and mineral soils are calculated using default 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).

Knowledge about dynamics of dead wood in forest lands is insufficient, both in terms of mortality factors and decay periods, because forest management principles were significantly changed since 1990, for instance, in the 80ths 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 extraction of the residues for biofuel production becomes more common. Comparison of different sources of information about dead wood (NFI and reports to the Timber Committee) demonstrates constant increase of dead wood stock in forests during the last decade; however, it could be also result of several extreme weather 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[196]. Both, mortality and increment factors are continuously improved using newly available NFI and research data.

Emissions of CO_2 from drained organic soils are calculated using default emission factors of the IPCC Wetlands Supplement (2.6 tonnes C ha^{-1} annually in forest land, 7.9 tonnes C ha^{-1} in cropland, 6.1 tonnes C ha^{-1} in grassland and 2.8 tonnes C ha^{-1} in peatlands).

The key categories in LULUCF sector in 2015 in Latvia are summarised in Table 6.4. The most significant key category according to the level assessment (Approach 1) and trend assessment (Approach 1) relates to Forest land remaining forest land. HWP included into the inventory since 2013 is also a key category by level of net emissions.

Table 6.4 LULUCF key categories in 2017 submission

IPCC category/Group	Gas	Identification criteria
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	L1,L2,T1,T2
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	L1,L2,T1,T2
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	L1,L2,T1,T2
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	L1,L2,T1,T2
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L1,L2,T1,T2
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	L2,T1,T2
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	L1,L2,T2
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	L1,T1
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	L1,T1
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L1,L2,T2

[196] *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 model for estimation of GHG emissions and CO_2 removals due to forest management).*

IPCC category/Group	Gas	Identification criteria
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	L2,T2
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	L1,L2,T1,T2
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	T2
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	L1,L2,T1,T2
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	L1,L2,T1,T2
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L2
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	T2
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	L1,L2
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	L1,L2,T1,T2
4.C.2 Land converted to Grassland –Mineral soil	CO_2	L1,L2,T1,T2
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	L1,L2,T1,T2
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	L1,L2,T1,T2
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	L1,L2,T1,T2
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	L1,L2,T1,T2
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	L1,L2,T1,T2
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	L1,L2,T1,T2
4.E.2 Land converted to Settlements – Mineral soils	CO_2	L1,T1
4.E.2 Land converted to Settlements – Organic soils	CO_2	L1,L2,T1,T2
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	L2,T2
4. G. Harvested wood products	CO_2	L1,L2,T1,T2

The sector reporting was considerably updated during previous inventories by development of national GHG accounting and projection tool for LULUCF sector and implementation of results of several scientific studies. The most important improvements in this report are implementation of country specific biomass expansion factors according to the study by J. Liepiņš[197] and carbon content in wood according to the study by E. Muižnieks et al.[198.]

6.2 LAND-USE DEFINITIONS AND THE CLASSIFICATION SYSTEMS USED AND THEIR CORRESPONDENCE TO THE LULUCF CATEGORIES

For the GHG inventory, land area and inland water bodies are classified according to the 2006 IPCC Guidelines. Definitions of the IPCC land-use categories in the national GHG inventory is provided in Table 6.5.

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[197] Liepiņš, J., Lazdiņš, A., Liepiņš, K., 2015. Above- and below-ground biomass functions for four most commonn trees species in Latvia, in: Abstracts. Presented at the International Scientific Conference Knowledge based forest sector, Riga, Latvia, pp. 51–53.

Liepins, J., Liepins, K., Lazdins, A., 2015. Biomass equations for the most common tree species in Latvia. Presented at the Adaptation and mitigation: strategies for management of forest ecosystems, Airport hotel ABC, pp. 47–50.

Liepiņš, J., Liepiņš, K., Lazdiņš, A., 2016. Estimation of the biomass stock from growing stock volume, in: Collection of Abstracts. Presented at the 11th International Scientific Conference Students on Their Way to Science, Jelgava, p. 120.

[198] Muiznieks, E., Liepins, J., Lazdins, A., 2015. Carbon content in biomass of the most common tree species in Latvia. Presented at the Latvia University of Agriculture 10th International Scientific Conference „Students on their way to science", Jelgava.

Table 6.5 National application of IPCC land-use categories

IPCC category	National land use categories and definitions fits to IPCC categories
Forest land	Land of a minimum area 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. 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.
Cropland	Arable land, including orchards and extensively managed arable lands (ploughed at least once per 20 years). Animal feeding glades (periodically ploughed areas if forest used for wild animal feeding), which according to national land use classification belong to forest land.
Grassland	Pastures, glades and bush-land which do not fit to forest definition. Vegetated areas on non-forest lands complying to forest definition where land use type can be easily returned to grassland by cutting grass and small trees without legal requirement of transformation of the land use, but except grassland used in forage production and extensively managed cropland reported under cropland. Non-forest lands with average diameter of trees at the breast height less than 2 cm are reported under grassland's category.
Wetlands	All inland water bodies (rivers, ponds, lakes), swamps (constantly wet areas where height of trees cannot reach more than 5 m and ground vegetation consists mostly of sphagnum and different sword grasses), flood-lands (usually small areas suffering from exceeding water periodically); alluvial lands (larger glades and bush-lands suffering from exceeding water).
Settlements	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 including ditches and their management bands, as well as seed orchards, forest nurseries and fire-breaks, drainage systems in cropland and grassland, other infrastructure – buffer zones of industrial networks, quarries etc., but excluding peat extraction sites.
Other land	Dunes not covered by woody vegetation.

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) 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[199].

The decision support tree was elaborated in 2013 to simplify identification of land use changes in cropland, grassland and forest land using the NFI data analysis (Table 6.6). The identification of land use changes according to this approach takes 10 years. Considering that there are still some unsolved issues, like interpretation of merged sectors of the NFI plots 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.

[199] *Lazdiņš and Zariņš, Vēsturiskās (1990. Gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana (Estimation of area of managed croplands and change of cropland's area until 2009).*

Table 6.6 Decision support table to estimate conversion of grassland, cropland and forest land

<table>
<tr><th>First NFI 2004-2008</th><th>Second NFI 2009-2013</th><th>Third NFI 2014-2019</th><th>Fifth NFI 2020-2024</th></tr>
<tr><td rowspan="8">Initial land use – grassland</td><td rowspan="4">Whole plot or sector is ploughed – no land use change marked</td><td rowspan="2">Whole plot or sector is ploughed – ploughed area is marked as cropland since second NFI</td><td>Whole plot or sector is ploughed – the area remains cropland</td></tr>
<tr><td>No signs of ploughing – the area remains cropland</td></tr>
<tr><td rowspan="2">No signs of ploughing – the area remains grassland</td><td>Whole plot or sector is ploughed – the area remains grassland</td></tr>
<tr><td>No signs of ploughing – the area remains grassland</td></tr>
<tr><td rowspan="4">No signs of ploughing – the area remains grassland</td><td rowspan="2">Whole plot or sector is ploughed – the area remains grassland</td><td>Whole plot or sector is ploughed – ploughed area is marked as cropland since third NFI</td></tr>
<tr><td>No signs of ploughing – the area remains grassland</td></tr>
<tr><td rowspan="2">No signs of ploughing – the area remains grassland</td><td>Whole plot or sector is ploughed – the area remains grassland</td></tr>
<tr><td>No signs of ploughing – the area remains grassland</td></tr>
</table>

The areas of IPCC land-use categories and Latvia's official land area are given in Table 6.7.

Table 6.7 Areas of IPCC land-use classes in 1990-2015, 1000 ha[200]

Year	Total country area[201]	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
1990	6 457.30	3 124.22	1 842.24	798.24	238.82	448.35	5.44
1991	6 457.30	3 128.56	1 837.27	798.26	239.41	448.35	5.44
1992	6 457.30	3 135.28	1 833.98	794.24	240.01	448.35	5.44
1993	6 457.30	3 143.49	1 828.93	790.49	240.60	448.35	5.44
1994	6 457.30	3 149.67	1 823.50	789.15	241.19	448.35	5.44
1995	6 457.30	3 160.27	1 817.85	783.61	241.78	448.35	5.44
1996	6 457.30	3 173.39	1 810.36	777.51	242.26	448.35	5.44
1997	6 457.30	3 185.24	1 802.95	772.60	242.73	448.35	5.44
1998	6 457.30	3 197.95	1 797.12	765.24	243.20	448.35	5.44
1999	6 457.30	3 209.19	1 789.13	761.52	243.67	448.35	5.44
2000	6 457.30	3 222.13	1 782.39	754.84	244.15	448.35	5.44
2001	6 457.30	3 236.66	1 773.20	748.62	245.04	448.35	5.44
2002	6 457.30	3 248.73	1 766.53	742.32	245.92	448.35	5.44
2003	6 457.30	3 257.90	1 759.41	739.39	246.81	448.35	5.44
2004	6 457.30	3 270.95	1 750.97	733.90	247.70	448.35	5.44
2005	6 457.30	3 281.85	1 742.26	730.82	248.59	448.35	5.44
2006	6 457.30	3 289.65	1 733.30	731.09	249.48	448.35	5.44
2007	6 457.30	3 297.27	1 724.07	731.81	250.36	448.35	5.44
2008	6 457.30	3 307.06	1 714.58	730.62	251.25	448.35	5.44
2009	6 457.30	3 305.78	1 714.80	731.72	251.66	447.90	5.44
2010	6 457.30	3 304.50	1 715.02	732.82	252.08	447.44	5.44
2011	6 457.30	3 303.22	1 715.24	733.93	252.49	446.99	5.44
2012	6 457.30	3 301.94	1 715.45	735.03	252.90	446.54	5.44

[200] *Based on the NFI data.*
[201] *According to the CSB data.*

Year	Total country area[201]	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
2013	6 457.30	3 300.66	1 715.67	736.13	253.32	446.09	5.44
2014	6 457.30	3 299.38	1 715.89	737.23	253.73	445.63	5.44
2015	6 457.30	3 298.36	1 716.11	738.07	254.14	445.18	5.44

Area of organic soils in croplands and grasslands is updated according to the inventory of historical data about farmlands implemented in 2009[202]. Further improvements will be implemented in next submissions. Area of cropland and grassland in UNFCCC 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 6.9; summary – in Table 6.8.

Table 6.8 Summary of land use change matrix (1000 ha)

Changes	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
1990	**3124.22**	**1842.24**	**798.24**	**238.82**	**448.35**	**5.44**
From Forest land		21.84	9.02	25.67	10.98	0.00
From Cropland	2.04		146.65	2.46	0.00	0.00
From Grassland	214.54	0.00		16.12	7.15	0.00
From Settlements	10.63	3.03	14.82		1.76	0.00
From Wetland	14.44	0.15	7.16	1.31		0.00
From Other land	0.00	0.00	0.00	0.00	0.00	
2015	**3 298.36**	**1 716.11**	**738.07**	**254.14**	**445.18**	**5.44**

Table 6.9 Land use change matrix (1000 ha)

Changes	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
Land use change 1989-1990						
1989	3 122.06	1 840.33	802.90	238.23	448.35	5.43
From Forest land	1 840.33	1.91		0.59		
From Cropland	802.90		0.00			
From Grassland	238.23					
From Settlements	448.35					
From Wetland	4.32					
From Other land						
Land use change 1990-1991						
1990	3 124.22	1 842.24	798.24	238.82	448.35	5.44
From Forest land		1.91		0.59		
From Cropland			6.87			
From Grassland	6.85					
From Settlements						

[202] *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	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
From Wetland						
From Other land						
Land use change 1991-1992						
1991	3 128.56	1 837.27	798.26	239.41	448.35	5.44
From Forest land		1.91		0.59		
From Cropland			5.20			
From Grassland	9.22					
From Settlements						
From Wetland						
From Other land						
Land use change 1992-1993						
1992	3 135.28	1 833.98	794.24	240.01	448.35	5.44
From Forest land		1.91		0.59		
From Cropland			6.95			
From Grassland	10.70					
From Settlements						
From Wetland						
From Other land						
Land use change 1993-1994						
1993	3 143.49	1 828.93	790.49	240.60	448.35	5.44
From Forest land		1.91		0.59		
From Cropland			7.34			
From Grassland	8.68					
From Settlements						
From Wetland						
From Other land						
Land use change 1994-1995						
1994	3 149.67	1 823.50	789.15	241.19	448.35	5.44
From Forest land		1.91		0.59		
From Cropland			7.56			
From Grassland	13.09					
From Settlements						
From Wetland						
From Other land						
Land use change 1995-1996						
1995	3 160.27	1 817.85	783.61	241.78	448.35	5.44
From Forest land		0.79		0.47		
From Cropland			8.27			
From Grassland	14.38					
From Settlements						
From Wetland						
From Other land						
Land use change 1996-1997						
1996	3 173.39	1 810.36	777.51	242.26	448.35	5.44

Changes	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
From Forest land		0.79		0.47		
From Cropland			8.21			
From Grassland	13.12					
From Settlements						
From Wetland						
From Other land						
Land use change 1997-1998						
1997	3 185.24	1 802.95	772.60	242.73	448.35	5.44
From Forest land		0.79		0.47		
From Cropland			6.61			
From Grassland	13.96					
From Settlements						
From Wetland						
From Other land						
Land use change 1998-1999						
1998	3 197.95	1 797.12	765.24	243.20	448.35	5.44
From Forest land		0.79		0.47		
From Cropland			8.78			
From Grassland	12.50					
From Settlements						
From Wetland						
From Other land						
Land use change 1999-2000						
1999	3 209.19	1 789.13	761.52	243.67	448.35	5.44
From Forest land		0.79		0.47		
From Cropland			7.53			
From Grassland	14.20					
From Settlements						
From Wetland						
From Other land						
Land use change 2000-2001						
2000	3 222.13	1 782.39	754.84	244.15	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			9.89			
From Grassland	16.11					
From Settlements						
From Wetland						
From Other land						
Land use change 2001-2002						
2001	3 236.66	1 773.20	748.62	245.04	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			7.35			
From Grassland	13.66					

Changes	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
From Settlements						
From Wetland						
From Other land						
Land use change 2002-2003						
2002	3 248.73	1 766.53	742.32	245.92	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			7.82			
From Grassland	10.74					
From Settlements						
From Wetland						
From Other land						
Land use change 2003-2004						
2003	3 257.90	1 759.41	739.39	246.81	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			9.13			
From Grassland	14.62					
From Settlements						
From Wetland						
From Other land						
Land use change 2004-2005						
2004	3 270.95	1 750.97	733.90	247.70	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			9.39			
From Grassland	12.48					
From Settlements						
From Wetland						
From Other land						
Land use change 2005-2006						
2005	3 281.85	1 742.26	730.82	248.59	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			9.65			
From Grassland	9.39					
From Settlements						
From Wetland						
From Other land						
Land use change 2006-2007						
2006	3 289.65	1 733.30	731.09	249.48	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			9.92			
From Grassland	9.19					
From Settlements						
From Wetland						
From Other land						

Changes	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
Land use change 2007-2008						
2007	3 297.27	1 724.07	731.81	250.36	448.35	5.44
From Forest land		0.69		0.89		
From Cropland			10.18			
From Grassland	11.37					
From Settlements						
From Wetland						
From Other land						
Land use change 2008-2009						
2008	3 307.06	1 714.58	730.62	251.25	448.35	5.44
From Forest land		0.41	1.29	1.89	1.57	
From Cropland	0.29			0.35		
From Grassland				2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
Land use change 2009-2010						
2009	3 305.78	1 714.80	731.72	251.66	447.90	5.44
From Forest land		0.41	1.29	1.89	1.57	
From Cropland	0.29			0.35		
From Grassland				2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
Land use change 2010-2011						
2010	3 304.50	1 715.02	732.82	252.08	447.44	5.44
From Forest land		0.41	1.29	1.89	1.57	
From Cropland	0.29			0.35		
From Grassland				2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
Land use change 2011-2012						
2011	3 303.22	1 715.24	733.93	252.49	446.99	5.44
From Forest land		0.41	1.29	1.89	1.57	
From Cropland	0.29			0.35		
From Grassland				2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
Land use change 2012-2013						
2012	3 301.94	1 715.45	735.03	252.90	446.54	5.44
From Forest land		0.41	1.29	1.89	1.57	

Changes	To Forest land	To Cropland	To Grassland	To Settlements	To Wetland	To Other land
From Cropland	0.29			0.35		
From Grassland				2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
Land use change 2013-2014						
2013	3 300.66	1 715.67	736.13	253.32	446.09	5.44
From Forest land		0.41	1.29	1.89	1.57	
From Cropland	0.29			0.35		
From Grassland				2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
2014	3299.38	1715.89	737.23	253.73	445.63	5.44
Land use change 2014-2015						
2014	3299.38	1715.89	737.23	253.73	445.63	5.44
From Forest land		0.41	1.29	1.89	1.57	
From Cropland	0.29			0.35		
From Grassland	0.27			2.30	1.02	
From Settlements	1.52	0.43	2.12		0.25	
From Wetland	2.06	0.02	1.02	0.19		
From Other land						
2015	3 298.36	1 716.11	738.07	254.14	445.18	5.44

6.3 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 forest land, grassland, cropland, wetlands, settlements and other lands. Activity data are provided by the National forest inventory (NFI)[203]. Source data of the inventory (about 16000 plots representing 400 ha each) are used in calculations of land use and land use changes, as well as drainage and rewetting of forest land. The NFI data are adapted to the harmonized country area for the whole accounting period and to land use categories used in the GHG inventory. Three cycles of the NFI (2004-2008, 2009-2013 and the 1st and 2nd year of 3rd cycle) are used in the GHG inventory.

Research data (LANDSAT images based remote sensing studies) are used to identify forest and woody areas converted to cropland and settlement as well as extensively managed croplands, like biological farms, where considerable area of arable land is set aside for a longer time period and can be reported by the NFI teams as grassland or forest land, depending from the vegetation. Vegetation index were estimated in all the NFI points, including those outside forest lands in satellite image series from 1990, 1995 and 2000 to

[203] *Source – http://www.silava.lv/userfiles/file/Meza%20statistiska%20inventarizacija/Kopsavilkumi%202014%20I%20cikls%20(2).xlsx; http://www.silava.lv/userfiles/file/Meza%20statistiska%20inventarizacija/Kopsavilkumi%202014%20II%20cikls%20(2).xlsx*

identify points where vegetation index permanently changed from values characteristic for forest lands to the one's characteristic for settlements, grassland and cropland.

Area of cropland considerably increased and area of grasslands decreased, when research data were applied, in comparison to the original NFI data, because extensively managed farmlands (biological farms and grassland utilized in forage production) are accounted under cropland category as well as lands, which at least once during last 10 years had value of vegetation index typical for cropland.

Land use categories (except forest land) converted to cropland are estimated since 2009, when the 2nd cycle of the NFI was started in Latvia; however, there are no evidences of conversion of considerable area of land use categories to cropland since 1990 due to the fact that the area of cropland continuously decreased until 2008. Later according to the NFI data it is stabilizing; however, it is complicated to identify, if returning to conventional agricultural practice are occasional cases or it is continuous process. Therefore, there is 5 years delay period (between 2 NFI cycles) to approve land use change from grassland to cropland or opposite, as well as afforestation and conversion of forest land to grassland.

Area of land converted to settlements before 2004 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"[204].

6.4 FOREST LAND (CRF 4.A)

6.4.1 Category description

From 1990 to 2013 and in 2015 forest land was a net sink, but in 2014 forest land was a net source because the total emissions resulting from forest land were bigger than the total removals. Total GHG removals in forest lands, excluding harvested wood products in 2015 were 2229.64 kt CO_2 eq. (Figure 6.2, Figure 6.3).

Forest land category includes emissions and removals resulting from carbon stock changes in living biomass, litter, dead wood, organic soils and emissions from drainage and rewetting of organic soils as well as biomass burning. Forest land category is subdivided into Forest land remaining forest land (CRF 4.A.1) and Land converted to forest land less than 20 years ago (CRF 4.A.2). The aggregated net GHG emissions from forest land remaining forest were -2573.94 kt of CO_2 eq. in Latvia in 2015, excluding removals in harvested wood products (respectively -1878.26 kt CO_2) and emissions from drainage and rewetting of organic soils (respectively 30.19 kt CO_2 eq.). The net emissions from land converted to forest in 2015 were -463.67 kt CO_2 eq.

[204] 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)."

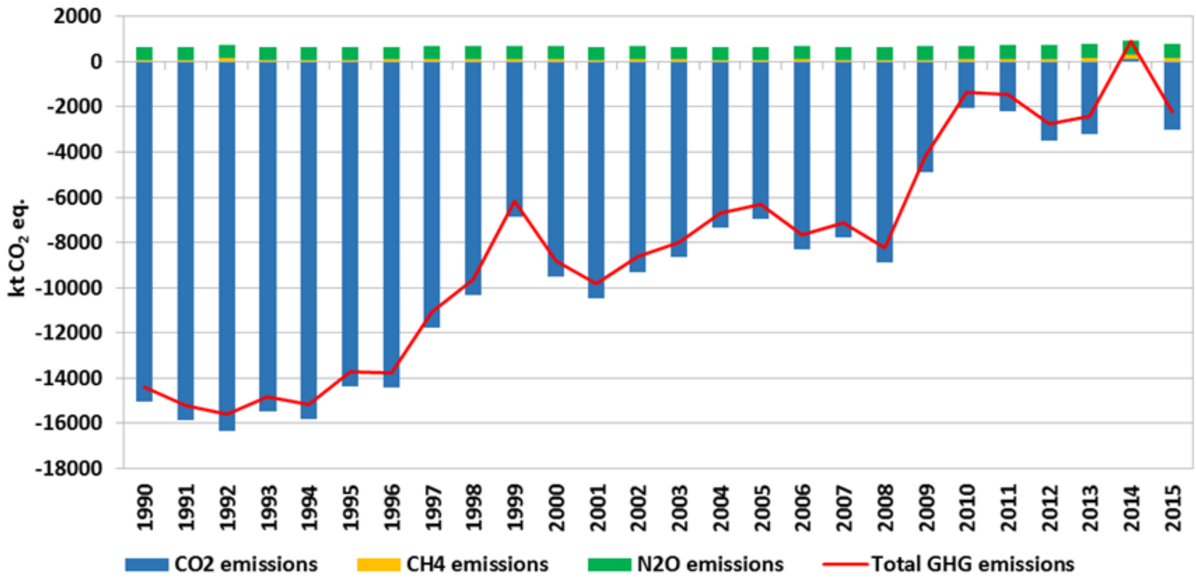

Figure 6.2 Summary of GHG emissions in forest land (kt CO_2 eq.)

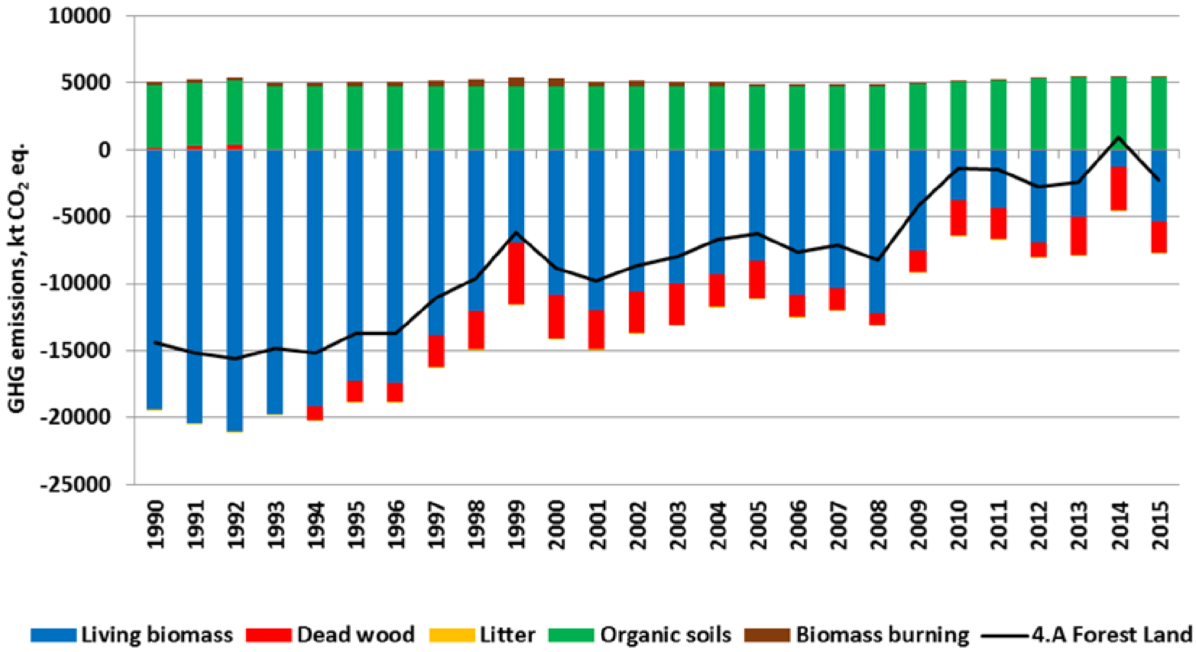

Figure 6.3 Summary of GHG emissions in forest land (kt CO_2 eq.) by source and sink categories

There are several key source and sink categories in forest land in Latvia – CO_2 in Forest Land remaining Forest Land and CO_2 in Land converted to Forest Land as well as 3 key source categories (CO_2, CH_4 and N_2O) under Emissions and removals from drainage and rewetting and other management of organic and mineral soils which are now evaluated separately in the CRF reporter. The NFI and research data are used to estimate time series for areas and gross increment[205]. Mortality data are calculated on the base of the NFI data and mortality factors, considering linear correlation between the modelled mortality in 2009-2015 and

[205] *http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls*

actual mortality data for the whole period[206]. Distinction between forest land remaining forest land and areas converted to forest land is made according to the age of dominant species in forests on afforested land – if age of dominant species 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[207].

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 20 cm deep. Distribution of the forest site types according to the NFI is shown in Table 6.10. Conversion of forest stands on drained mineral or organic soil to naturally wet soil is accounted as rewetting.

Table 6.10 Distribution of drained, naturally dry and wet mineral and organic soils in Latvia's forests, 1000 ha

Year	Forest at the end of year	Forest on dry mineral soils	Forest on drained mineral soils	Forest on wet mineral soils	Forest on drained organic soils	Forest on wet organic soils
1990	3124.22	1544.49	611.03	262.82	432.75	273.13
1991	3128.56	1547.62	612.29	262.93	432.81	272.91
1992	3135.28	1553.75	612.63	263.38	432.83	272.70
1993	3143.49	1560.73	613.49	263.50	432.89	272.88
1994	3149.67	1564.29	616.19	263.65	432.54	273.01
1995	3160.27	1573.23	618.24	263.41	432.60	272.79
1996	3173.39	1583.28	619.44	265.04	433.06	272.58
1997	3185.24	1592.98	619.68	265.83	433.90	272.87
1998	3197.95	1602.72	620.49	266.87	434.45	273.42
1999	3209.19	1612.69	622.15	266.75	434.28	273.31
2000	3222.13	1623.61	622.71	267.53	434.87	273.41
2001	3236.66	1636.02	625.28	267.29	434.76	273.30
2002	3248.73	1647.32	626.10	267.61	434.54	273.16
2003	3257.90	1655.39	627.50	267.46	434.52	273.03
2004	3270.95	1667.23	627.79	267.83	435.20	272.89
2005	3281.85	1677.04	628.80	268.08	435.18	272.75
2006	3289.65	1684.20	629.60	267.91	435.33	272.62
2007	3297.27	1689.66	630.73	268.88	435.11	272.88
2008	3307.06	1698.81	631.23	268.73	435.30	273.00
2009	3305.78	1676.17	681.61	260.91	445.56	241.54
2010	3304.50	1653.52	731.99	253.08	455.83	210.08

[206] *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).*

[207] *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*

Year	Forest at the end of year	Forest on dry mineral soils	Forest on drained mineral soils	Forest on wet mineral soils	Forest on drained organic soils	Forest on wet organic soils
2011	3303.22	1630.88	782.36	245.26	466.10	178.62
2012	3301.94	1608.24	832.74	237.43	476.37	147.15
2013	3300.66	1585.59	883.12	229.61	486.64	115.69
2014	3299.38	1586.32	882.16	229.39	485.96	115.55
2015	3298.36	1587.26	881.23	229.18	485.28	115.41

The carbon stock change in living biomass is estimated with the default method of the 2006 IPCC Guidelines – 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. The time series for gross annual increment of growing stock of trees on a forest land remaining forest are given in Figure 6.4.

The Land converted to forest land provides relatively small net increment of growing stock of trees – about 0.29 mill. m^3 in 2015 (Table 6.11). Taking into account that these forests are generally young stands, no emissions from commercial felling are considered (the smallest commercially and legally valuable harvesting age is 30 years for grey alder). Areas afforested 20 years ago (in 1990-1995) are accounted under the forest land remaining forest land category.

The dynamics of carbon stock changes in living biomass is very much affected by commercial felling. The accessibility of forest resources was low at the beginning of the 1990s due to implementation of land reform; therefore, felling was also at a low level and the CO_2 sink of living biomass was high. The felling stock increased during 1990s with implementation of the land reform and reached top average in early 2000s. Updated figures[208] of felling, including biofuel gathering, are shown in Table 6.12.

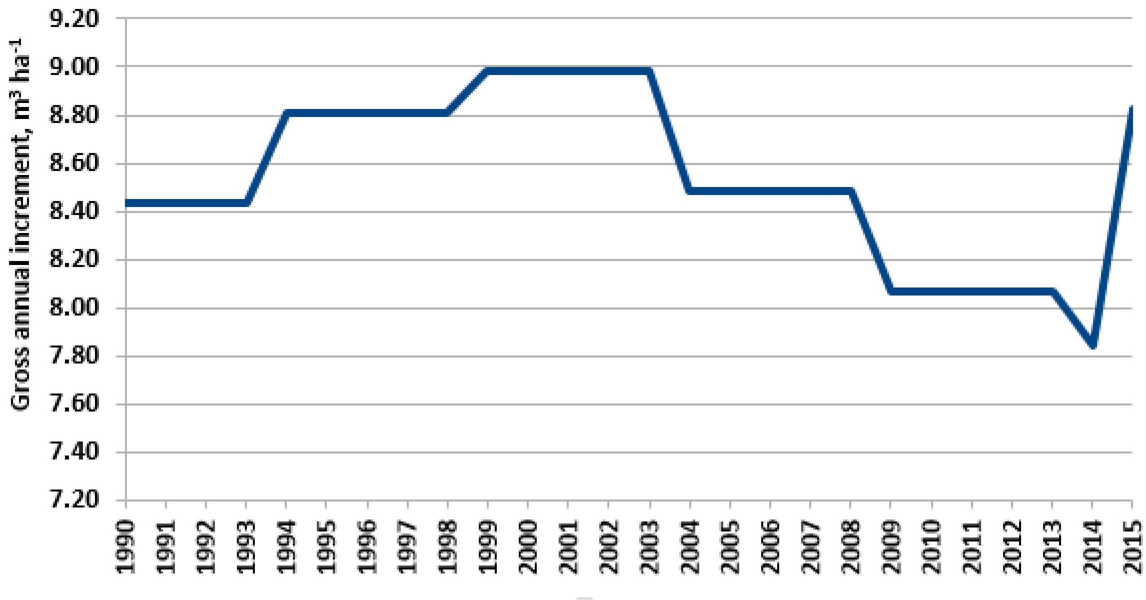

Figure 6.4 Gross annual increment in forest land remaining forest, m^3 ha^{-1}

[208] *Values updated according to results of the second NFI cycle.*

Table 6.11 Changes of growing stock of timber on the Land converted to forest[209]

Year	Stock changes, m³	Stem biomass, 1000 tonnes	Crown biomass, 1000 tonnes	Below-ground biomass, 1000 tonnes	Total biomass, 1000 tonnes
1990	123.46	0.05	0.01	0.02	0.08
1991	503.10	0.22	0.05	0.07	0.34
1992	1280.42	0.57	0.13	0.17	0.87
1993	2586.57	1.15	0.27	0.35	1.77
1994	4457.40	1.97	0.46	0.61	3.04
1995	7045.30	3.12	0.73	0.96	4.81
1996	10494.13	4.65	1.09	1.43	7.17
1997	14868.59	6.58	1.55	2.02	10.15
1998	20248.26	8.96	2.11	2.75	13.83
1999	26663.37	11.77	2.82	3.64	18.24
2000	34194.50	15.10	3.62	4.67	23.39
2001	42959.33	18.97	4.54	5.87	29.38
2002	52978.38	23.39	5.60	7.24	36.23
2003	64202.65	28.35	6.79	8.77	43.91
2004	76724.97	33.76	8.18	10.48	52.42
2005	90560.76	39.85	9.66	12.36	61.87
2006	105645.13	46.49	11.27	14.42	72.18
2007	121948.77	53.66	13.00	16.65	83.32
2008	139524.09	61.40	14.88	19.05	95.33
2009	158210.04	69.53	16.97	21.63	108.13
2010	177913.00	78.19	19.08	24.32	121.60
2011	198587.36	87.27	21.30	27.15	135.73
2012	220202.45	96.77	23.62	30.11	150.50
2013	242735.73	106.68	26.04	33.19	165.90
2014	266169.86	118.51	27.02	36.07	181.59
2015	290498.22	126.82	30.49	39.14	196.46

Table 6.12 Harvesting stock, in 1000 m³

Year	Total excluding deforestation	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other	Pine
1990	6297.54	568.35	405.01	1827.46	1355.41	109.19	24.32	0.01	2007.79
1991	5531.96	499.26	355.78	1605.29	1190.64	95.92	21.36	0.01	1763.70
1992	5056.32	456.33	325.19	1467.27	1088.27	87.67	19.53	0.01	1612.06
1993	5991.68	540.75	385.34	1738.70	1289.58	103.89	23.14	0.01	1910.27
1994	7216.99	651.33	464.14	2094.27	1553.31	125.13	27.87	0.01	2300.93
1995	8672.68	782.71	557.76	2516.69	1866.61	150.37	33.49	0.01	2765.03
1996	8519.10	768.85	547.89	2472.12	1833.56	147.71	32.90	0.01	2716.07
1997	11239.42	1014.36	722.84	3261.52	2419.05	194.88	43.41	0.01	3583.36
1998	12632.65	1140.10	812.44	3665.81	2718.91	219.03	48.79	0.02	4027.55
1999	16925.69	1527.54	1088.54	4911.59	3642.90	293.47	65.36	0.02	5396.26
2000	13855.70	1269.63	666.58	4099.52	3867.37	0.00	50.45	0.00	3902.15
2001	13037.03	1235.76	593.86	3613.68	3394.98	233.06	34.57	0.00	3931.13
2002	14090.92	1399.42	816.16	3979.92	3512.58	223.99	40.51	0.00	4118.34
2003	14599.66	1473.65	996.39	3944.79	3300.02	231.89	48.93	0.00	4604.00
2004	13542.74	1282.88	1075.65	3795.57	2934.95	246.67	45.72	0.00	4161.30
2005	14209.18	847.32	839.85	3597.28	3705.24	261.30	83.08	0.00	4875.10

[209] *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).*

Year	Total excluding deforestation	Aspen	Grey alder	Birch	Spruce	Black alder	Oak, ash	Other	Pine
2006	12340.08	1180.35	860.65	3561.31	2380.31	255.29	52.55	0.00	4049.62
2007	12752.59	1178.77	1076.25	3854.25	2548.87	254.88	64.54	0.19	3774.86
2008	11287.94	990.28	894.22	3294.99	1982.87	256.93	46.12	0.00	3822.53
2009	13512.20	1214.00	767.53	3959.19	2155.57	254.86	55.14	0.00	5105.91
2010	16349.79	1424.07	1036.81	5710.59	2397.13	374.76	56.47	0.00	5349.97
2011	16021.17	1427.85	1247.54	4373.27	2738.80	280.85	83.37	10.64	5858.86
2012	14769.64	1170.10	4402.29	1257.07	2372.48	219.03	57.44	10.81	5280.41
2013	14684.99	1188.44	4311.90	1305.46	2413.88	285.54	76.30	9.63	5093.84
2014	16565.43	1725.31	2713.64	3185.63	2592.06	434.41	85.75	786.25	5199.63
2015	17022.03	1772.86	2788.44	3273.44	2663.51	446.38	88.12	807.92	5342.95

The total area of the land converted to forest is shown in Table 6.13 and Table 6.14. In 2010 it start to reduce, because area afforested in 1990-1995 in the convention reporting is accounted under the forest land remaining forest land category.

Table 6.13 The cumulative area of land converted to forest, 1000 ha

Year	Land converted to forest at the end of year	Forest on dry mineral soils	Forest on drained mineral soils	Forest on wet mineral soils	Forest on drained organic soils	Forest on wet organic soils
1990	4.66	3.97	0.38	0.26	0.00	0.05
1991	11.50	8.31	2.12	0.62	0.40	0.05
1992	20.73	15.66	2.94	1.31	0.76	0.05
1993	31.43	23.86	4.29	1.67	1.16	0.45
1994	40.11	28.63	7.46	2.07	1.16	0.79
1995	53.20	38.79	10.00	2.07	1.56	0.79
1996	67.59	50.05	11.68	2.71	2.36	0.79
1997	80.71	60.37	12.16	3.62	3.37	1.19
1998	94.67	70.72	13.22	4.79	4.09	1.85
1999	107.17	81.31	15.12	4.79	4.09	1.85
2000	121.38	92.84	15.92	5.69	4.86	2.06
2001	137.48	105.86	18.74	5.89	4.92	2.06
2002	151.14	117.93	19.86	6.37	4.92	2.06
2003	161.88	126.77	21.57	6.37	5.12	2.06
2004	176.51	139.38	22.16	6.89	6.01	2.06
2005	188.98	149.96	23.47	7.29	6.2	2.06
2006	198.37	157.88	24.58	7.29	6.57	2.06
2007	207.56	164.11	26.02	8.41	6.57	2.46
2008	218.93	174.03	26.82	8.41	6.97	2.71
2009	222.81	177.11	27.29	8.56	7.09	2.76
2010	222.02	176.22	27.39	8.44	7.21	2.75
2011	219.05	174.96	26.12	8.23	6.94	2.80
2012	213.70	170.69	25.77	7.69	6.70	2.85
2013	165.57	24.90	7.48	6.42	2.50	2.50
2014	202.06	163.88	22.20	7.23	6.55	2.21
2015	193.11	157.01	20.17	7.39	6.28	2.26

Table 6.14 Cumulative area of the land converted to forest more than 20 years ago, 1000 ha

Year	Land converted to forest > 20 years ago	Forest on dry mineral soils	Forest on drained mineral soils	Forest on wet mineral soils	Forest on drained organic soils	Forest on wet organic soils
2010	4.66	3.97	0.38	0.26	0.00	0.05
2011	11.50	8.31	2.12	0.62	0.40	0.05
2012	20.73	15.66	2.94	1.31	0.76	0.05
2013	31.43	23.86	4.29	1.67	1.16	0.45
2014	40.11	28.63	7.46	2.07	1.16	0.79
2015	53.20	38.79	10.00	2.07	1.56	0.79

6.4.2 Methodological issues

6.4.2.1 Forest land remaining forest land (CRF 4.A.1)

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 organic carbon). National statistics (State forest service) are used to estimate 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"[210] and factors and coefficients elaborated within the scope of the research program on impact of forest management on GHG emissions and CO_2 removals[211].

Changes of the carbon stock and GHG emissions are estimated according to the Tier 2 methods with country specific data. Default method (the carbon loss to be subtracted from the carbon removals for the reporting year) is used in calculations of removals and emissions of CO_2 in living biomass.

Methodologies for estimation of carbon stock changes and GHG emissions are considerably improved; they are now merged together into the "Emissions projection & inventory model (EPIM)" spreadsheet tool. Separate versions (with different input data) are elaborated for the UNFCCC and the Kyoto protocol reporting. The tool is still under development, current working version can be downloaded from the website "Land use, land use change and forestry sector in Latvia"[212].

The concept of the EPIM:

Land use and land use change data are elaborated separately to simplify tool structure, the connection is organized as linked tables;

- 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;
- calculations are done on annual basis using periodic (5 years period) and annual input data;

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[210] *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).*

[211] *Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums*

[212] *https://drive.google.com/folderview?id=0Bxv4jQ_04jXZNTM5aGNDTVdRVzQ&usp=sharing*

- historical data (1990-2004) – backward calculation on the base of the NFI data; for 1970-1989 research data and expert judgements are utilized;
- all modules in the spreadsheet are merged together following to the forest management cycle (from growth to decay);
- the tool combines all land use and land use change categories.

Content of the tool (separate calculation sheets):

- living biomass (annual increment of living biomass, summary of growing stock and characteristics of biomass);
- mortality (natural reduction of number 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);
- emissions from soils (CO_2, CH_4 and N_2O from drained organic soils and CH_4, DOC, CO_2 emissions from rewetted soils in forest land and wetlands);
- fire (emissions of CO_2, CH_4 and N_2O due to incineration of harvesting residues and wildfires);
- conversion from forests (as a land use change to estimate area of managed forests);
- 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 cropland and grassland (emissions or removals in soil);
- settlements (carbon stock change in soil, living and dead biomass);
- managed 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 data on timber stock changes and mortality rate[213];
- 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 6.15), BEFs used for verification of the biomass calculation in NFI (Table 6.16);

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[213] *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.*

- average carbon stock in biomass is provided in Table 6.17.

The figures in are based on stock change in forest stands with different dominant species.

Table 6.15 Wood density[214]

Species	Density, tonnes m^{-3}
Aspen	0.40
Grey alder	0.39
Birch	0.49
Spruce	0.39
Black alder	0.49
Oak, ash	0.49
Other species (mostly *Salix* sp.)	0.46
Pine	0.44

Table 6.16 Crown and below-ground biomass from stem biomass[215]

Species	Stem biomass to crown biomass	Stem biomass to below-ground biomass
Aspen	1.20	0.27
Grey alder	1.22	0.28
Birch	1.19	0.31
Spruce	1.41	0.39
Black alder	1.19	0.30
Oak, ash	1.19	0.30
Other species	1.21	0.30
Pine	1.22	0.29

Table 6.17 Average carbon stock in living biomass

Species	C, kg in tonne of dry biomass[216]
Aspen	507.57
Grey alder	522.12
Birch	521.09
Spruce	528.02
Black alder	522.12
Oak, ash	522.12
Other species	522.12
Pine	530.91

Mortality and decay:

- species specific coefficients of mortality (Table 6.18) not dependant on size of tree (dominant or undergrowth trees), depend on the 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 the 1990s;
- 20 years decomposition period (mortality since 1970 considered as emissions);
- constant mortality values considered for periods before 1990.

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[214] *Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums*

[215] *Not used in calculation, but for verification of the NFI data and comparison with the default BEFs in the IPCC guidelines*

[216] *Dried at 105 ^oC temperature.*

Table 6.18 Average periodic mortality (m^3 ha^{-1} yr^{-1})[217]

Species	1970-1993	1994-1998	1999-2003	2004-2008	2009-2012	2013	2014	2015
Aspen	1.97	2.35	2.37	2.32	2.32	2.94	2.97	2.66
Grey alder	0.36	0.40	0.43	0.58	0.58	2.60	2.54	2.31
Birch	1.92	2.01	1.90	1.72	1.72	2.17	2.10	1.94
Spruce	1.95	2.12	2.33	2.48	2.48	3.00	2.77	2.52
Black alder	1.57	1.71	1.78	1.98	1.98	2.58	2.65	2.35
Oak, ash	2.76	3.20	3.21	3.46	3.46	4.84	4.88	4.46
Other species	0.90	0.79	0.81	0.93	0.93	2.79	1.70	0.92
Pine	1.39	1.49	1.66	1.78	1.78	1.67	1.79	1.75

Commercial felling:

- dominant species specific harvesting data since 1970 (1990-2013 Central statistical bureau updated by NFI data, since 2014 NFI, 1970-1989 research papers[218]);
- decomposition of crown and underground biomass – 20 years; species specific wood densities and different BEFs for coniferous and deciduous trees (Table 6.15 and Table 6.16).

The methodology for harvested wood products is based on Rüter, S., 2011[219]. More detailed description follows in further chapters.

Emissions from drained soils are accounted – 2.6 tonnes C ha^{-1} and 2.8 kg N_2O-N ha^{-1} (IPCC Wetlands Supplement) annually from organic soils.

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[220].

New project was implemented in 2014 to estimate carbon stock change in organic forest soil due to establishment of drainage system[221]. The empiric material is collected in experimental trials established in early 60[ths]. The study results will be implemented in following inventories.

Drained organic soil in forest land is source of CH_4 emissions. CH_4 emissions are calculated by equation 2.6 in IPCC Wetlands Supplement (equation No. 1 in the NIR).

[217] *Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums; Lazdiņš, Donis, and Strūve, Latvijas Meža Apsaimniekošanas Radītās Ogļskābās Gāzes (CO_2) Piesaistes Un Siltumnīcefekta Gāzu (SEG) Emisiju References Līmeņa Aprēķina Modeļa Izstrāde.*

[218] *Zigurds Saliņš, Mežs - Latvijas Nacionālā Bagātība (Jelgava: Jelgavas tipogrāfija, 2002); Zigurds Saliņš, Meža izmantošana Latvijā: stāvoklis, perspektīvas (Jelgava [Latvia]: LLU Meza izmantosanas katedra, 1999).*

[219] *Projection of Net Emissions from Harvested Wood Products in European Countries, Johann Heinrich von Thünen Institute, Hamburg.*

[220] *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)."*

[221] *Andis Lazdiņš, Aldis Butlers, and Ainārs Lupiķis, "Case Study of Soil Carbon Stock Changes in Drained and Afforested Transitional Bog," in Foresst Ecosystems and Its Management: Towards Understanding the Complexity (presented at the 9th Baltic theriological conference, Ilgas: Latvian State Forest Research Institute "Silava," 2014); Andis Lazdiņš and Ainārs Lupiķis, Hidrotehniskās Meliorācijas Ietekme Uz CO_2 Emisijām Mežaudzēs Uz Susinātām Augsnēm (Salaspils, 2014), Salaspils.*

$$CH_{4\_organic} = A * \left((1 - Frac_{ditch}) * EF_{CH\_4\_land} + Frac_{ditch} * EF_{CH\_4\_ditch} \right); \ where$$
$CH_{4\_organic}$ – annual CH_4 loss from drained organic soils, kg $CH_4 \, yr^{-1}$
A – land area of drained organic soils in a land – use category, ha
$EF_{CH\_4\_land}$ – emission factor for direct CH_4 emissions from drained organic soils, kg $CH_4 \, ha^{-1} \, yr^{-1}$
$EF_{CH\_4\_ditch}$ – emission factor for CH_4 emissions from drainage ditches, kg $CH_4 \, ha^{-1} \, yr^{-1}$
$Frac_{ditch}$ – fraction of the total area of drained organic soil which is ocupied by ditches (1)

The CH_4 emission factor for organic soils of drained forest land (Table 2.3 and Table 2.4 in IPCC Wetlands Supplement) is 2.5 kg CH_4 ha^{-1} yr^{-1} and emission factor for drainage ditches is 217 kg CH_4 ha^{-1} yr^{-1}. Data for fraction of drainage ditches of total drained area on organic soils is obtained by evaluation fraction of ditches in state managed forest lands to all drained forest organic soils.

GHG emissions from rewetted organic soils are estimated according to the Tier 1 methods. CO_2 emissions are calculated using equation 3.3:

$$CO_2 - C_{rewetted\ org\ soil} = CO_2 - C_{composite} + CO_2 - C_{DOC}; \ where$$
$CO_2 - C_{rewetted\ org\ soil}$ – $CO_2 - C$ emissions / removals from rewetted organic soils, tonnes $C \, yr^{-1}$
$CO_2 - C_{composite}$ – $CO_2 - C$ emissions / removals from the soil and non – tree vegetation, tonnes $C \, yr^{-1}$
$CO_2 - C_{DOC}$ – off – site $CO_2 - C$ emissions from dissolved organic carbon exported from rewetted organic soils, tonnes $C \, yr^{-1}$ (2)

complemented by equations 3.4 and 3.5 of the IPCC Wetlands Supplement.

$$CO_2 - C_{composite} = \sum_{c,n} \left(A * EF_{CO2} \right); \ where$$
$A_{c,n}$ – area of rewetted organic soils in climate zone c and nutrient status n, ha
$EF_{CO2c,n}$ – $CO_2 - C$ emission factor for rewetted organic soils in climate zone c, nutrient status n, tonnes $C \, ha^{-1} \, yr^{-1}$ (3)

$$CO_2 - C_{DOC} = \sum_{c} \left(A * EF_{DOC\_REWETTED} \right); \ where$$
A_c – area of rewetted organic soils in climate zone c, ha
$EF_{DOC\_rewetted,c}$ – $CO_2 - C$ emission factor from DOC exported from rewetted organic soils in climate zone c, tonnes $C \, ha^{-1} \, yr^{-1}$ (4)

Emission factor for CO_2-C (0.5 tonnes CO_2-C ha^{-1} yr^{-1}) is taken from Table 3.1 of the IPCC Wetlands Supplement. N_2O emissions from rewetted organic soils according to Tier 1 method are assumed to be negligible and are not estimated, CH_4 emissions are calculated applying Tier 1 method using equation 3.7 of the IPCC Wetlands Supplement (equation No. 5). Default emission factor (216 kg CH_4-C ha^{-1} yr^{-1}) from Table 3.3 was used (Table 6.19).

$$CH_4 - C_{rewetted\ org\ soil} = \frac{\sum_{c,n} \left(A * EF_{CH4soil} \right) c,n}{1000}; \ where$$
$CH_4 - C_{rewetted\ org\ soil}$ – $CH_4 - C$ emissions / removals from rewetted organic soils, tonnes $C \, yr^{-1}$
A_c, n – area of rewetted organic soils in climate zone c and nutrient status n, ha
$EF_{CH4soil}$ – emission factor from rewetted organic soils in climate zone c and nutrient status n, kg $CH_4 - C \, ha^{-1} \, yr^{-1}$ (5)

Table 6.19 Emission factors for rewetted organic soils, tonnes C ha^{-1} yr^{-1}

No	GHG	Emission factor
1	CO_2	0.5
2	CH_4	0.216

Rewetting is reported under forest land – conversion of forests on drained organic soils to forest on naturally wet soil. The conversion is usually approved by changes in ground vegetation and groundwater table during the site visits. Rewetting takes place due to wearing of drainage systems. In 2015, total rewetted area according to comparison of the NFI data is 12.04 kha. It is assumed, that the increase of rewetted area increases linearly and 2 kha of forests were rewetted every year from 2009 to 2015 according to an average figures for 2009-2013 provided by the NFI and linear extrapolation of 5 years average in 2014 and 2015. Total emissions from soil due to rewetting in 2015 approached to 108.7 kt CO_2 eq. (Figure 6.5).

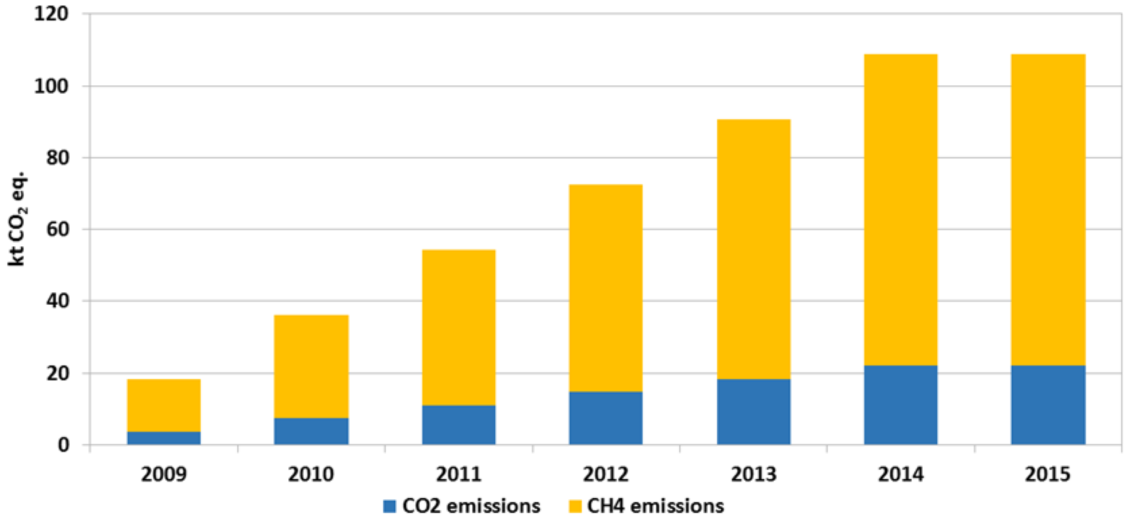

Figure 6.5 Emissions due to rewetting (kt CO_2 eq.)

6.4.2.2 Land converted to forest land (CRF 4.A.2)

From 1990 to 2008 in section lands converted to forest land all categories except grasslands converted to forest land are noted as NO because other conversions do not take place or the latest identifiable land use category in afforested areas is grassland. Since 2009 when NFI data on land use changes are introduced the conversion from cropland, wetland and settlements to forest land is accounted.

Grasslands converted to forest land are estimated using spatial approach – analysis of the NFI data about forests on former farmland (land being cropland and grassland before 1990) which was afforested after 1990. Areas where trees did not reach 2 cm diameter at breast height were excluded from estimation and accounted under grassland category to avoid accounting of extensively managed farmlands under forest land category. The year of afforestation of every single NFI plot selected for analysis was determined by subtraction of age of stand from a year when field measurements were done.

Gains in living biomass on afforested lands are estimated using interpolation (stock change method assuming that the increment structure in areas afforested in different periods is similar) . Weighted 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 were applied to calculation. 2016 is the third 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 are noted 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) and losses in living biomass are reported as natural mortality.

Emissions from organic soils in afforested lands were calculated using the same approach as for emissions from drained organic soils on lands remaining forest.

It is assumed that average stock of dead wood, and consequently in litter in forest land remaining forest and land converted to forest 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 150 years, which corresponds to 2 generations of trees. The main difference between the 1st and following generations of trees is presence of trees, which corresponds to about 20% of carbon stock in living biomass in mature stands.

It is assumed in the calculation, that dead wood stock in afforested lands will reach 12.3 tonnes C ha^{-1} within 150 years. Values of average carbon stock in dead wood in 1990-2015 were used in calculation. 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. Two generations of trees (150 years) were considered to properly encompass carbon stock in harvesting residues, stumps and the above-ground fraction of dead trees.

Average carbon stock in litter is 12.1 tonnes C ha^{-1} according to the BioSoil project forest soil inventory data. Considering the same transformation period of 150 years.

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 of grassland. The project started in 2012 on comparison of carbon stock in cropland remaining cropland and grassland remaining grassland shows no difference in carbon stock between grassland, recently afforest land and forest land remaining forest land in the upper soil layer (0-40 cm); however, there are evidences of statistically significant carbon stock changes in deeper soils layers after afforestation .

Since 2009 Latvia reports "NE" for carbon stock change in living biomass, dead wood and litter for Cropland Converted to Forest Land, Wetland Converted to Forest Land and Settlements Converted to Forest Land as well as in mineral soils (Cropland Converted to Forest Land and Settlements Converted to Forest Land) and organic soils (Wetland Converted to Forest Land). "NE" notation key will be replaced with actual values of CO_2 removals and GHG emissions in next submission after completion of the spatial analysis of digitalized information of the NFI sample plots and extrapolation of obtained data to the time period not covered by the NFI (1990-2003).

6.4.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainties are estimated on the base the NFI and expert judgement. Uncertainty of soil carbon (CO_2) emissions are estimated according to data obtained within the scope of the international forest soil monitoring project BioSoil and values provided in the IPCC Wetlands Supplement. The uncertainty of CO_2 emission factor according to IPCC Wetlands Supplement (Table 2.1) in organic soil is 25 %.

The uncertainty of area (Table 6.20) is estimated as standard error of proportion (equation No. 10).

Table 6.20 Uncertainty of the forest land use data in 2015

Land use category	Number of NFI plots	Share of NFI plots, %	Uncertainty, %
Forest land	8322	51.5	1.5
forest land remaining forest land	7885	48.8	1.6
drained organic soil	1116	6.9	5.3
other soil	5040	31.2	2.3
land converted to forest land	437	2.7	8.0
drained organic soil	10	0.1	43.5
other soil	380	2.4	8.7

Uncertainty of annual increment of growing stock of trees in forest lands is 0.9 %, uncertainty of increment on afforested lands 16 %. Uncertainties calculated according to 2006 IPCC Guidelines Volume 1, Chapter 3 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 average according to the study results. Combined category uncertainty is calculated according to 2006 IPCC Guidelines TIER 1 – simple propagation of errors.

95 % confidence interval for CH_4 emission factor for drained organic soil of forest land is -0.6-+5.7 kg CH_4 ha^{-1} yr^{-1}. Uncertainty range of CH_4 emission factor for drainage ditches in drained forest land is 41-393 kg CH_4 ha^{-1} yr^{-1} (IPCC Wetlands Supplement, Table 2.3 and Table 2.4).

Uncertainty range of CO_2-C emission factor for rewetted organic soils is -0.71-+1.71 tonnes CO_2-C ha^{-1} yr^{-1} (IPCC Wetlands Supplement, Table 3.1). Uncertainty range of CO_2-C emission factor from DOC exported from rewetted organic soils is 0.14-0.36 tonnes CO_2-C ha^{-1} yr^{-1} (IPCC Wetlands Supplement, Table 3.2). 95% range of CH_4-C emission factor from rewetted organic soils is 0-856 kg CH_4-C ha^{-1} yr^{-1} (IPCC Wetlands Supplement, Table 3.3).

6.4.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives. General and source-specific QC activities are carried out by LSFRI Silava according to the QA/QC guidelines[222]

Quality control procedures listed in 2006 IPCC Guidelines Chapter 4.4.3 were implemented for all calculations, including elaboration of country specific allometric biomass equations, wood density and carbon content factors. Several quality meetings are held annually between experts.

The NFI data have gone through the following QC measures:

[222] *https://drive.google.com/open?id=0Bxv4jQ_04jXZdEhJVFJ4OVRPTkE*

- 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 and that the guidelines and instructions are understood correctly;
- verification measurements were carried out during field seasons;
- field data are checked by evaluation if all sample plots are measured, no required information is missing (if missing entries are found, they are completed and re-measurement is done, if necessary), the compatibility between data variables is checked using logical controls;
- calculated results are compared with the results of previous inventories. If considerable or unexpected changes are found, reasons for the changes 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 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[223].

The data based on forest statistics were produced by the LSFRI Silava[224]. Data descriptions are available 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.

6.4.5 Category-specific recalculations

Recalculations are introduced due to changes in activity data, in Submission 2017 actual NFI data of mortality and harvesting stock were used instead of extrapolated values. Recalculated NFI data based on repeated measurement of borders of the plots and their sectors as well as new biomass expansion factors and carbon content in wood were implemented in the calculations. Summary of the impact of recalculation on the aggregated net GHG emissions from forest land is shown in Figure 6.6. In spite of considerable relative changes, absolute values of recalculations are within the range of uncertainty for the whole period.

[223] *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.*

[224] *http://www.silava.lv/userfiles/file/2010%20nov%20MRM_visi%20mezi_04-08g.xls*

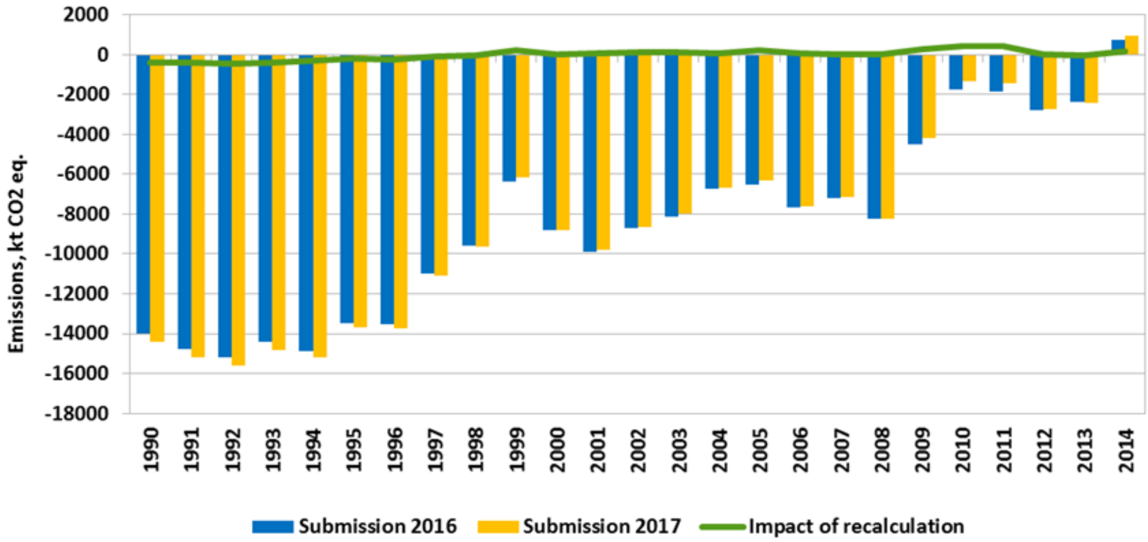

Figure 6.6 Impact of recalculation on the aggregated net GHG emissions from forest land

6.4.6 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 1990-2016);
- estimation of carbon stock changes in drained organic soils in forest lands (2017);
- estimation of transition period for dead wood and litter carbon stock in afforested lands (2015-2018);
- development of production version of EPIM tool, including instantaneous calculation of uncertainties, broader representation of land use change options and closer integration of Kyoto protocol and the UNFCCC reporting requirements (2017);
- improvement and simplification of structure of land use change calculation tool, including uncertainty estimates;
- implementation of Yasso model in calculation of carbon stock changes in soil, dead wood and litter following to afforestation, deforestation and forest management;
- implementation of continuous forest soil carbon monitoring system in the NFI plots (up to 200 plots in 16 x 16 km network).

6.5 CROPLAND (CRF 4.B)

6.5.1 Category description

Cropland remaining cropland and land converted to cropland is a key category of CO_2 emissions (Figure 6.7). Under the cropland's category emissions from organic soils (CO_2, N_2O and CH_4), living and dead woody biomass (CO_2) are reported. Net aggregated emissions from cropland remaining cropland were 2599.52 kt of CO_2 in 2015 (excluding 119.26 kt of CO_2 eq. emissions from drained organic soils, Figure 6.8). Decrease of CO_2 emissions in cropland remaining cropland is associated with land use change from cropland to grassland. The net

GHG emissions from land converted to croplands in 2015 (excluding emissions from drainage of organic soils) were 301.93 kt CO_2 eq. (Figure 6.9).

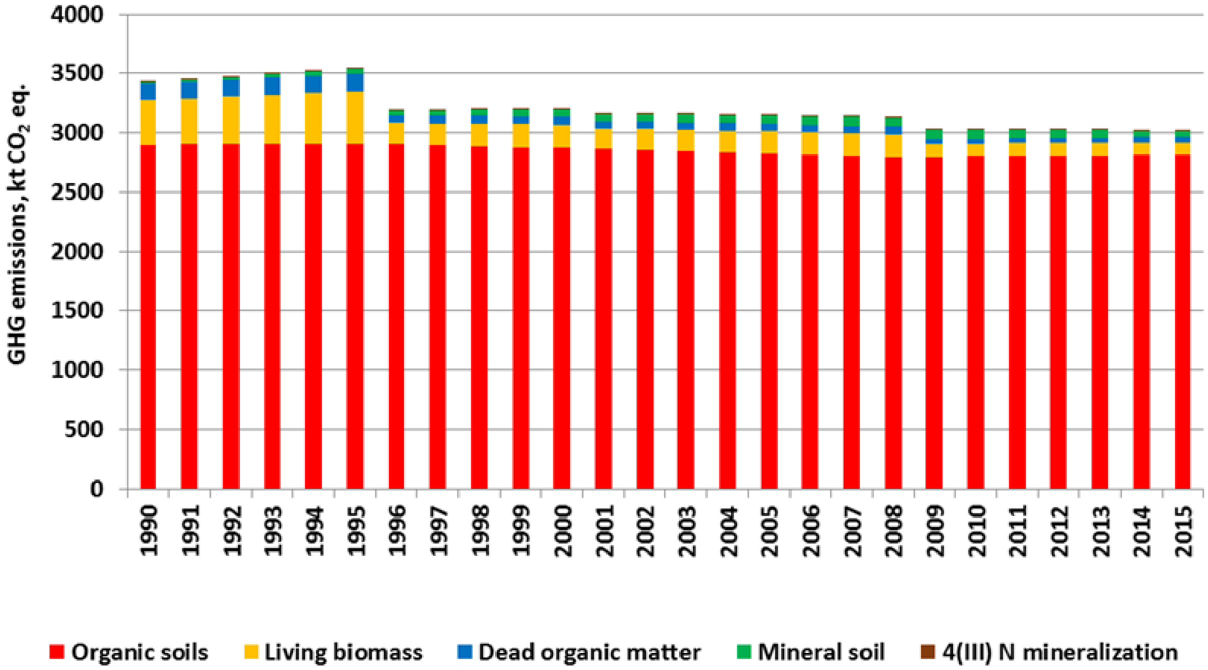

Figure 6.7 Summary of GHG emissions in cropland (kt CO_2 eq.) by source categories

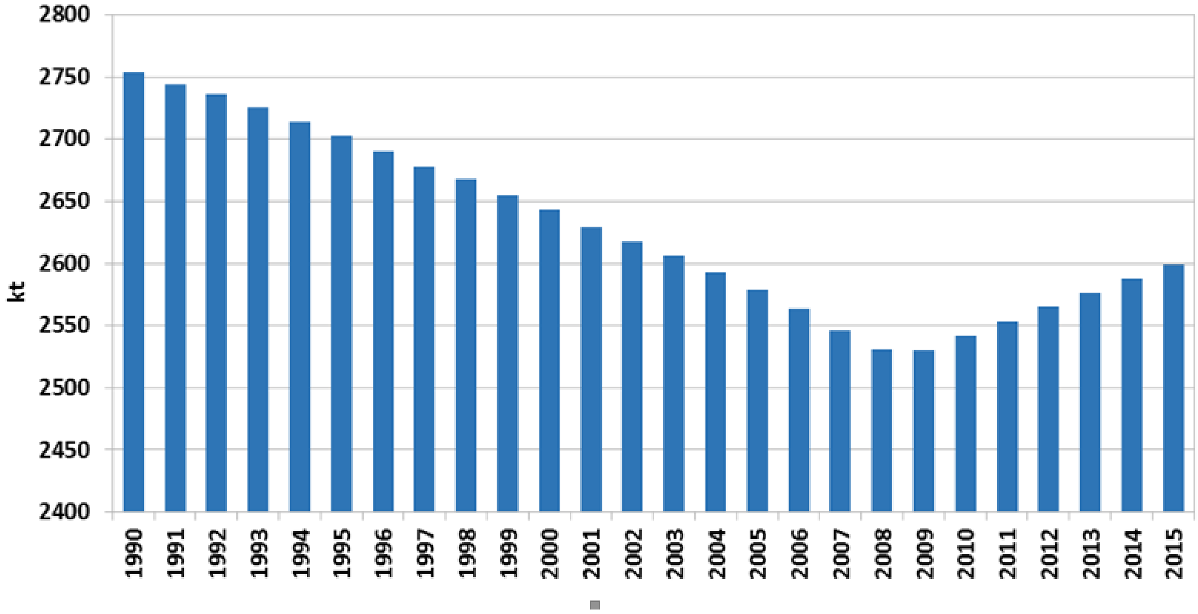

Figure 6.8 Summary of CO_2 emissions in cropland remaining cropland (kt)

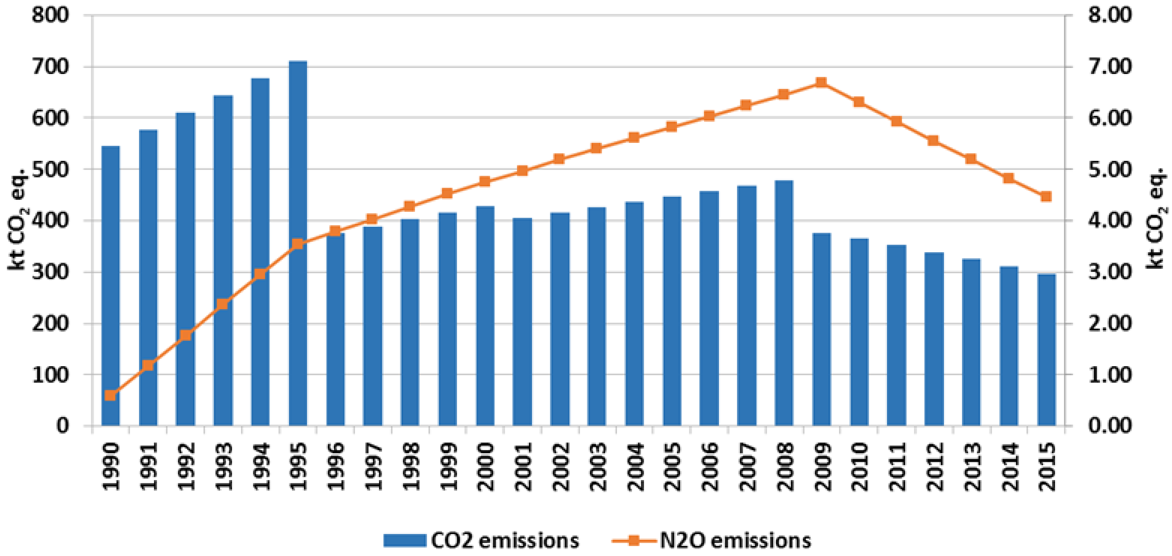

Figure 6.9 Summary of GHG emissions from land converted to cropland[225] (kt CO_2 eq.)

The total area of croplands is estimated using the approach described further in chapter Category-specific recalculations and following to research results. Updated values of area of organic and other soils split into cropland remaining cropland (including land converted to cropland at least 20 years ago) and land converted to cropland less than 20 years ago are shown in Table 6.21. The stock change method was applied to characterize biomass of living trees in cropland on the base of stock changes during 5 years period.

Table 6.21 Area of cropland (1000 ha)

Year	Cropland	Land remaining cropland		Land converted to cropland	
		organic soil	other soils	organic soil	other soils
1990	1842.24	95.33	1745.00	0.43	1.48
1991	1837.27	94.97	1738.49	0.86	2.95
1992	1833.98	94.70	1733.56	1.29	4.43
1993	1828.93	94.34	1726.96	1.72	5.91
1994	1823.50	93.96	1720.00	2.15	7.39
1995	1817.85	93.57	1712.84	2.58	8.86
1996	1810.36	93.14	1704.99	2.76	9.47
1997	1802.95	92.72	1697.21	2.94	10.08
1998	1797.12	92.38	1690.94	3.12	10.69
1999	1789.13	91.92	1682.61	3.30	11.30
2000	1782.39	91.53	1675.48	3.48	11.91
2001	1773.20	91.02	1666.10	3.64	12.44
2002	1766.53	90.64	1659.13	3.80	12.97
2003	1759.41	90.23	1651.72	3.96	13.50
2004	1750.97	89.76	1643.06	4.12	14.03
2005	1742.26	89.27	1634.15	4.28	14.56
2006	1733.30	88.77	1625.00	4.44	15.09
2007	1724.07	88.26	1615.59	4.60	15.62
2008	1714.58	87.73	1605.94	4.76	16.15

[225] *N_2O on secondary axis*

Year	Cropland	Land remaining cropland		Land converted to cropland	
		organic soil	other soils	organic soil	other soils
2009	1714.80	87.70	1605.33	4.87	16.90
2010	1715.02	87.67	1604.73	4.98	17.64
2011	1715.24	87.63	1604.12	5.09	18.40
2012	1715.45	87.60	1603.51	5.19	19.16
2013	1715.67	87.57	1602.90	5.28	19.93
2014	1715.89	87.53	1602.29	5.37	20.70
2015	1716.11	87.50	1601.68	5.46	21.46

6.5.2 Methodological issues

6.5.2.1 Cropland remaining cropland (CRF 4.B.1)

Activity data for calculations are provided by research project[226] (area of organic soils). Area of land remaining cropland is estimated using remote sensing based research data[227] on the base of the NFI. Area of organic soils in farmland according to summaries of land surveys is 5.18 ± 0.5 %. This value characterizes area of organic soils in cropland before 1990, because it is based on field measurements completed in 60[ths], 70[ths] and early 80[ths]. It is assumed that share of organic soil in cropland remaining cropland, cropland converted to grassland, grassland converted to cropland and grassland remaining grassland is equal. Minor changes are introduced by conversion of forest land on organic soil to cropland and grassland. Therefore, the area of organic soil in cropland is linearly correlating with the total area of cropland. In 2015 according to this estimation there were 90.1 kha of organic soil in cropland remaining cropland and 2.88 kha in land converted to cropland. The study data on distribution of organic soil show that only about 2.2 % of farmlands are located on organic soil, including 1.0 % of cropland and 2.9 % of grassland; however, this study does not demonstrate, what are the driving forces of reduction of area of cropland on organic soil – if it is land use change or decomposition of organic layer driven phenomena[228].

Carbon stock change in living and dead woody biomass is based on activity data provided by the NFI. The biomass increment is used in calculations before 2009 and stock change method is applied for calculations in 2009-2015 assuming linear increment of carbon stock in cropland. Carbon stock in living and dead biomass is calculated using the same coefficients as in calculations of carbon stock changes in forested land. The conversion factors for estimation of carbon in biomass are developed domestically[229].

Net carbon stock changes in mineral soil in cropland are reported as not occurring because no significant changes in management systems took place since 1990 and according to Tier 1 method of the 2006 IPCC Guidelines Chapter 5[230] the carbon stock changes in mineral soil should be reported in case of changes in management practice. This assumption is approved

[226] *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)."*
[227] *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.*
[228] *Lazdiņš et al., Atbalsts Klimata Pētījumu Programmai (Pārksats Par Projekta 2013. Gada Darba Uzdevumu Izpildi).*
[229] *Andis Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums, Salaspils 2013.*
[230] *Section 5.2.3.1 Choice of Method, Tier 1.*

by a pilot study on implementation of Yasso model on mineral soils in cropland and grassland[231]. It is planned to update obtained data in 2017 by more detailed evaluation of management systems and their relation to certain soil types to provide actual figures of carbon stock change in soil.

The assumptions used in EPIM tool for estimation of carbon stock change in living and dead biomass are shown in Table 6.22, default 20 years decay period is considered for dead wood.

Table 6.22 Assumptions for calculation of carbon stock changes in living and dead biomass in cropland

Year	Cropland with woody vegetation, 1000 ha	Gross increment of living biomass		Wood density, kg m⁻³	Natural mortality, m³ ha⁻¹	BEFs		Carbon content, kg t⁻¹
		mill. M³	m³ ha⁻¹			stem to crown	stem to below-ground	
1990	2.34	0.01	2.52	0.44	0.48	0.23	0.31	523.00
1991	2.34	0.01	2.52	0.44	0.48	0.23	0.31	523.00
1992	2.34	0.01	2.52	0.44	0.48	0.23	0.31	523.00
1993	2.34	0.01	2.52	0.44	0.48	0.23	0.31	523.00
1994	2.65	0.01	2.52	0.44	0.49	0.24	0.31	523.07
1995	2.65	0.01	2.52	0.44	0.49	0.24	0.31	523.07
1996	2.65	0.01	2.52	0.44	0.49	0.24	0.31	523.07
1997	2.65	0.01	2.52	0.44	0.49	0.24	0.31	523.07
1998	2.65	0.01	2.52	0.44	0.49	0.24	0.31	523.07
1999	2.65	0.01	2.52	0.44	0.5	0.24	0.31	523.44
2000	2.65	0.01	2.52	0.44	0.5	0.24	0.31	523.44
2001	2.65	0.01	2.52	0.44	0.5	0.24	0.31	523.44
2002	2.65	0.01	2.52	0.44	0.5	0.24	0.31	523.44
2003	2.65	0.01	2.52	0.44	0.5	0.24	0.31	523.44
2004	2.65	0.01	2.52	0.44	0.54	0.24	0.31	524.33
2005	2.65	0.01	2.52	0.44	0.54	0.24	0.31	524.33
2006	2.65	0.01	2.52	0.44	0.54	0.24	0.31	524.33
2007	1.45	0.01	6.19	0.44	1.34	0.24	0.31	524.33
2008	1.45	0.01	6.19	0.44	1.34	0.24	0.31	524.33
2009	1.45	0.01	6.19	0.44	1.42	0.24	0.31	523.90
2010	1.45	0.01	6.19	0.44	1.42	0.24	0.31	523.90
2011	1.45	0.01	6.19	0.44	1.42	0.24	0.31	523.90
2012	1.45	0.01	6.10	0.44	1.40	0.24	0.31	523.90
2013	1.46	0.01	6.19	0.44	1.82	0.24	0.31	523.90
2014	1.46	0.01	6.29	0.45	1.85	0.24	0.30	522.09
2015	1.46	0.01	6.38	0.44	1.50	0.24	0.31	522.38

CO_2 emissions from drained organic soils in croplands were calculated using IPCC Wetlands Supplement Tier 1 method. Emission factor – 7.9 tonnes C ha^{-1} annually.

Drained organic soil in cropland is source of CH_4 emissions. CH_4 emissions are calculated by equation 2.6 in IPCC Wetlands Supplement. The emission factor for organic soils (Table 2.3 and table 2.4 in IPCC Wetlands Supplement) is 0±2.8 kg CH_4 ha^{-1} yr^{-1} (cropland, drained) and emission factor for drainage ditches 1165±830 kg CH_4 ha^{-1} yr^{-1} (deep – drained cropland); respectively, only CH_4 emissions from ditches are calculated. Drainage systems on organic soils are considered. Area of ditches is considered equally proportional to area of drained organic soil in cropland using digital topographic maps 1:10000, digitalized soil maps and

[231] *https://drive.google.com/file/d/0Bxv4jQ_04jXZRU9vQXZsNE12LTA/view*

database of peat extraction sites (the latest source specifically for evaluation of area of the ditches in lands converted for peat extraction).

6.5.2.2 Land converted to cropland (CRF 4.B.2)

Transition period for all land use changes is considered 20 years; respectively, land converted to cropland in 1990 is accounted under the cropland remaining cropland category in 2010. Land use changes to cropland in 1990-2008 are estimated using remote sensing based evaluation of vegetation index.

Area of organic soil in land converted to cropland is calculated using different approach than in cropland remaining cropland. Instead of using proportion of area of organic soil in the final land use category, the values characteristic for initial land use are applied. Respectively, if share of organic soil in forest land remaining forest in 1990 is 22 %, it is considered, that area of organic soil in forest land converted to cropland in 1990 is 22 %[232]. These values will be updated with actual field measurement data during implementation of 3rd and 4th NFI cycle (until 2021).

Unlike to cropland remaining cropland carbon stock change in living biomass in forest land converted to cropland is calculated as losses in living biomass due to felling of trees, considering average carbon stock in living biomass in forest land remaining forest in a particular year. Losses in dead wood are accounted similarly, as loss of average carbon stock in dead wood in a particular year. Carbon stock in litter is considered as constant value 12.14 ± 2.8 t C ha^{-1} according to the BioSoil project results in fertile stand types (*Hylocomiosa, Oxalidosa, Myrtilloso-sphagnosa, Myrtillosoi-polytrichosa, Myrtillosa mel., Mercurialosa mel.*). Instant oxidation method is applied to living biomass, dead wood and litter carbon pools.

Carbon stock changes in mineral soil are estimated using Equation 2.25 of the 2006 IPCC Guidelines. Impact factors for calculations of the carbon stock change under different management activities are taken from Table 5.5 in 2006 IPCC Guidelines:

- FLU 0.69 (Long-term cultivated, Temperate moist);
- FMG 1.00 (Full tillage, Temperate dry and wet);
- FI 1.00 (Medium input, all).

The initial carbon stock in mineral forest soil at 0-30 cm depth (reference C stock) is 82.6 ± 7.8 t ha^{-1} according to the forest soil monitoring project BioSoil[233]. Forest stand types similar to agricultural lands are selected to calculate average carbon stock in forest soil (*Hylocomiosa, Oxalidosa, Myrtilloso-sphagnosa, Myrtillosoi-polytrichosa, Myrtillosa mel., Mercurialosa mel.*). The carbon stock in forest land converted to cropland after transition period of 20 years according to the Equation 2.25 is 57 t C ha^{-1} at 0-30 cm depth; respectively, reduction of carbon stock in mineral soils is 25.6 t ha^{-1} or 1.3 t C ha^{-1} annually.

In organic soil of forest land converted to cropland the factor for cropland remaining cropland (7.9 t C ha^{-1} annually) is used to estimate carbon stock changes. The same approach as for cropland remaining cropland is used to calculate CH_4 emissions from drainage ditches.

[232] *Lazdiņš, Bārdule, and Stola, "Preliminary Results of Evaluation of Area of Organic Soils in Arable Lands in Latvia."*
[233] *Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums*

6.5.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of area estimates is provided in Table 6.23.

Table 6.23 Uncertainty of the cropland use data in 2015

Land use category	Number of NFI plots	Share of NFI plots, %	Uncertainty, %
Cropland	4295	26.6	2.6
cropland remaining cropland	4255	26.3	2.6
organic soil	221	1.4	13.3
other soil	4034	25.0	2.7
land converted to cropland	40	0.3	53.4
organic soil	5	0.03	113.9
other soil	35	0.2	64.5

The uncertainty of CO_2 emission factor for organic soil is determined according to IPCC Wetlands Supplement. According to Table 5.5 of the 2006 IPCC Guidelines the uncertainty of impact factor for different management practices applied in croplands is 12 % for long term cultivating. No uncertainty is considered for full tillage and medium input (impact factor – 1). Uncertainty of CH_4 emission factor for drainage ditches is 71 % (Table 2.4 in IPCC Wetlands Supplement).

Uncertainty of average carbon stock in litter in forests is 23 %, uncertainty of carbon stock in mineral soil in forest land at 0-30 cm is 9 %, uncertainty of dead wood stock in forests is 2 %, uncertainty of carbon stock in dead wood according to the expert judgement is 30 %; the combined uncertainty of carbon stock in dead wood is 31 %.

Consistency of time series of calculations is secured by use of the NFI data for the cropland and grassland area and the NFI based remote sensing analysis for land use changes. The estimation of area of organic soil represents situation before 1990. Area of cropland on organic soil might be overestimated or underestimated; however, more accurate data are expected during the field evaluation of the status of organic soils identified during the digitization of the soil inventory maps[234] project implemented within the scope of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy ".

6.5.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

The QA/QC plans for the cropland category includes the QC measures based on the IPCC (2006 IPCC Guidelines, Chapter 5.4.3, Tier 1 based QA/QC). The QA/QC procedures are implemented during every inventory. Several quality meetings are held annually between experts. Potential errors and inconsistencies are documented and corrections are made if necessary. Land use, as well as carbon stock in living and dead biomass related QA/QC procedures is implemented within the scope of the standard NFI procedure by re-measuring

[234] *https://geolatvija.lv/geo/p/247*

of 20 % of all sample plots. Training of the NFI field teams takes place every spring before starting the field works.

A part of remote sensing data (10 %) was evaluated manually during the remote analysis to estimate uncertainty of the automatic classification of vegetation index.

6.5.5 Category-specific recalculations

Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors as well as new biomass expansion factors and carbon content in wood were implemented in the calculations. Summary of the impact of recalculation on the aggregated net GHG emissions from cropland is shown in Figure 6.10. The impact of recalculation is within the range of uncertainty. Different impact value in 2014 isassociated with slight update of activity data of organic soils.

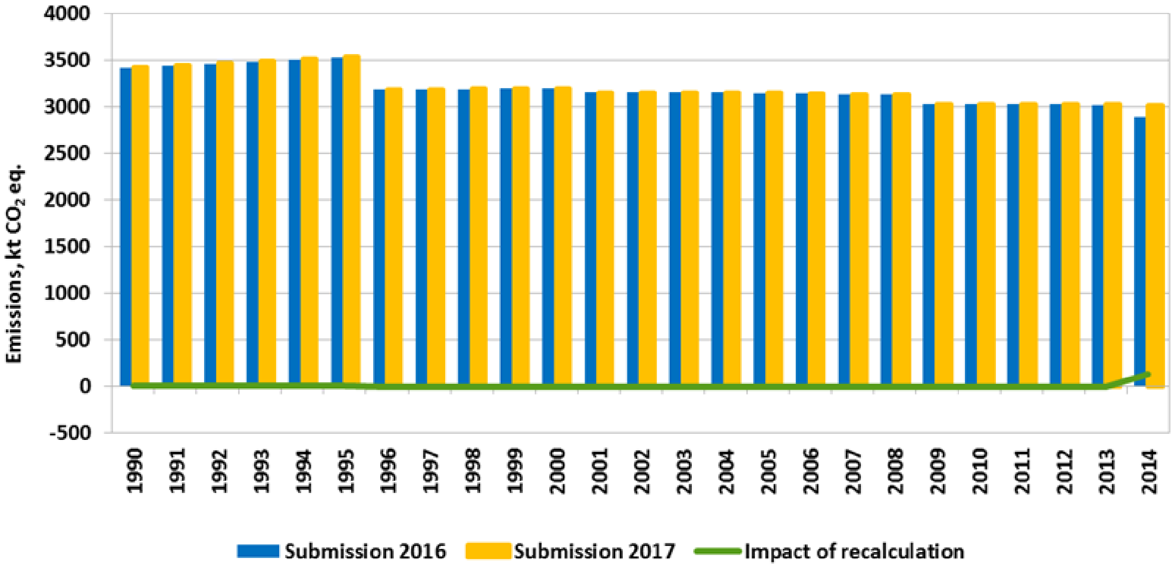

Figure 6.10 Impact of recalculation on the aggregated net GHG emissions from cropland

6.5.6 Category-specific planned improvements

There are several improvements proposed for the following inventories:

- updated area of organic soil in cropland according to the NFI study started in 2012[235]; 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 CO_2 emissions from organic soil considering area changes and recent findings in Nordic and Baltic countries;
- updated N_2O emissions due to land use changes using emphyrical data on carbon stock changes in soil;
- Tier 3 methodology to estimate carbon stock changes in cropland considering changes of cropping practices since 1970.

[235] *Lazdiņš, A., 2012. Atbalsts klimata pētījumu programmai (starpziņojums par 2012. gada darba uzdevumu izpildi) (No. 020512/S68). LVMI Silava, Salaspils.*

Losses in living biomass, dead wood, litter and soil due to conversion of forest land to cropland are reported using Tier 1 approach, resulting in high emissions, which can lead to overestimation or underestimation of actual emissions, therefore Tier 2 approach will be developed. This activity is of special importance considering that the most of the land use conversions in projections of the processes in LULUCF sector relates to conversion of naturally afforested lands (agricultural lands where agricultural activities or active management ended after 1990) to cropland or grassland resulting in considerably smaller emissions than it is estimated according to Tier 1 approach.

6.6 GRASSLAND (CRF 4.C)

6.6.1 Category description

The grassland's is a key category of CO_2 emissions from soils (Figure 6.11). Total area of grassland in Latvia in 2015 was 738.07 kha, including 594.34 kha of grassland remaining grassland. Grassland remaining grassland is divided into mineral and organic soils. Area of the grassland is estimated using research data[236] on the base of remote sensing data analysis. The net emissions from grassland remaining grassland were 635.90 kt CO_2 eq. (including emissions from biomass burning) in Latvia in 2015 (Figure 6.12). The CO_2 removals are accounted in living and dead biomass in grasslands not fulfilling criteria of forest definition. The peaks in time series of N_2O and CH_4 emissions in 2003, 2006, 2009 and 2014 are due to increment of area of wildfires in grassland remaining grassland.

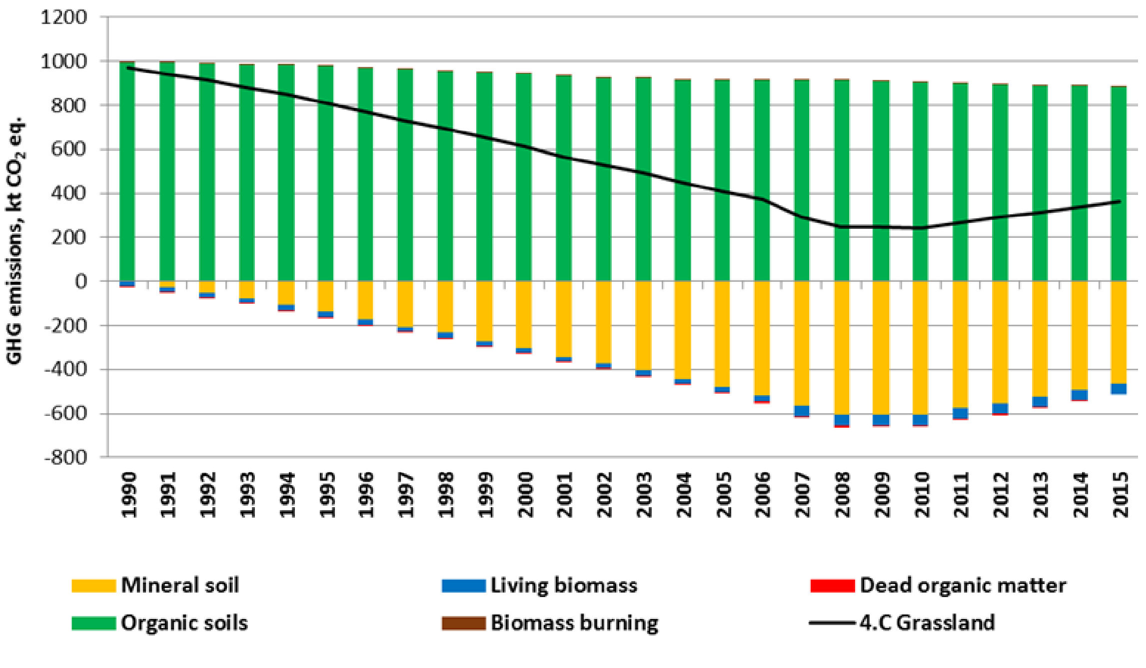

Figure 6.11 Summary of GHG emissions in grassland (kt CO_2 eq.) by source and sink categories

[236] *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.*

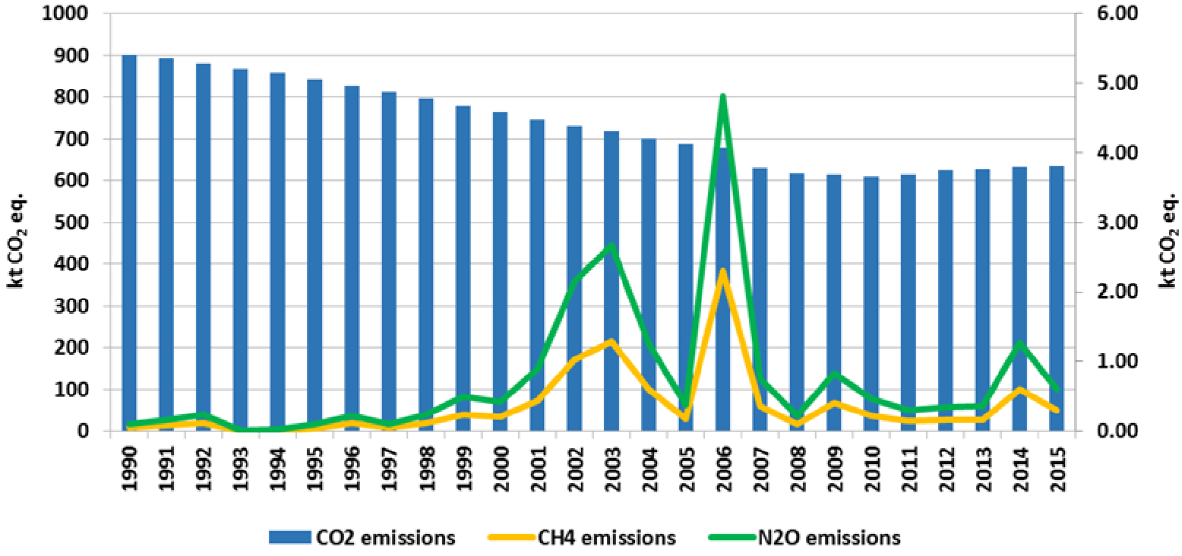

Figure 6.12 Summary of GHG emissions from grassland remaining grassland[237] (kt CO_2 eq.)

Land converted to cropland is a key category of CO_2 removals due to sequestration of carbon in mineral soil after conversion of cropland to grassland. Soil carbon stock changes are estimated using Tier 1 method. Under this category all lands converted to grassland less than 20 years ago[238] are accounted and the total area is estimated to be 143.73 kha in 2015. Net GHG emissions in land category land converted to grassland excluding emissions from drained organic soil in 2015 were -333.52 kt CO_2 eq. (Figure 6.13). Increase of removals of CO_2 in land converted to grassland is associated with removals of CO_2 in soil due to land use change from cropland to grassland which is calculated using Tier 1 method and will be updated in further submissions.

[237] *CH_4 and N_2O emissions on secondary axis*

[238] *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.*

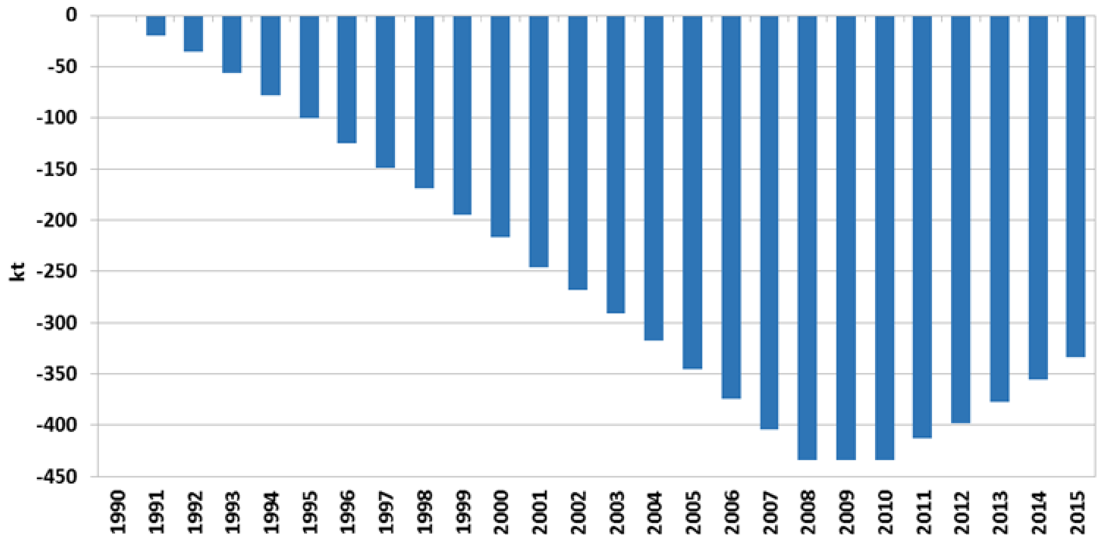

Figure 6.13 Summary of CO_2 emissions in land converted to grassland (kt)

Grassland remaining grassland is divided into mineral (95% of total area of grassland remaining grassland) and organic (5% of total area of grassland remaining grassland) soils. It is assumed that mineral soils are neither a source nor sink of CO_2. It could be changed depending on management level (degraded or improved) in grasslands; however, according to the expert judgement it was considered that all grasslands are managed in way that there are no degraded or improved grasslands. The judgement is based on a pilot study of implementation of the Yasso model in grassand[239] approving that soil carbon stock changes in grassland remaining grassland are not significant.. This type of management systems is not associated with decrease of carbon stock in soil. Organic soils are considerable source of CO_2 emissions. Organic soils and drainage ditches in grasslands are accounted as a source of methane also as it is recommended in IPCC Wetlands Supplement Chapter 2.

From 1990 to 2008 all categories of land use change to grassland, except cropland to grassland, are reported as NO, because there are no evidences of such conversions. Since 2009 conversion from forest land, wetland and settlements to grassland is accounted. All grassland is reported in the managed lands category.

Increase of the area of organic soils in the land converted to cropland category is associated with conversion of cropland to grassland during the 1990s and during the last decade. Opposite process – reduction of area of grassland – took place due to afforestation (both natural expansion of forest and planting) of the grassland.

6.6.2 Methodological issues

6.6.2.1 Grassland remaining grassland (CRF 4.C.1)

Woody biomass increment figures for 2004-2015 are taken from the NFI. Tor the earlier years results of recalculation of increment of living biomass in grassland are considered[240]. 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

[239] *https://drive.google.com/file/d/0Bxv4jQ_04jXZRU9vQXZsNE12LTA/view*
[240] *Jansons, Methods Utilized to Recalculate Historical Forest Increment Data.*

biomass) in forest land in a particular year. Decay period for dead wood is considered 20 years according to 2006 IPCC Guidelines.

The assumptions for biomass calculations used in EPIM tool are shown in Table 6.24 default 20 years decay period is considered for dead wood.

Table 6.24 Relative stock changes for grassland management in mineral soils

Factor	Level	Climate regime	IPCC default	Uncertainty
Land use	All	All	1.0	NA
Management	Nominally managed (non-degraded)	All	1.0	NA
Management	Moderately degraded grassland	Temperate / Boreal	0.95	± 13%
Management	Severely degraded	All	0.7	± 40%
Management	Improved grassland	Temperate / Boreal	1.14	± 11%
Input (applied only to improved grassland)	Medium	All	1.0	NA
Input (applied only to improved grassland)	High	All	1.11	± 7%

The calculations are done in EPIM tool. The assumptions used in EPIM tool are shown in Table 6.25, default 20 years decay period is considered for dead wood.

Table 6.25 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 t^{-1}
		mill. M^3	m^3 ha^{-1}			stem to crown	stem to below-ground	
1990	19.13	0.02	0.97	0.44	0.18	0.23	0.31	523.00
1991	19.44	0.02	0.95	0.44	0.18	0.23	0.31	523.00
1992	19.75	0.02	1	0.44	0.19	0.23	0.31	523.00
1993	20.07	0.02	0.99	0.44	0.19	0.23	0.31	523.00
1994	20.38	0.02	0.99	0.44	0.19	0.24	0.31	523.07
1995	20.69	0.02	0.97	0.44	0.19	0.24	0.31	523.07
1996	21.00	0.02	0.96	0.44	0.19	0.24	0.31	523.07
1997	21.32	0.02	0.96	0.44	0.19	0.24	0.31	523.07
1998	21.63	0.02	0.94	0.44	0.19	0.24	0.31	523.07
1999	21.94	0.02	0.98	0.44	0.2	0.24	0.31	523.44
2000	22.26	0.02	0.97	0.44	0.19	0.24	0.31	523.44
2001	22.57	0.02	0.96	0.44	0.19	0.24	0.31	523.44
2002	22.88	0.02	0.94	0.44	0.19	0.24	0.31	523.44
2003	23.19	0.02	0.93	0.44	0.19	0.24	0.31	523.44
2004	23.51	0.02	0.92	0.44	0.2	0.24	0.31	524.33
2005	23.82	0.02	0.91	0.44	0.2	0.24	0.31	524.33
2006	24.13	0.02	0.89	0.44	0.19	0.24	0.31	524.33
2007	23.54	0.05	2.12	0.44	0.46	0.24	0.31	524.33
2008	23.54	0.05	2.12	0.44	0.46	0.24	0.31	524.33
2009	23.54	0.05	2.12	0.44	0.49	0.24	0.31	523.90
2010	23.54	0.05	2.12	0.44	0.49	0.24	0.31	523.90
2011	23.54	0.05	2.12	0.44	0.49	0.24	0.31	523.90
2012	23.62	0.04	1.88	0.44	0.43	0.24	0.31	523.90
2013	23.76	0.05	1.93	0.44	0.57	0.24	0.31	523.90
2014	23.93	0.05	1.98	0.45	0.58	0.23	0.30	522.09
2015	24.09	0.05	2.03	0.44	0.48	0.24	0.31	522.38

The emission factor of drained organic soils is considered to be 6.1 tonnes C ha^{-1} yearly according to IPCC KP Supplement.

Emission factors for CH_4 emissions from drained organic soil and drainage ditches are respectively 16 kg and 1165 kg CH_4 yearly according to Tables 2.3 and 2.4 in IPCC KP Supplement. Total area of drainage ditches is estimated by using the same approach as explained in cropland. Ditch density on organic soils is assumed to be 0.045 ha ha^{-1}.

Default coefficients on impact of different management regime on carbon emissions obtained from 2006 IPCC Guidelines Chapter 6, Table 6.2 are used to calculate carbon stock changes in mineral soil (Table 6.26). Combined impact factor for carbon stock changes in mineral soil is equal to 1 (land use – all, management – non-degraded, input – medium).

Table 6.26 Relative stock changes due to grassland management on mineral soils

Factor	Level	Climate regime	IPCC default	Uncertainty
Land use	All	All	1.0	NA
Management	Nominally managed (non-degraded)	All	1.0	NA
Management	Moderately degraded grassland	Temperate / Boreal	0.95	± 13%
Management	Severely degraded	All	0.7	± 40%
Management	Improved grassland	Temperate / Boreal	1.14	± 11%
Input (applied only to improved grassland)	Medium	All	1.0	NA
Input (applied only to improved grassland)	High	All	1.11	± 7%

N_2O and CH_4 emissions from biomass burning are calculated according to methodology described in following chapter on Biomass burning.

6.6.2.2 Land converted to grassland (CRF 4.C.2)

Carbon stock changes in mineral soils in cropland converted to grassland are reported as net removals using tier 1 method, the soil carbon stock difference is 23.7 tonnes C ha^{-1}. Research data[241] based tier 2 or tier 3 method will be implemented in future submissions.

Methane emissions from ditches on organic soils have been included in estimates also for lands converted to grasslands and it is calculated with the same approach as grassland remaining grassland.

"NE" for carbon stock changes in living biomass, dead wood and litter for forest land converted to grassland, wetlands converted to grassland and settlements converted to grassland as well as in mineral soils (forest land converted to grassland and settlements converted to grassland) and organic soils (wetlands converted to grassland) is reported. The "NE" notation key will be replaced with actual values for CO_2 removals and GHG emissions after completion of the third NFI cycle in 2018.

6.6.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

[241] *https://sites.google.com/site/lvlulucf/research-projects/augsnesogleklakrajumunovertesanaaramzemeunplavas*

Uncertainty of area estimates is provided in Table 6.27.

Table 6.27 Uncertainty of the grassland use data in 2015

Land use category	Number of NFI plots	Share of NFI plots, %	Uncertainty, %
Grassland	1747	10.8	4.2
grassland remaining grassland	1407	8.7	5.0
organic soil	73	0.5	25.7
other soil	1334	8.3	5.1
land converted to grassland	340	2.1	9.8
organic soil	17	0.1	55.1
other soil	324	2.0	10.0

The uncertainty estimate for the CO_2 emission factor for organic soils is 19 % according to the Table 2.1 in IPCC Wetlands Supplement.

Uncertainties for emission factors used in calculation of CH_4 emissions from organic grasslands and drainage ditches are 83 % and 71 % according to Table 2.3 and Table 2.4 in IPCC Wetlands Supplement.

The time series of emissions from grasslands is consistent; however, overestimation or underestinmation is possible due to lack of knowledge about current area and distribution of organic soils.

6.6.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

The QA/QC plans for the Grassland's category includes the QC measures based on the IPCC (2006 IPCC Guidelines, Chapter 6.4.3, Tier 1 approach). 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. Several quality meetings are held annually between experts.

6.6.5 Category-specific recalculations

Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors as well as new biomass expansion factors and carbon content in wood were implemented in the calculations. Summary of the impact of recalculation on the aggregated net GHG emissions from grassland is shown in Figure 6.14. Considerable reduction of GHG emissions due to recalculation after 2009 is associated with replacement of extrapolated land use change data with actual NFI data, respectively, the extrapolation considered more conversion of organic soils to grassland.

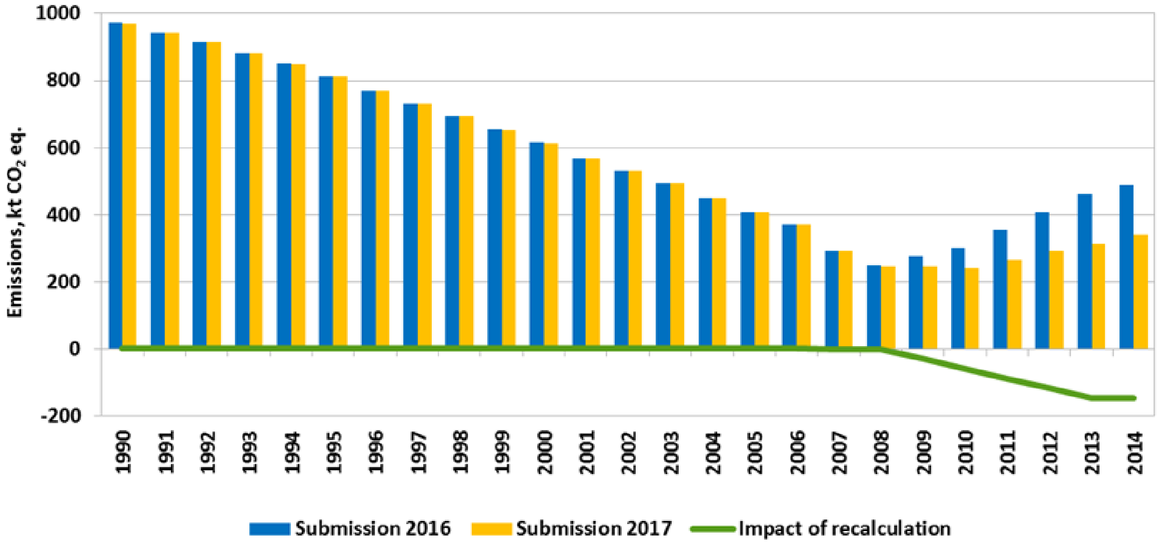

Figure 6.14 Impact of recalculation on the aggregated net GHG emissions from grassland

6.6.6 Category-specific planned improvements

It is planned to improve accounting of organic soil and ditch area in next years. Now we have limited knowledge about area of organic soils and drainage ditches in grasslands. Starting from 2017 new NFI inventory data and results about organic soils in grassland will be available and on the basis of the NFI inventory it will be possible to specify accounting.

Country specific data are necessary to estimate carbon stock changes according to the soil mapping data, as well as to estimate share of organic soil in land converted to grassland.

6.7 WETLANDS (CRF 4.D)

6.7.1 Category description

Wetlands remaining wetlands is a key category of CO_2 emissions mainly due to peat extraction for horticulture. The net GHG emissions in wetlands in 2015 were 1012.05 kt CO_2 eq (Figure 6.15, Figure 6.16).

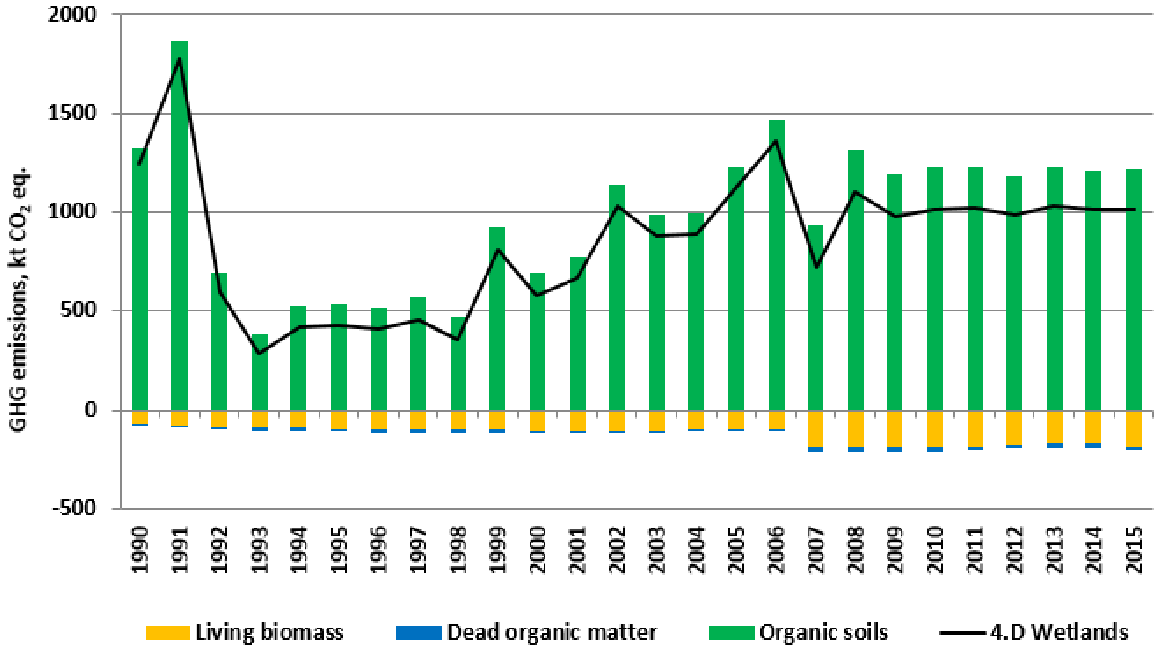

Figure 6.15 Summary of GHG emissions from wetlands (kt CO_2 eq.) by source and sink categories

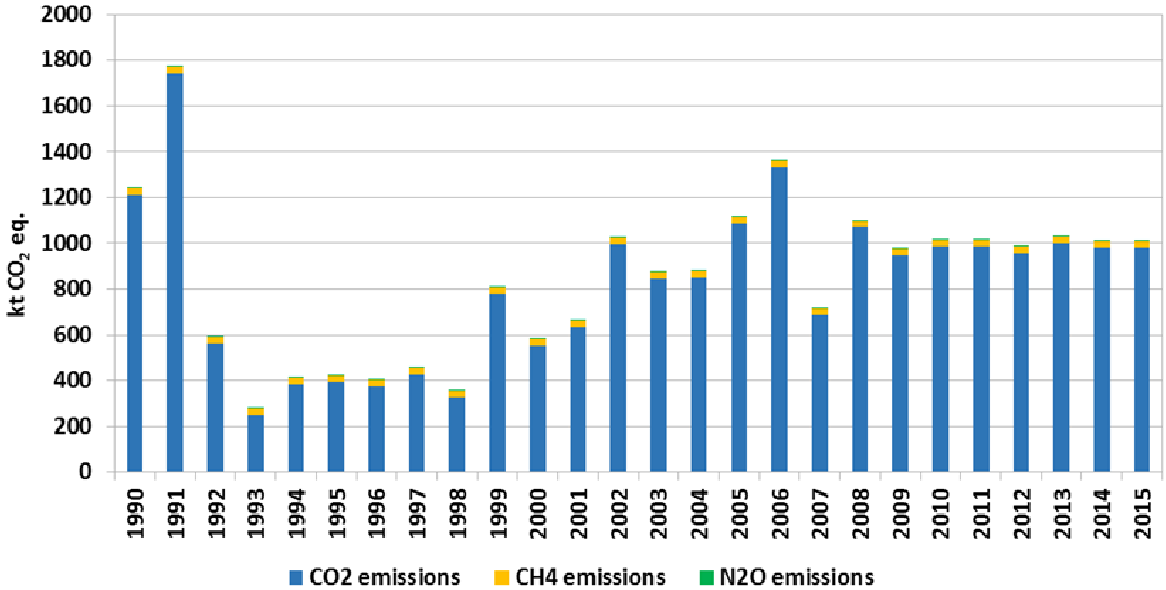

Figure 6.16 Summary of GHG emissions from wetlands (kt CO_2 eq.)

According to the 2006 IPCC Guidelines 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. In 2015 total area of wetlands was 445.18 kha, including 27.0 kha of peat-lands drained for peat extraction (Table 3a.3.3 of the IPCC GPG LULUCF 2003) and area with woody vegetation (Table 6.28).

Latvia reports CO_2 emissions associated mainly with industrial peat extraction in this category. The rest of the area of wetlands is not managed and CO_2 emissions are not calculated, exception is area with woody vegetation located adjacent to water courses, water body or swamps and which does not fit to definition of forest land category – shorelines of rivers and lakes, which are usually maintained, because of environmental restrictions, as buffer zones. Other types of wetlands remaining wetlands included in CRF table 4.D.1 are lower, upper and transitional bogs and water bodies, excluding drainage ditches and channels. All these types of lands are estimated using the NFI data and a consistent methodology, therefore no overlapping is possible.

Aggregated emissions from industrial peat-lands are equal for the whole time series due to lack of data about status of industrial peat-lands prepared for extraction 20-40 years ago. However, there are no evidences of new industrial peat-lands prepared for peat extraction after 1990; therefore, the risk of underestimation of emissions does not exist. N_2O contributes to about 0.4 % of net emissions from peat-lands. Removals in this category are reported in living and dead biomass, mainly in narrow bands of trees (buffer zones) across lakes and rivers which do not fulfils threshold values of forest definition.

6.7.2 Methodological issues

Emission factor for carbon stock changes (2.8 t C ha^{-1} yr^{-1}) due to drainage is taken from IPCC Wetlands Supplement[242]. Carbon content in air dry peat (0.45 t C per tonne of peat) is considered according to Table 7.5 of 2006 IPCC Guidelines[243]. Moisture of peat reported in national statistics is considered 40 %.

Off-site CO_2-C emissions associated to the horticultural (non-energy) use of peat extracted and removed are reported using instant oxidation method. Off-site emissions from peat used for energy are reported in the Energy Sector (1.A.1. Energy industries, 1.A.2. Manufacturing industries and construction and 1.A.4. Other sectors), and is therefore not included here.

Data on peat extraction for horticulture purposes is taken from statistical reports using extrapolation method for the periods, when official data are not available. Carbon content in peat is considered 54 %, relative moisture – 40 %, according to a methodology used in statistical accounting.

CH_4 emissions from drained organic soils are calculated according to methodology applied in drained forests on organic soil. As drainage of wetlands in national conditions is occurring only in territories for peat extraction default emission factors for drained organic soil (6.1 kg CH_4 ha^{-1} yr^{-1}) and drainage ditches (542 kg CH_4 ha^{-1} yr^{-1}) for peat extraction are utilized. Density of ditches is considered 0.07 ha per 1 ha of peatland.

The calculations are done in EPIM tool. The assumptions used in EPIM tool are shown in Table 6.28, default 20 years decay period is considered for dead wood.

Table 6.28 Assumptions for calculation of carbon stock changes in living and dead biomass in wetlands

Year	Wetlands 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 $tonne^{-1}$
		mill. M^3	m^3 ha^{-1}			stem to crown	stem to below-ground	
1990	189.25	0.06	0.33	0.44	0.06	0.23	0.31	523.00
1991	191.55	0.07	0.37	0.44	0.07	0.23	0.31	523.00
1992	193.42	0.08	0.41	0.44	0.08	0.23	0.31	523.00
1993	194.24	0.08	0.42	0.44	0.08	0.23	0.31	523.00

[242] *Emission factors for CO_2–C and associated uncertainty for lands managed for peat extraction, by climate zone*
[243] *Conversion factors for CO_2–C for volume and weight production data*

Year	Wetlands 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 $tonne^{-1}$
		mill. M^3	m^3 ha^{-1}			stem to crown	stem to below-ground	
1994	195.72	0.09	0.44	0.44	0.09	0.24	0.32	523.07
1995	196.29	0.09	0.45	0.44	0.09	0.24	0.32	523.07
1996	197.92	0.09	0.46	0.44	0.09	0.24	0.32	523.07
1997	199.26	0.09	0.46	0.44	0.09	0.24	0.32	523.07
1998	201.05	0.09	0.47	0.44	0.09	0.24	0.32	523.07
1999	201.2	0.09	0.47	0.44	0.09	0.24	0.31	523.44
2000	202.54	0.1	0.47	0.44	0.09	0.24	0.31	523.44
2001	203.12	0.1	0.47	0.44	0.09	0.24	0.31	523.44
2002	204.27	0.1	0.47	0.44	0.09	0.24	0.31	523.44
2003	205.96	0.1	0.47	0.44	0.09	0.24	0.31	523.44
2004	206.59	0.1	0.46	0.44	0.1	0.24	0.31	524.33
2005	206.71	0.1	0.46	0.44	0.1	0.24	0.31	524.33
2006	210.16	0.1	0.46	0.44	0.1	0.24	0.31	524.33
2007	97.62	0.18	1.85	0.44	0.4	0.24	0.31	524.33
2008	97.62	0.18	1.85	0.44	0.4	0.24	0.31	524.33
2009	97.62	0.18	1.85	0.44	0.43	0.24	0.31	523.90
2010	97.62	0.18	1.85	0.44	0.43	0.24	0.31	523.90
2011	97.62	0.18	1.85	0.44	0.43	0.24	0.31	523.90
2012	97.62	0.17	1.73	0.44	0.40	0.24	0.31	523.90
2013	97.62	0.17	1.79	0.44	0.53	0.24	0.31	523.90
2014	97.62	0.18	1.84	0.45	0.54	0.23	0.30	522.09
2015	97.62	0.18	1.89	0.44	0.45	0.24	0.31	522.38

6.7.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of area estimates is provided in Table 6.29.

Table 6.29 Uncertainty of the wetland use data in 2015

Land use category	Number of NFI plots	Share of NFI plots, %	Uncertainty, %
Wetlands	1123	7.0	5.7
wetlands remaining wetlands	1119	6.9	5.9
drained soil	68	0.4	24.2
wet soil	1051	6.5	6.1
land converted to wetlands	4	0.03	13.4

The uncertainty estimate for the CO_2 emission factor for organic soils is 55 % according to the Table 2.1 in IPCC Wetlands Supplement.

Uncertainty range of emission factors for drained organic soil and drainage ditches are 1.6-11 kg CH_4 ha^{-1} yr^{-1} (77%) and 102-981 kg CH_4 ha^{-1} yr^{-1} (81%) according to the Table 2.3 and Table 2.4 in IPCC Wetlands Supplement.

Complete consistency of the time-series is secured by use of the same data source for estimation of area and emissions for the whole time period. Emissions associated with peat extraction might be considerably overestimated area of peat-lands prepared for extraction is reduced during last decades. 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.

6.7.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

Quality control procedures named in 2006 IPCC Guidelines were done, particularly, data about peat extraction were compiled from different sources (national statistics and Union of peat producers) as well as emission factors provided by different authors were compared. Several quality meetings are held annually between experts.

6.7.5 Category-specific recalculations

Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors as well as new biomass expansion factors and carbon content in wood were implemented in the calculations. Summary of the impact of recalculation on the aggregated net GHG emissions from wetlands is shown in Figure 6.17.

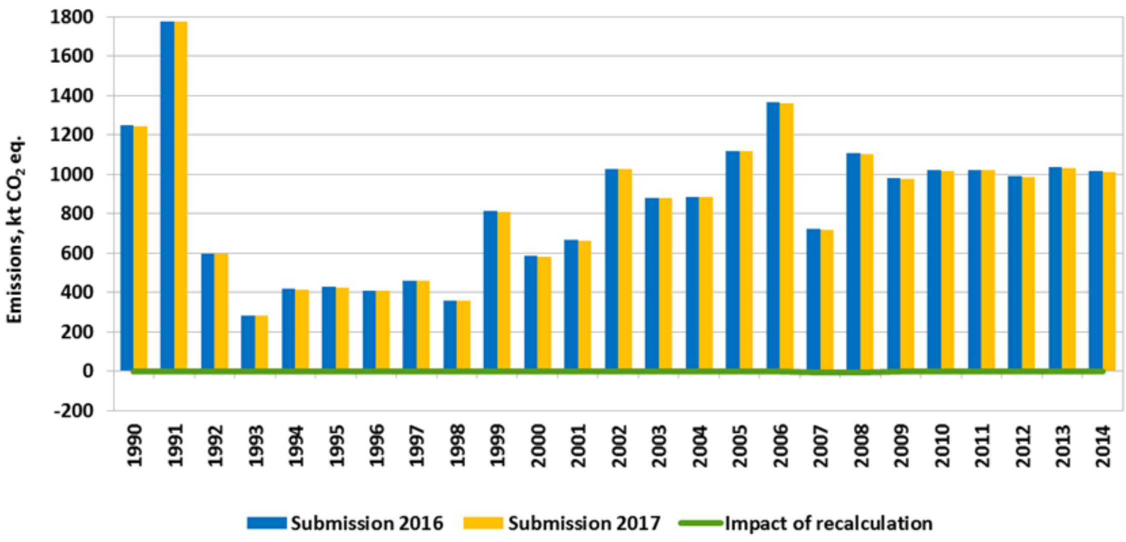

Figure 6.17 Impact of recalculation on the aggregated net GHG emissions from wetland

6.7.6 Category-specific planned improvements

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. Wetlands are one of the priorities in further development of GHG inventory in LULUCF sector in Latvia. Implementation of the national emission factors are proposed within the REstore project[244] which is aimed on elaboration for the emission

[244] *http://restore.daba.gov.lv/public/eng/*

factors for nitrogen poor organic soils under peat extraction, after afforestation, utilization as cropland or grassland and rewetted.

6.8 SETTLEMENTS (CRF 4.E)

6.8.1 Category description

Net CO_2 emissions from settlements in 2015 were 994.71 kt CO_2 (Figure 6.18). However, removals in woody vegetation and dead biomass in settlements remaining settlements were compensated by emissions due to land use change (land converted to settlements category). Net CO_2 emissions from land converted to settlements in 2015 were 1088.71 kt CO_2 (Figure 6.20).

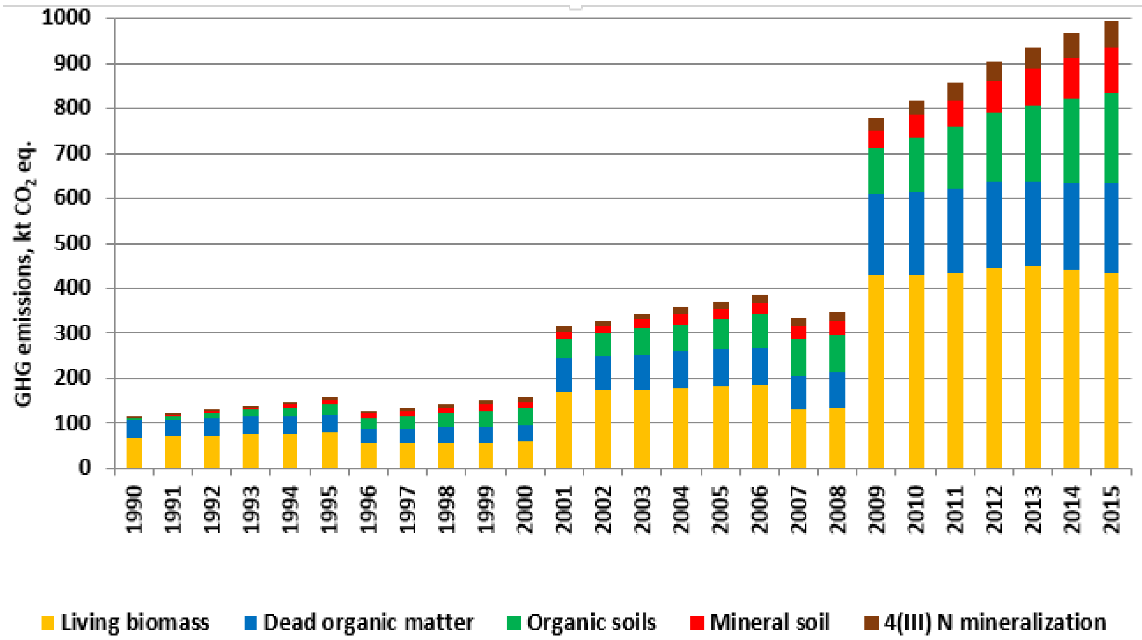

Figure 6.18 Summary of net GHG emissions from settlements (kt CO_2 eq.) by source categories

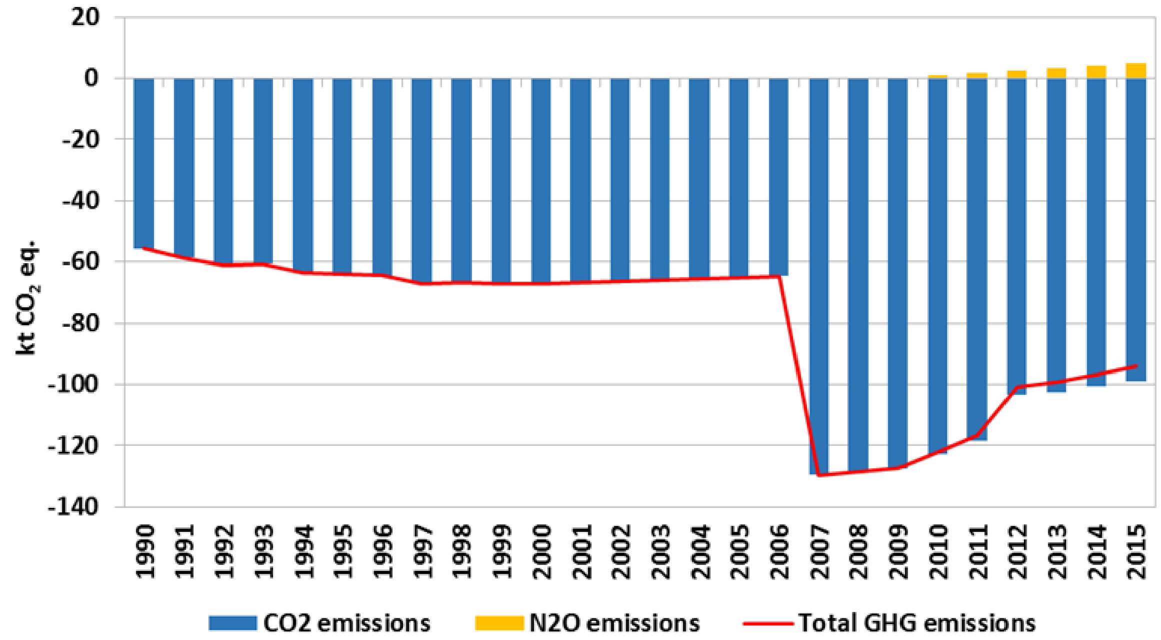

Figure 6.19 Summary of net GHG emissions from settlements remaining settlements (kt CO_2 eq.)

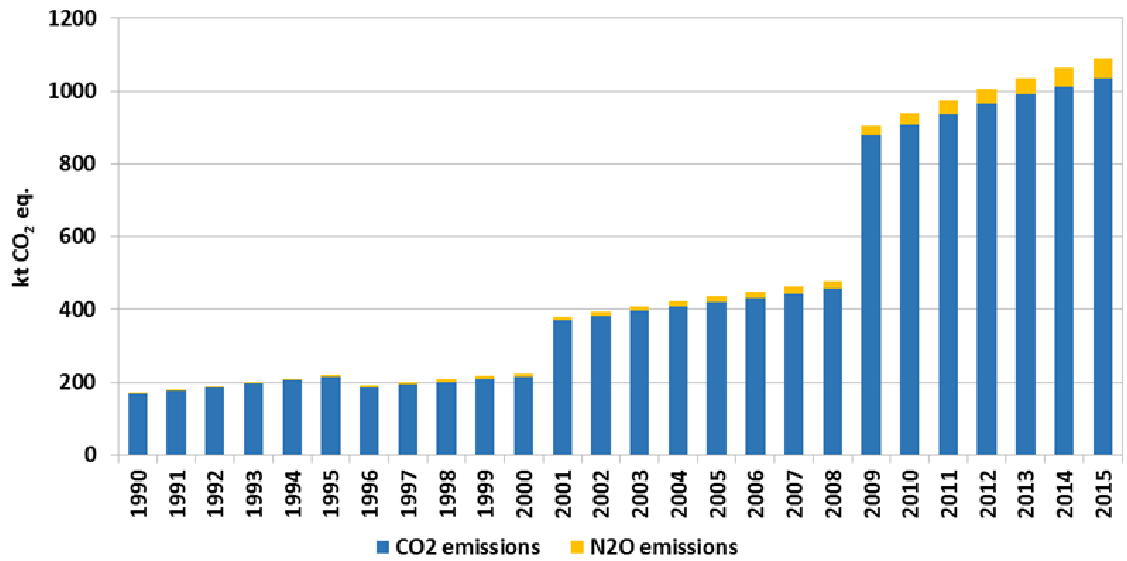

Figure 6.20 Summary of net GHG emissions from land converted to settlements (kt CO_2 eq.)

Land converted to settlements is a key category 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 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. At the same time conversion of grassland to forest land is more intensive in terms of the converted area; however, young forests on farmlands can not fully compensate emissions due to the forest lands conversion to settlements.

Under the settlements category emissions from soils, litter, living and dead biomass due to conversion of land use type are reported. In 2015 removals in living and dead biomass in settlements 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.

Total area of settlements in 2015 was 211.55 kha. The total area of settlements is estimated according to the information provided by the NFI. According to the expert estimation, increase of area of settlements during last 20 years occurred due to conversion of forest land. Increase of area of settlements is generally associated with road construction. All roads, including forest roads are reported in the settlements category; therefore, the deforested area is considerably higher than official statistics, where forest roads as well as new drainage systems are not accounted as deforested area and still belong to forest land.

6.8.2 Methodological issues

6.8.2.1 Settlements remaining settlements (CRF 4.E.1)

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 on weighed (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 counted 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. EPIM tool is used in calculations.

Emissions from soils in settlements remaining settlements are calculated according 2006 IPCC Guidelines. It is assumed that inputs equal outputs so that settlement mineral soil C stocks do not change in settlements remaining settlements. Emissions from organic soils in settlements remaining settlements are calculated using equation 2.26 in 2006 IPCC Guidelines (equation No. 6). If soils are drained and the peat is not removed, the emissions are calculated using emission factors for cultivated organic soils, due to deep drainage in settlements similar to cropland. Annual emission factor (EF) for cultivated organic soils in cool temperate climatic temperature regime is 7.9 tonnes C ha^{-1} yr^{-1} (IPCC 2014 Wetlands supplement)[245].

$$L_{Organic} = \sum_c (A \cdot EF)_c, \text{ where}$$

$L_{Organic}$ = annual carbon loss from drained organic soils, tonnes C yr^{-1};
A = land area of drained organic soils in climate type c, ha;
EF = emission factor for climate type c, tonnes C $ha^{-1} yr^{-1}$. (6)

6.8.2.2 Land converted to settlements (CRF 4.E.2)

Area of land converted to settlements is estimated by evaluation of vegetation index of the permanent and temporal NFI points (23 thousand 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 (2009-2013). Points, where the vegetation index permanently changed from forest to non-forest land were marked as potentially deforested. Then logical selection was used to separate those points where removal of woody vegetation is not associated with land use change (for instance, cleaning of roadsides outside

[245] Table 2.1 Tier 1 CO_2 emission/removal factors for drained organic soils in all land-use categories (Cropland, drained, boreal and temperate)

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.

NFI data are used to estimate land converted to settlements in 2009-2015.

Area of land converted to settlement since 1990 is estimated using satellite image analysis. Total area of land converted to settlements in 2015 is 42.59 kha.

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 in a particular year. 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 wood carbon pools.

Carbon stock changes in dead biomass are accounted using instant oxidation method considering that all dead biomass converts to emissions in the year of the land use change. Average carbon stock in dead biomass (12.14 tonnes C ha^{-1} in litter and 6.0 tonnes C ha^{-1} in dead wood) is used in calculations. Carbon stock in dead wood in converted land is considered to be equal to average carbon stock in dead biomass in forest land remaining forest land in a year of the 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 6.21) by total biomass distribution between species).

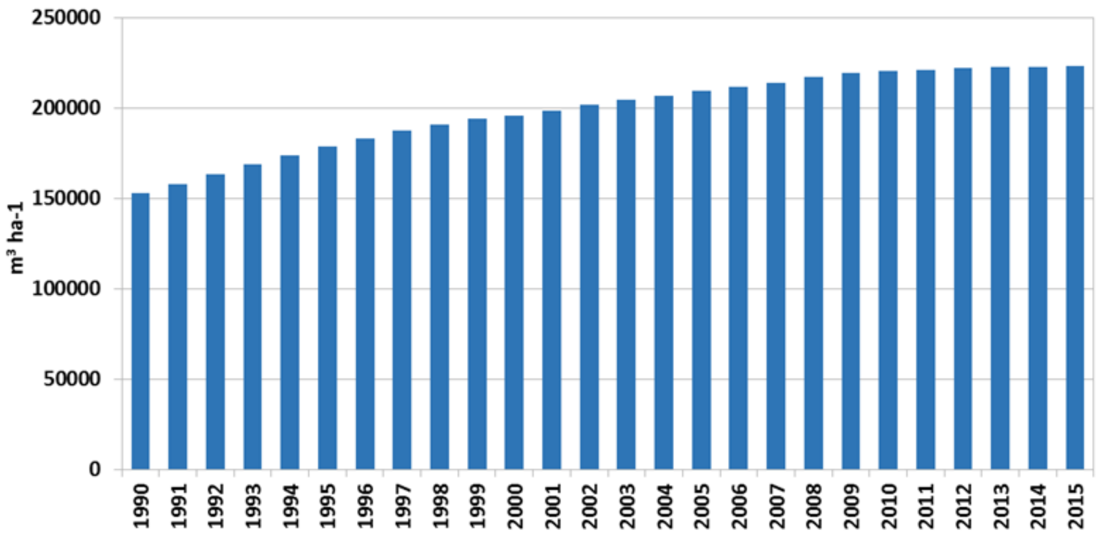

Figure 6.21 Assumption for average growing stock of living biomass in forest areas converted to settlements (m^3 ha^{-1})

Since 2009 "NE" for carbon stock changes in living biomass and dead organic matter for cropland converted to settlements, grassland converted to settlements and wetlands converted to settlements is reported. "NE" notation key will be replaced with actual values for CO_2 removals and GHG emissions after completion of the spatial analysis of digitized information of the NFI sample plots and extrapolation of the data obtained to the time period not covered by the NFI (1990–2003).

The total change in soil C stocks for land converted to settlements is computed using equation 2.24 in 2006 IPCC Guidelines, which combines the change in soil organic C stocks for mineral soils and organic soils. Change in soil organic C stocks is estimated for mineral soils with land-use conversion to settlements using Equation 2.25 in 2006 IPCC Guidelines (equation No. 7). Emission from mineral soil due to land use change to settlements is accounted according to average carbon stock in forest mineral soil, assuming that carbon accumulated in upper 30 cm (82.6 tonnes C ha^{-1}) partially turns into emissions within 20 years (0.8 tonnes C h^{-1} annually). The impact factor (F_{LU} x F_{MG} x F_I) is 0.8.

$$\Delta C_{Mineral} = \frac{\left(SOC_0 - SOC_{(0-T)}\right)}{D}$$

$$SOC = \sum_{c,s,i} \left(SOC_{REFc,s,i} \cdot F_{LUc,s,i} \cdot F_{MGc,s,i} \cdot F_{Ic,s,i} \cdot A_{c,s,i}\right), \text{ where}$$

$\Delta C_{Mineral}$ = annual change in carbon stocks in mineral soils, tonnes C yr^{-1};
SOC_0 = soil organic carbon stock in the last year of an inventory time period, tonnes C;
$SOC_{(0-T)}$ = soil organic carbon stock at the beginning of the inventory time period, tonnes C;
D = time dependence of stock change factors which is the default time period for transition between equilibrium SOC values, yr;
c = represents the climate zones;
s = the soil types;
i = the set of management systems that are present∈ a country;
SOC_{REF} = the reference carbon stock, tonnes C ha^{-1};
F_{LU} = stock changefactor for land−use systems or sub-system for a particular land−use, dimensionless;
F_{MG} = stock change factor for management regime, dimensionless;
F_I = stock change factor for input of organic matter, dimensionless;
A = land area of the stratum being estimated, ha . (7)

Land converted to settlements on organic soils within the inventory time period is treated the same as settlements remaining settlements. Carbon losses are computed using equation 2.26 in 2006 IPCC Guidelines.

6.8.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of area estimates is provided in Table 6.30.

Table 6.30 Uncertainty of the settlements use data in 2015

Land use category	Number of NFI plots	Share of NFI plots, %	Uncertainty, %
Settlements	661	4.1	7.8
settlements remaining settlements	570	3.5	8.7
organic soil	1	0.01	-
other soil	569	3.5	8.7
land converted to settlements	91	0.6	19.6
organic soil	12	0.1	47.0
other soil	78	0.5	22.0

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.

Uncertainty of annual carbon stock change factor (EF) for cultivated organic soils in cool temperate climatic temperature regime is ± 18 % (IPCC Wetlands Supplement, Table 2.1).

Uncertainties of emission factors for estimation of CH_4 emissions from drained organic soils are indicated under chapter Cropland.

6.8.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

The QA/QC plans for the settlements' category include the QC measures based on the 2006 IPCC Guidelines. Specific QA/QC checks across the settlements methodology were done. 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. Several quality meetings are held annually between experts.

6.8.5 Category-specific recalculations

Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors as well as new biomass expansion factors and carbon content in wood were implemented in the calculations. Summary of the impact of recalculation on the aggregated net GHG emissions from settlements is shown in Figure 6.22.

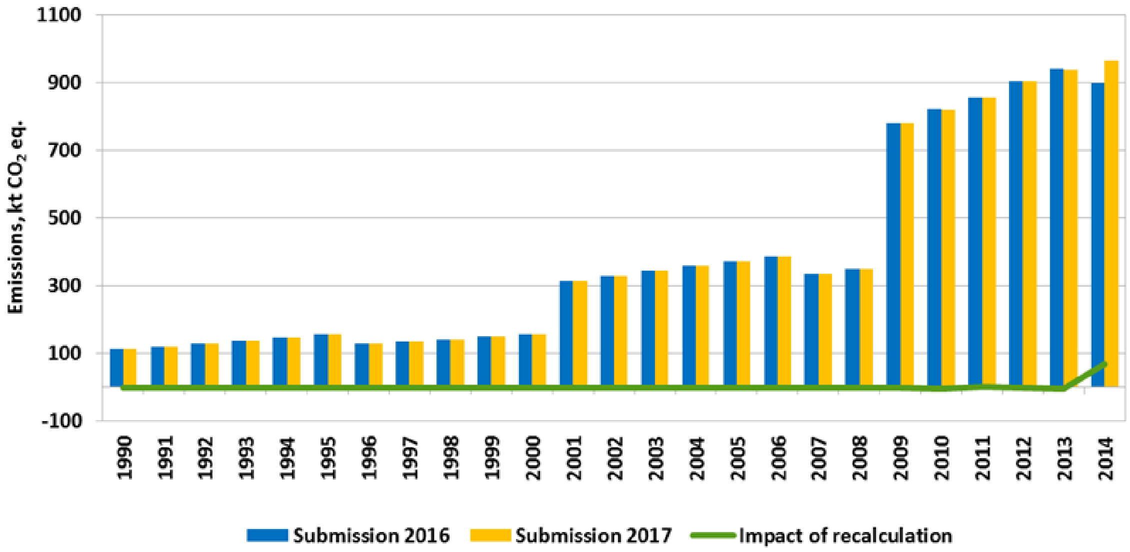

Figure 6.22 Impact of recalculation on the aggregated net GHG emissions from settlements

6.8.6 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 settlements are considered as 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. In 2016 high resolution satellite images and aerophoto images was used to increase accuracy of determination of the deforested areas and to evaluate dynamics of carbon stock in living. The obtained data will be implemented in the inventory after publishing.

Losses in living biomass, dead wood, litter and soil due to conversion of forest land to settlements are reported using Tier 1 approach, resulting in high emissions, which can lead to overestimation or underestimation of actual emissions, therefore Tier 2 approach (based on a single tree accounting in the NFI) will be developed.

6.9 OTHER LAND (CRF 4.F)

According to the 2006 IPCC Guidelines 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 include unmanaged lands, wetlands and settlements (1 459.3 mill. ha in 2008). Instead of other lands defined by national land use statistics since 2009 the NFI is used to estimate area of other lands. It is assumed that other lands are dunes not covered by woody vegetation. Total area of these lands is considered constant for the whole reporting period (5.44 kha). No GHG emissions or CO_2 removals are reported in this category.

6.10 BIOMASS BURNING (CRF 4(V))

6.10.1 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. Total aggregated emissions from biomass burning in 2015 were 85.55 kt of CO_2 eq. (Figure 6.23).

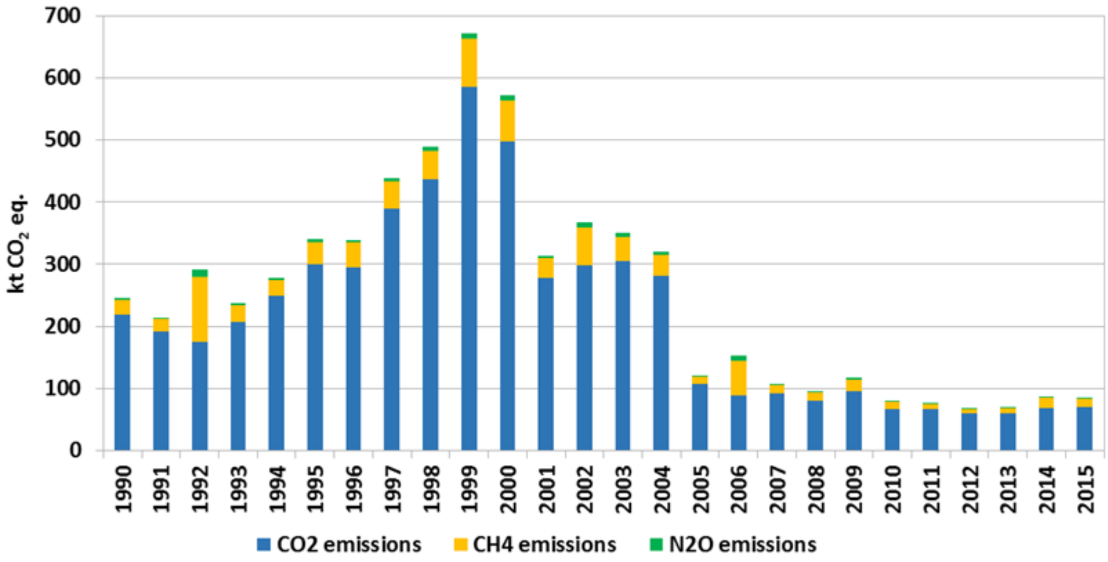

Figure 6.23 Aggregated emissions from biomass burning (kt CO_2 eq.)

Biomass burning occurs in forest land and grassland. Taking into account that wetlands (bogs and fens) belong 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 GHG inventory (reporting emissions under land use categories according to national statistics) secures that emissions from biomass burning are not overlapping.

The area statistics on forest wildfires are compiled by the State forest service and they are based on information given by the local units. Area of forest fires and biomass in burned area is shown in Figure 6.24.

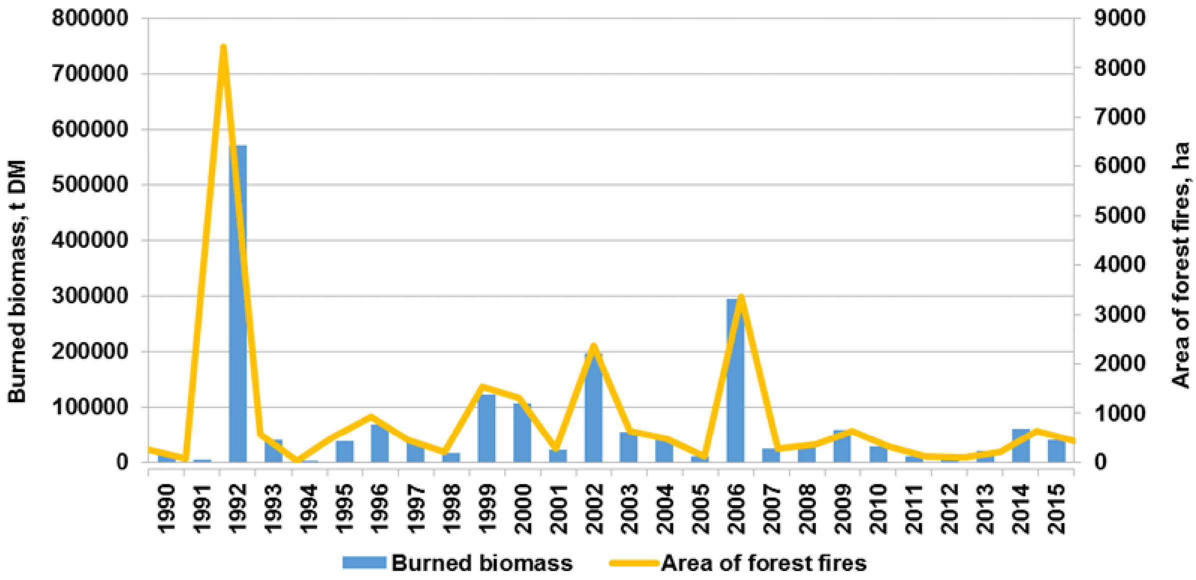

Figure 6.24 Area of forest fires and biomass in burned area

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 the Rural Support Service. Wildfires in grasslands are more common in south eastern part of the country and around Riga. Concentration of wildfires in the south-east correlates with area of abandoned farmlands. Total area of burned grassland is shown in Table 6.31. For 1990-1992 no statistical information exists. It was decided to use extrapolated burned area of following years period for 1990-1992 instead of notification key NO.

Table 6.31 Burned area of grassland since 1990

Year	Area, ha
1990	555
1991	893
1992	1232
1993	21
1994	98
1995	526
1996	1 224
1997	576
1998	1 255
1999	2 685
2000	2 262
2001	4 800
2002	11 547
2003	14 335
2004	6 717
2005	2 027
2006	25 806
2007	4 048
2008	1 170
2009	4 462
2010	2 495

Year	Area, ha
2011	1 618
2012	1 872
2013	1 885
2014	6 819
2015	3 257
Total	101 505

Emissions from biomass burning are represented by incineration of harvesting residues during forest logging operations. The activity data for this calculation was based on an outdated study until 2010[246]. Now a questionnaire for private forest owners on utilization of harvesting residues is used[247]. This switch leads to reduction of emissions in 2005. In case of on-site incineration of harvesting residues during commercial harvesting, all emissions also are applied to the forest land remaining forest land category, because no commercial felling takes place in young stands (younger than 20 years) on land converted to forest land.

6.10.2 Methodological issues

Tier 1 and 2 methods of calculation provided in the 2006 IPCC Guidelines were utilized. Emissions from any type of fires were calculated using equation 2.27 of the 2006 IPCC Guidelines:

$$L_{fire} = A * M_B * C_f * G_{ef} * 10^{-3}; \text{ where}$$

L_{fire} – amount of greenhouse gas emissions from fire, tonnes of each GHG e.g. CH_4, N_2O, etc.;
A = area burnt, ha;
M_B = mass of fuel available for combustion, tonnes ha^{-1}. This includes biomass, ground litter and dead wood. When Tier 1 methods are used then litter and dead wood pools are assumed zero, except where there is a land-use change;
C_f = combustion factor, dimensionless;
G_{ef} = emission factor, g kg^{-1} dry matter burnt. (8)

6.10.2.1 Forest wildfires

Tier 1 method and default emission factors of calculation provided in the 2006 IPCC Guidelines was utilized. Amount of burned biomass is considered according to average growing stock of living biomass, dead wood and litter in a particular year. Combustion efficiency or fraction of biomass combusted (dimension-less) is considered 0.45 according to Table 2.6 of 2006 IPCC Guidelines[248]. Factors of emissions are shown in Table 6.32.

Table 6.32 Emission factor for each GHG (g kg^{-1} dry matter burned)

Gas	CH_4	CO	N_2O	NO_x	CO_2
Emission factor	6.1±2.2	78±31	0.06	1.1±0.6	1550±95

[246] *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.*
[247] *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.*
[248] *Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types.*

6.10.2.2 Grassland wildfires

Tier 1 method and default emission factors of calculation provided in the 2006 IPCC Guidelines was utilized. Emissions from wildfires in grassland were calculated using equation 2.27 of the 2006 IPCC Guidelines. Mass of available fuel in grassland's fires – 2.1 t dm ha^{-1} (Table 2.4 of 2006 IPCC Guidelines[249]), fraction of the biomass combusted 0.74 (Table 2.6 of 2006 IPCC Guidelines[250]). Factors of emissions for grassland fires are shown in Table 6.33.

Table 6.33 Emission factors for grassland's wildfires[251]

No	Gas	Factor, g kg^{-1} dry matter burned
1.	CO	65±20
2.	CH_4	2.3±0.9
3.	NO_x	3.9±2.4
4.	N_2O	0.21±0.10

6.10.2.3 Controlled fires in forests

Tier 2 method and default emission factors of calculation provided in the 2006 IPCC Guidelines was utilized. 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. Factors of emissions are shown in Table 6.32. The following assumptions have been made for burned harvesting residues calculation:

- 1990 to 2000 – 50 % of harvesting residues are left for incineration and 67 % of the left residues are incinerated, the rest are left to decay;
- 2001 to 2004 – 30 % of harvesting residues are left for incineration and 67 % of the left residues are incinerated, the rest are left to decay;
- 2005 to 2009 – 7 % of harvesting residues are left for incineration and 100 % of the left residues are incinerated; the rest of the residues are left for decay or extracted for bioenergy production.
- starting from 2010 – 4 % of harvesting residues are left for incineration and 100 % of the left residues are incinerated; the rest of the residues are left for decay or extracted for bioenergy production.

CO_2 emissions are calculated only from wildfires taking into account that carbon located in harvesting residues is already accounted as losses in living biomass. Incinerated residues are extracted from removals in dead wood. CO_2 emissions are reported using instant oxidation method and do not appears in the inventory as removals in dead wood.

6.10.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

[249] *Fuel (dead organic matter plus live biomass) biomass consumption values for fires in a range of vegetation types.*
[250] *Combustion factor values (proportion of prefire biomass consumed) for fires in a range of vegetation types.*
[251] *IPCC 2006 Table 2.5 Emission factors (g kg^{-1} dry matter burned) for various types of burning.*

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 are based on the 2006 IPCC Guidelines default values.

6.10.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

Quality control procedures named in 2006 IPCC Guidelines 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. Several quality meetings are held annually between experts.

6.10.5 Category-specific recalculations

Recalculations are done due to new biomass expansion factors and carbon content in wood were implemented in the calculations. Summary of the impact of recalculation on the aggregated net GHG emissions from biomass burning is shown in Figure 6.25.

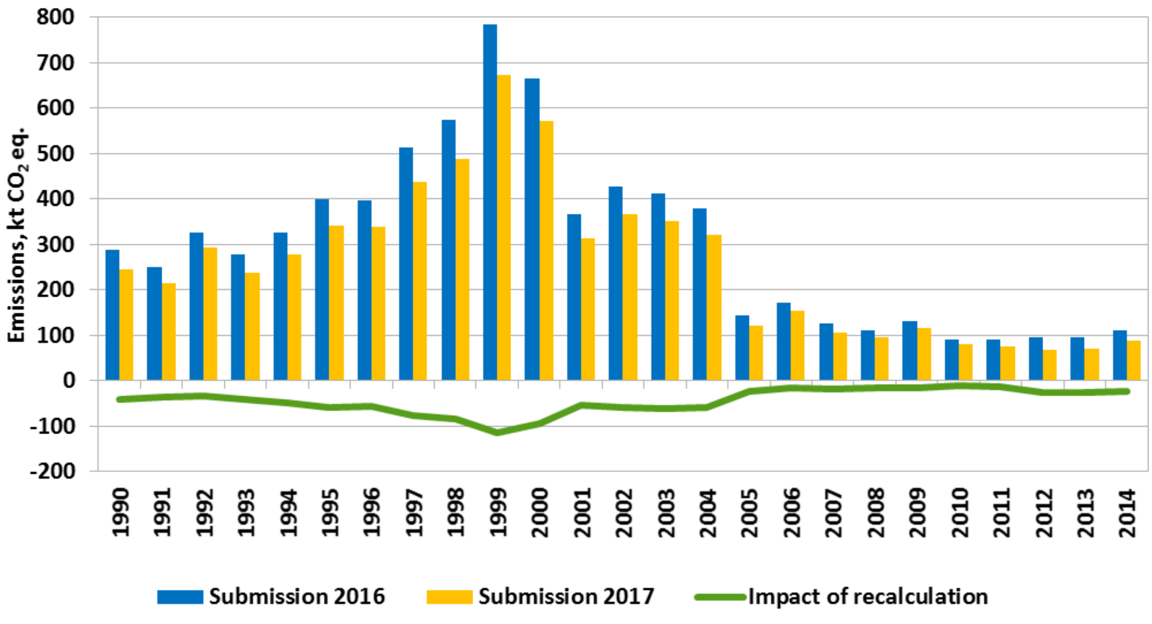

Figure 6.25 Impact of recalculation on the aggregated net GHG emissions from biomass burning

6.10.6 Category-specific planned improvements

A new methodology on estimation of incineration efficiency in forest fires will be elaborated and different types of forest fires will be separated to account the GHG emissions more accurate. Information provided by the State forest service will be used with higher level of accuracy by splitting different types of forest fires and following activities in the forest stands to avoid double accounting of harvested wood extracted in sanitary felling after forest fires. Burning of harvesting residues will be evaluated by forest owners questionnaires.

6.11 HARVESTED WOOD PRODUCTS (CRF 4.G)

6.11.1 Category description

The category harvested wood products is a key category of CO_2 removals. The net emissions in harvested wood category in 2015 were -1788 kt CO_2. The net emissions during the reporting period are shown in Figure 6.26. Increase of removals in the harvested wood products during the last decade is associated with increase of harvesting rate and implementation of more advanced timber processing technologies. Approach B is used in calculation.

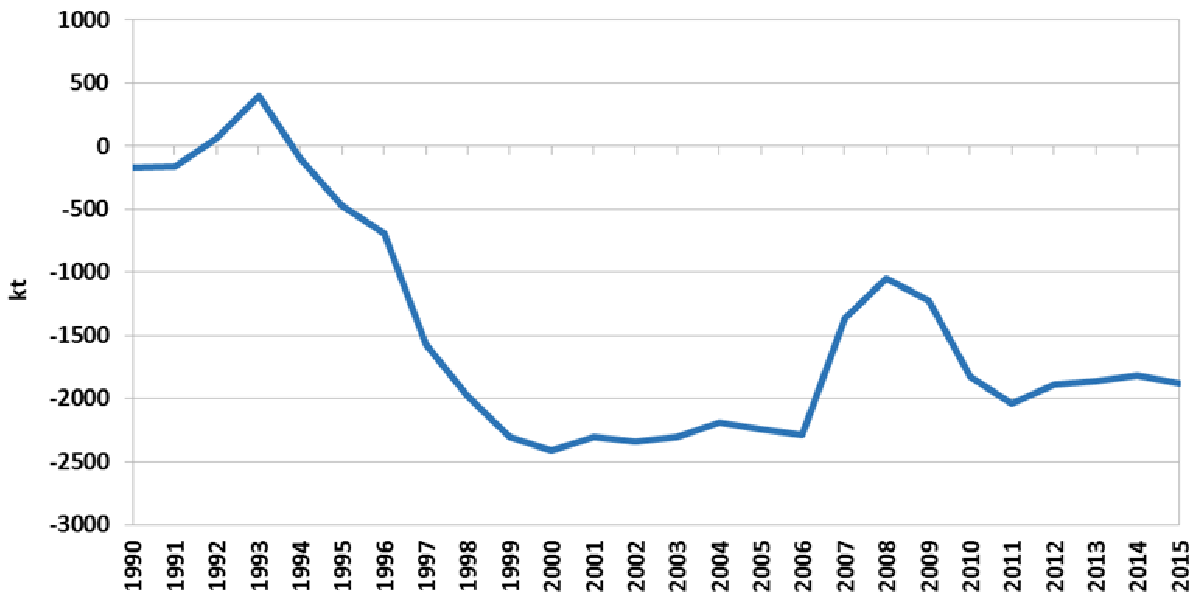

Figure 6.26 Net emissions from HWP during period 1990-2015 (kt)

Net emissions due to production of the harvested wood products are calculated according to methodology in IPCC KP Supplement. CO_2 emissions due to roundwood production in deforested land are accounted using instantaneous oxidation method.

6.11.2 Methodological issues

The net emissions from the harvested wood products are calculated according to the methodology elaborated by S. Rüter, 2011 (refers to approach B in CRF Reporter). The methodology corresponds to Tier 2 for HWP in IPCC KP Supplement for HWP. Three main HWP groups are used in calculations – sawnwod, wood based panels and paper and paperboard with more detailed division on products in Table 6.34 (according to Table 2.8.1 of IPCC KP Supplement).

Table 6.34 HWP categories and their subcategories

HWP category	HWP subcategory
Sawn wood	Coniferous sawnwood
	Non-coniferous sawnwood
Wood-based panels	Hardboard (HDF)
	Insulating board (Other board, LDF)
	Fibreboard compressed
	Medium-density fibreboard (MDF)
	Particle board
	Plywood
	Veneer sheets
Paper and paperboard	-

The calculation is based on harvesting statistics collected by the State forest service, production statistics by the Forest industry association, FAO and EUROSTAT. Linkage with land area used 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 harvested wood is accounted in estimates.

The proportion is calculated by equation No. 9 to estimate share of harvesting stock extracted due to deforestation and is used to calculate share of domestic industrial roundwood. The data to calculate proportion is obtained from Central statistical bureau of Latvia and is collected by the State forest service. 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.

$$IRW_P(i) = \left(1 - \frac{D * M_{avg}}{MH_{total}}\right) * IRW_{total}(i);\ where$$

$IRW_P(i)$ = production of industrial roundwood excluding roundwood from deforested area in year i, Gg C yr^{-1};
D = annual deforested area, ha;
M_{avg} = average growing stock in country, $m^3 ha^{-1}$;
MH_{total} = total harvested stock volume, m^3;
$IRW_{total}(i)$ = total industrial domestic roundwood production. (9)

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 default conversion factors recommended in IPCC KP Supplement (Table 2.8.1) and are provided in Table 6.35 and Table 6.36. Input data in calculation are extrapolated 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 6.35 Assumptions for estimation of carbon stock in harvested wood products

HWP categories	Density (oven dry mass over air dry volume), Mg m^{-3}	C conversion factor (per air dry volume), C m^{-3}
Sawnwood – Coniferous	0.450	0.225
Sawnwood – Non-Coniferous	0.560	0.280
Veneer sheets	0.505	0.253
Plywood	0.542	0.267

HWP categories	Density (oven dry mass over air dry volume), Mg m^{-3}	C conversion factor (per air dry volume), C m^{-3}
Particle board	0.596	0.269
Hardboard	0.788	0.335
MDF (Medium density fibreboard)	0.691	0.295
Fibreboard compressed	0.739	0.315
Insulating board	0.159	0.075
-	**oven dry mass over air dry mass, Mg Mg^{-1}**	**per air dry mass, Mg C Mg^{-1}**
Paper and paperboard (aggregate)	0.900	0.386

Share of locally originated wood in harvested wood products is calculated using equation No. 10.

$$f_{IRW}(i)=\frac{IRW_P(i)-IRW_{EX}(i)}{IRW_P(i)+IRW_{(IM)}(I)-IRW_{EX}(i)};\ where$$

$f_{IRW}(i)$ = *share of industrial roundwood for the domestic production of HWP originating from domestic forests in year i;*

$IRW_P(i)$ = *production of industrial roundwood excluding roundwood from deforested area in year i, Gg C yr*$^{-1}$;

$IRW_{EX}(i)$ = *export of industrial roundwood in year i, Gg C yr*$^{-1}$;

$IRW_{(IM)}(I)$ = *import of industrial roundwood in year i, Gg C yr*$^{-1}$. (10)

Organic carbon in harvested wood products originated from domestic wood is calculated using equation No. 11.

$$CHWP = f_{IRW}(i) * HWP_D;\ where$$

$CHWP$ = *organic carbon in domestically produced HWP excluding HWP from wood produced in deforested area, Gg C yr*$^{-1}$;

HWP_D = *Domestical production of HWP, Gg C yr*$^{-1}$. (11)

The rate of the CO_2 emissions and removals in harvested wood products is calculated using equations No. 12 and 13.

$$C(i+1)=e^{-k} * C(i)+\left[\frac{1-e^{-k}}{k}\right] * inflow(i);\ where$$

$C(i+1)$ = *annual carbon stock, Gg C yr*$^{-1}$;

e = *exponential constant;*

k = *decay constant for each HWP category, units yr*$^{-1}$;

$C(i)$ = *carbon stock in particular category at the begining of year i, Gg C;*

$inflow(i)$ = *the inflow to the particular HWP category during year i, Gg C yr*$^{-1}$;

$$k=\frac{\ln(2)}{HL};\ where$$

HL = *the number of years it takes to lose one-half of the material currently in the pool, yr* (12)

$$\Delta C(i)=C(i+1)-C(i);\ where$$

$\Delta C(i)$ = *carbon stock change of the HWP category during year i, Gg C yr*$^{-1}$. (13)

Table 6.36 Common coefficients to estimate balance between CO_2 emissions and removals in harvested wood products

Factors	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
$k = \frac{1 - \ln(2)}{H * L}$	0.99	0.99	0.85

The equations of calculation of the harvested wood products are included into the National tool for calculation of the net emissions due to forest management as separate module.

6.11.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty level of the activity data for the whole time series is assumed 15 % in 1990-2015.

6.11.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

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. Several quality meetings are held annually between experts.

6.11.5 Category-specific recalculations, if applicable, including changes made in response to the review process

Recalculations have been done to correct technical errors on calculations for HWP from deforestation events. In previous inventories some fraction of HWP from deforestation was included in total HWP pool. Recalculations have slight impact to the total net emissions from HWP pool. Summary of the impact of recalculation on CO_2 emissions from HWP is shown in Figure 6.27.

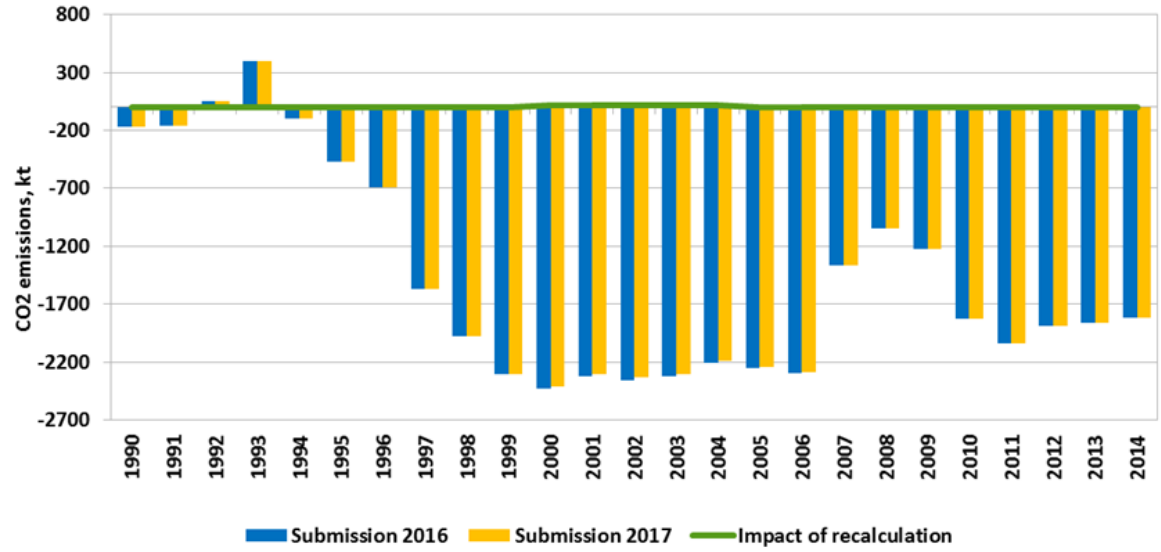

Figure 6.27 Impact of recalculation on CO_2 emissions from HWP

6.11.6 Category-specific planned improvements

There are no improvements planned for the next inventory.

6.12 DIRECT N_2O EMISSIONS FROM MANAGED SOILS

6.12.1 Category description

Direct N_2O emissions from drainage of organic soils are estimated for forest land, land converted to cropland, settlements and wetlands. Direct N_2O emissions corresponding to land-use change from N mineralisation associated with loss of soil organic matter from change of land use or management are estimated for land-use change to croplands and settlements on mineral soils. Total aggregated direct N_2O emissions from managed soils in 2015 were 2.36 kt N_2O.

6.12.2 Methodological issues

Direct emissions of N_2O due to drainage of organic soils are calculated according equation No. 14 (Equation 2.7 of the IPCC Wetlands Supplement).

$$N_2O-N_{OS}=\left[\left(F_{OS,CG,Temp}\cdot EF_{2CG,Temp}\right)+\left(F_{OS,F,Temp,NR}\cdot EF_{2F,Temp,NR}\right)\right];\ where$$

N_2O-N_{OS} = Annual direct N_2O-N emissions from managed / drained organic soil, $kg\ N_2O-N\ yr^{-1}$

F_{OS} = Annual area of managed / drained organic soils, ha. The subscripts CG, F, Temp, NR refer to cropland and grassland, forestland, temperate and nutrient rich, respectively.

EF_2 = Emission factor for N_2O emissions from drained / managed organic soils, $kg\ N_2O–N\ ha^{-1}yr^{-1}$

(14)

Activity data consist of areas of land remaining in a land-use category and land converted to other land-use category on drained organic soils. Data of annual area of drained organic soil are taken from the NFI. Default N_2O emission factors for drained organic soils are shown in Table 6.37 according Table 2.5 of the IPCC Wetlands Supplement.

Table 6.37 Tier 1 N_2O emission/removal factors for drained organic soils in all land-use categories

Land-use category	Climate/ vegetation zones	Emission factor (kg N_2O-N ha^{-1} yr^{-1})	95% Confidence interval	
Forest land, drained	Temperate	2.8	-0.57	6.1
Cropland, drained	Boreal and temperate	13	8.2	18
Grassland, deep-drained, nutrient-rich	Temperate	8.2	4.9	11
Peatland managed for extraction	Boreal and temperate	0.3	-0.03	0.64

N_2O emissions from land converted to another land-use category on drained organic soils are calculated in the same way as emissions from land remaining in a land-use category.

Direct N_2O emissions from N inputs to managed soils and from N mineralisation resulted from loss of soil organic C stocks in mineral soils due to land-use change are estimated by Tier 1 methodology using equation No. 15 (equation 11.1 of 2006 IPCC Guidelines):

$$N_2O - N_{N\ inputs} = F_{SOM} * EF_1;\ where$$

$N_2O - N_{N\ inputs}$ – *annual direct* $N_2O - N$ *emissions from N inputs to managed soils, kg* $N_2O - N\ yr^{-1}$

EF_1 – *emission factor for N mineralised from mineral soil as a result of loss of soil carbon, kg* $N_2O - N\ (kg\ N)^{-1}$

(15)

The equation No. 15 is supplemented by equation 11.8 from 2006 IPCC Guidelines (equation No. 17 in the NIR). Default emission factor for N mineralised from mineral soil as a result of loss of soil carbon (0.01 kg N2O-N (kg N)-1) from Table 11.1 of 2006 IPCC Guidelines is used. Default C:N ratio (15) for soil organic matter is utilized for estimation of annual amount of N mineralised in mineral soils as a result of loss of soil carbon due to land use change to cropland (2006 IPCC Guidelines). As there is no fixed default emission factors for settlements provided by IPCC guidelines, default emission factors of croplands land-use category are applied, C:N ratio for soil organic matter applied based on expert judgement is 15, and annual carbon losses in organic soil in settlements are accounted using emissions factor from cropland – 7.9 tonnes C ha^{-1} yearly (IPCC 2014 Wetlands supplement)[252].

6.12.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty of soil nitrogen (N_2O) emissions are estimated according to data obtained within the scope of the international forest soil monitoring project BioSoil and values provided in the 2006 IPCC Guidelines. Uncertainty ranges of emission factors for N_2O emissions from drained organic soils are listed in Table 6.37.

[252] *Table 2.1 Tier 1 CO_2 Emission/Removal Factors For Drained Organic Soils In All Land-Use Categories (Cropland, drained, boreal and temperate)*

Uncertainty range of emission factor for N mineralised from mineral soil as a result of loss of soil carbon is 0.003-0.03 kg N_2O-N (kg N)$^{-1}$. Uncertainty range of C:N ratio of the soil organic matter for land-use change is 10-30.

6.12.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives.

QA/QC procedures include double check of area affected by the land use change and soil CO_2 emissions – under calculation of land use changes and during calculation of N_2O emissions. Several quality meetings are held annually between experts.

6.12.5 Category-specific recalculations

Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors.

6.12.6 Category-specific planned improvements

N_2O emissions might be considerable part of emissions from wetlands, therefore, it is necessary to develop method for estimation impact of drainage on N_2O emissions, and it is important to be able to separate wetlands on organic soils (high N_2O emissions) and mineral soils (low N_2O emissions).

6.13 INDIRECT N_2O EMISSIONS FROM MANAGED SOILS (CRF 4 (IV))

6.13.1 Category description

Indirect N_2O emissions from N mineralisation associated with loss of soil organic matter from change of land use or management are estimated for land-use change to croplands and settlements on mineral soils. Total aggregated indirect N_2O emissions from N mineralisation in 2015 were 0.00998 kt N_2O. Indirect N_2O emissions from organic soils are not calculated, because 2006 IPCC Guidelines does not include such a methodology.

6.13.2 Methodological issues

Indirect N_2O emissions from land use change to cropland are calculated according to 2006 IPCC Guidelines. Amount of N_2O-N emissions produced from leaching and run-off as a result from land use change to cropland are estimated by Tier 1 methodology using equation 11.10 (equation No. 16 in the NIR).

$$N_2O_{(L)} - N = F_{SOM} * Frac_{LEACH\text{-}H} * EF_5;\ where$$

$N_2O_{(L)} - N$ – annual amount of $N_2O - N$ produced from leaching and runoff of N additions to managed soils where leaching/runoff occurs, kg $N_2O - N\ yr^{-1}$

$Frac_{LEACH\text{-}(H)}$ – fraction of all N added to/ mineralised in managed soils in regions where leaching/ runoff occurs that is lost through leaching and runoff, kg N (kg of N additions)$^{-1}$

EF_5 – emission factor for N_2O emissions from leaching and runoff, kg $N_2O - N$ (kg N leached and runoff)$^{-1}$)

(16)

It is supplemented by equation 11.8 from 2006 IPCC Guidelines (equation No. 17 in the NIR).

$$F_{SOM} = \left(\Delta C_{Mineral} * \frac{1}{R} \right) * 1000;\ where$$

F_{SOM} – the net annual amount of N mineralised in mineral soils as a result of loss of soil carbon throught chenge in land use or management, kg N .

$\Delta C_{Mineral}$ – average annual loss of soil carbon for land – use type, tonnes C

R – C : N ratio of the soil organic matter (17)

Default C:N ratio (15) for soil organic matter (2006 IPCC Guidelines) is utilized for estimation of annual amount of N mineralised in mineral soils as a result of leaching/run-off associated with loss of soil carbon through land use change to cropland. Carbon losses are calculated according to the Tier 1 method of the 2006 IPCC Guidelines. Default values of fraction of all N added to/mineralised in managed soils due to leaching and run-off (0.3 kg N (kg of N additions)$^{-1}$) and emission factor for N_2O emissions from N leaching and run-off (0.0075 kg N_2O-N (kg N leached and run-off)$^{-1}$) are taken from table 11.3 of 2006 IPCC Guidelines.

Indirect N_2O emissions from land use change to settlements are also accounted using the 2006 IPCC Guidelines Tier 1 method. Amount of N_2O-N emissions produced from leaching and run-off as a result from land use change to settlements are estimated by Tier 1 methodology using equation 11.10 supplemented by equation 11.8 from 2006 IPCC Guidelines. C:N ratio 15 for soil organic matter based on expert judgement is utilized for estimation of annual amount of N mineralised in mineral soils as a result of leaching/run-off associated with loss of soil carbon thorough land use change to settlements. Tier 1 method of the 2006 IPCC Guidelines (loss of 20 % of soil carbon in land converted to settlement) is used to estimate carbon stock changes. Default values of fraction of all N added to mineralised in managed soils due to leaching and run-off (0.3 kg N (kg of N additions)$^{-1}$) and emission factor for N_2O emissions from N leaching and run-off (0.0075 kg N_2O-N (kg N leached and run-off)$^{-1}$) are taken from table 11.3 of 2006 IPCC Guidelines.

6.13.3 Uncertainties and time-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Uncertainty range of C:N ratio of the soil organic matter for land-use change from Forest Land or Grassland to Cropland is 10-30 %. Uncertainty range of fraction of all N added to/mineralised in managed soils in regions where leaching/run-off occurs that is lost through leaching a run-off is 0.1-0.8 kg N (kg of N additions^{-1}). Uncertainty range of emission factor for N_2O emissions from N leaching and run-off according to 2006 IPCC Guidelines is 0.0005-0.025 kg N_2O-N (kg N leached and run-off^{-1}).

6.13.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the LULUCF sector in order to achieve these quality objectives. QA/QC procedures include double check of area affected by the land use change and soil CO_2 emissions – under calculation of land use changes and during calculation of N_2O emissions. Several quality meetings are held annually between experts.

6.13.5 Category-specific recalculations

Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors. Summary of the impact of recalculation on indirect N_2O emissions from managed soils is shown in Figure 6.28.

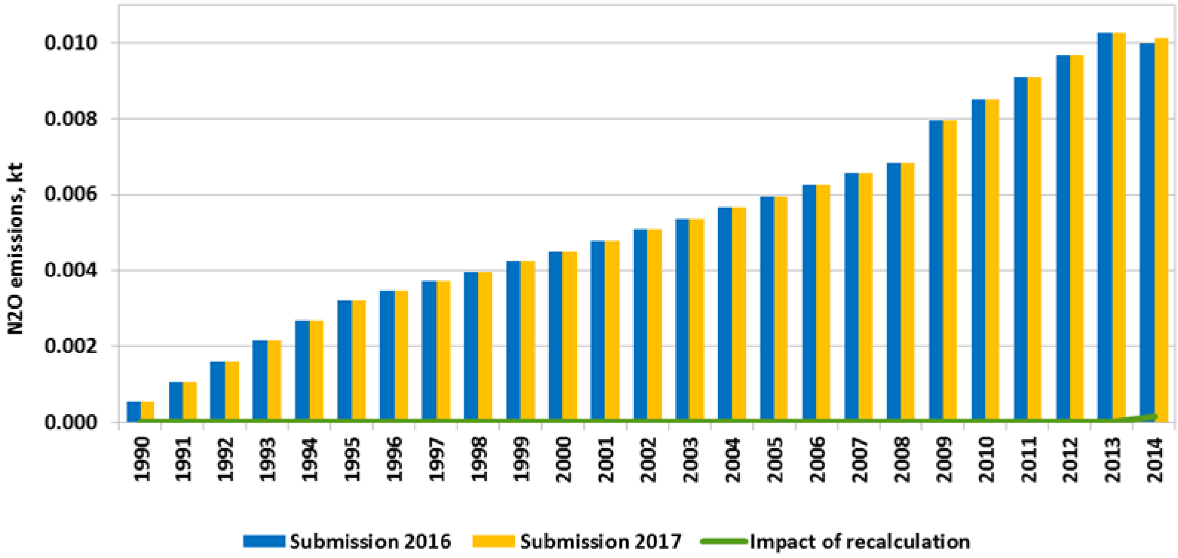

Figure 6.28 Impact of recalculation on indirect N_2O emissions from managed soils

6.13.6 Category-specific planned improvements

Information on land use changes, particularly, distribution of organic and mineral soil and losses of carbon due to land use changes should be estimated.

7 WASTE (CRF 5)

7.1 OVERVIEW OF SECTOR

In 2015, emissions from the Waste sector were 687.44 kt CO_2 equivalents; it contributes about 6.0% of total GHG emissions (excluding LULUCF, including indirect CO_2) (Figure 7.1). Solid waste disposal and wastewater handling are the main sources of GHG emissions in Waste sector. Incineration and Biological treatment of solid waste (composting) together contributes only 6.4% of GHG emissions from Waste sector in 2015.

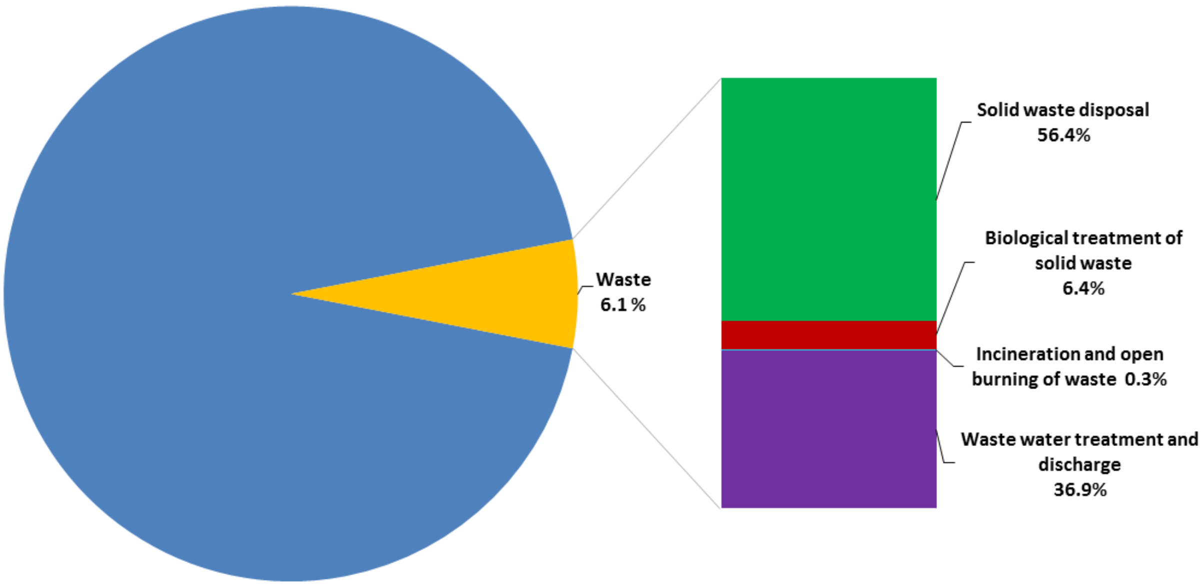

Figure 7.1 Emissions from the waste sector compared with the total emissions in 2015

Emission categories reported under Waste sector as well as methods and emission factors used are summarized in Table 7.1.

Table 7.1 Waste sector reported emissions and methods

Sector categories	Reported GHG	Methods	EF
A. Solid waste disposal			
1. Managed waste disposal sites	CH_4	Tier 2 (D)	CS, D
2. Unmanaged waste disposal sites	CH_4	Tier 2 (D)	CS, D
3. Uncategorized waste disposal sites	NO	NA	NA
B. Biological treatment of solid waste			
1. Composting	CH_4, N_2O	Tier1 (D)	CS, D
2. Anaerobic digestion at biogas facilities	NA	NA	NA
C. Incineration and open burning of waste			
1. Waste incineration	CO_2, N_2O	D	D
2. Open burning of waste	NO	NA	NA
D. Wastewater treatment and discharge			
1. Domestic wastewater	CH_4, N_2O	D	CS, D
2. Industrial wastewater	CH_4, N_2O	D	CS, D
3. Other (as specified in table 6.B)	NMVOC	D	D
E. Other (please specify)	NO	NA	NA

GHG emissions from Waste sector have been fluctuated from 1990-2015. In 2015, emissions were approximately 1.23% higher than in 1990.

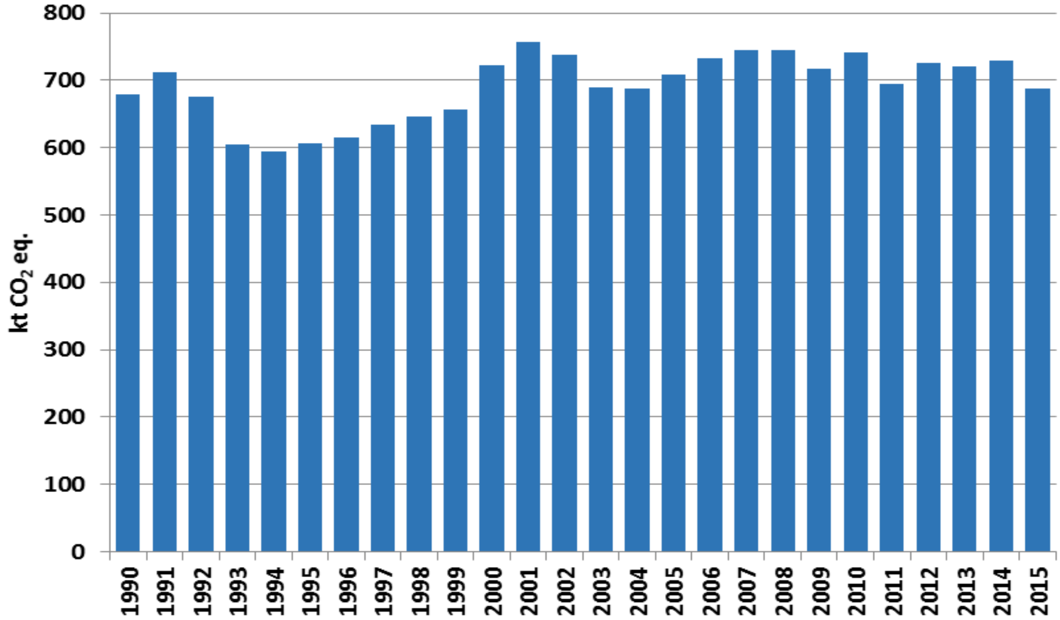

Figure 7.2 Total GHG emissions from Waste sector 1990-2015 (kt CO_2 eq.)

Fluctuations in total GHG emissions in waste sectors could be explained with changes of economic situation in last 20 years (Figure 7.2). Some industry sectors were almost closed in the middle of 1990s. Biggest influence to total emission trend in the beginning on 1990s gives GHG emissions from Waste water handling, decrease of total emissions in years 2002-2004 is due to starting of methane collection in landfills.

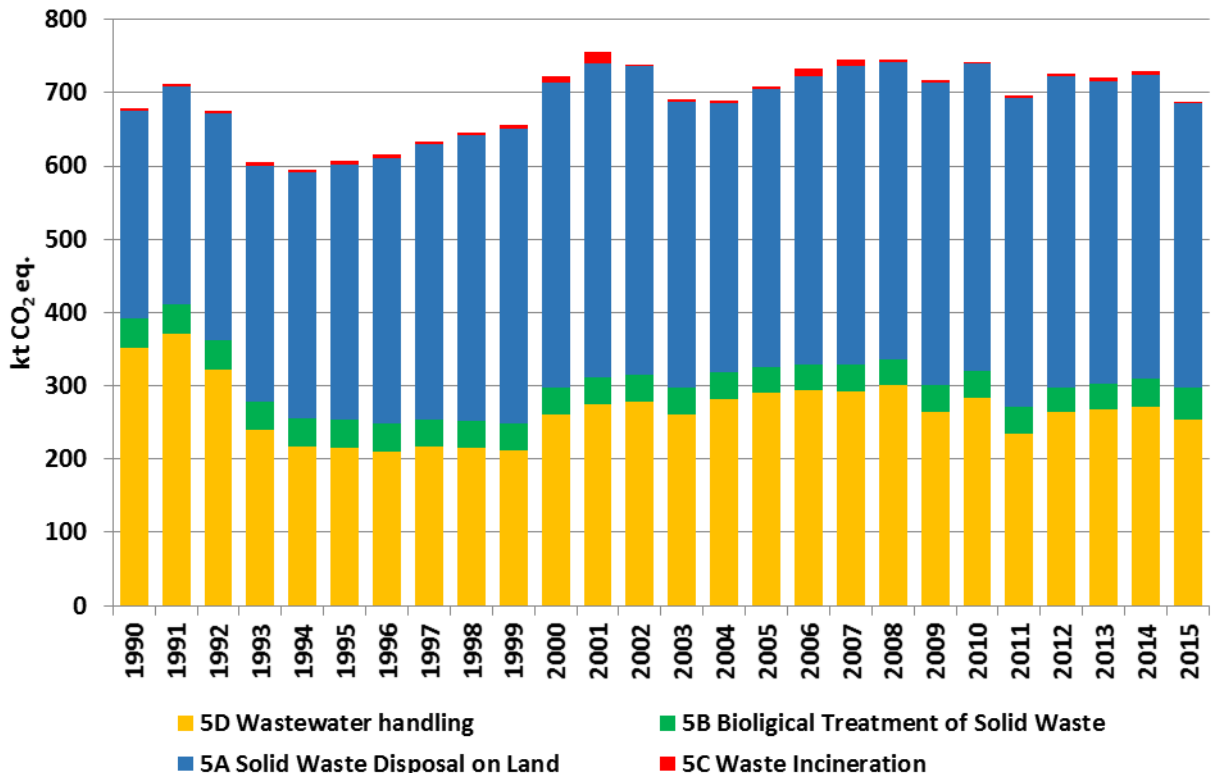

Figure 7.3 GHG Emissions in Waste subsectors 1990-2015 (kt CO_2 eq.)

Emissions from 5.C and 5.B in last year's, when emissions from these sectors were calculated, are very small in comparison with other sectors – 5.A Solid waste disposal (SWD) and 5.D Waste water treatment and discharge (WWH).

Key categories from Waste sector are summarized in Table 7.2.

Table 7.2 Key categories in Waste sector in 2017 submission

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
5.A.1. Managed Waste Disposal on Land	CH_4	L1,L2	X	X
5.A.2. Unmanaged Waste Disposal Sites	CH_4	L1,L2,T1,T2	X	X
5.D.1 Domestic Wastewater	CH_4	L1,L2,T1	X	X
5.D.2 Industrial Wastewater	CH_4	L1,L2,T1,T2	X	X
5.B.1. Composting	CH_4	L1,L2,T2		X
5.B.1. Composting	N_2O	L2,T2		X

According to the annual waste statistics report[253] the total generated amount of waste is shown in Table 7.3.

Table 7.3 Generated waste in Latvia (kt)

Year	Municipal (all non-hazardous) waste	Hazardous waste	Total
2006	1420.46	54.372	1474.832
2007	1386.57	41.605	1428.175

[253] *http://www.lvgmc.lv/lapas/vide/atkritumi/atkritumu-statistikas-apkopojumi/atkritumu-statistikas-apkopojumi?id=1713&nid=380*

Year	Municipal (all non-hazardous) waste	Hazardous waste	Total
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
2013	1902.007	109.23	2011.237
2014	2128.725	80.978	2209.703
2015	2087.507	86.603	2174.110

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. Emissions are estimated since 1990, data on incinerated amount 1990 – 1998 are extrapolated according to disposed and incinerated waste amounts proportion. Calculation of indirect GHG emissions from cremation is shown in Section 7.4.1.1. Emissions from waste incineration with energy recovery are allocated under Energy sector (CRF 1.A.2.f Non-metalic minerals).

CH_4 and N_2O are emitted from waste composting. Enterprises data available only since 2003, when composting facilities started to report within state statistical survey about waste composting. Emissions from household waste composting are estimated since 1990. For emission calculations 2006 IPCC Guidelines and default emission factors were used.

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 permits according to integrated pollution prevention and control (IPPC) directive. Biogas collection and use for energy production from biodegradable waste and sludge is set as one of waste management priorities in Latvia.

Main activity data sources for GHG emissions calculations in Waste sector are databases[254] "3-Waste", "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 waste are combined in one database "3-Waste". Data in this database are gathered from State Statistical survey about waste, which is conducted annually.

Statistical survey must be completed annually by all enterprises, which have permits on polluting activities (A and B category) and all enterprises, which have permits on waste

[254] http://parissrv.lvgmc.lv/public_reports

management operations. To estimate disposed waste amounts in preliminary years; data from Landfill research 2016 [255]were used.

"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.

7.2 SOLID WASTE DISPOSAL (CRF 5.A)

7.2.1 Category description

Methane emission is calculated from SWD (Table 7.4). It is main GHG source from waste sector in Latvia. Compared to 2014, CH_4 emissions have decreased by 6.4% in 2015. Compared to 1990 CH_4 emissions have increased by 104 kt CO_2 eq. due to First order decay calculation method. IPCC Waste Model from 2006 IPCC Gudelines is used.

Table 7.4 Reported emissions under subcategory Solid Waste Disposal on Land

CRF	**Source**	**Emissions reported**
5.A 1	Managed Waste Disposal on Land	CH_4, NMVOC
5.A 2	Unmanaged Waste disposal Sites	CH_4, NMVOC
5.A 3	Uncategorized Waste disposal Sites	Not occurring

To estimate CH_4 emissions with IPCC Waste Model (First Order Decay (Tier2)) was used. Time series for disposed waste amounts till 1965 was developed. The base year for estimation of disposed amount is 1975. According to Landfill research made in 2016 255disposed amount in 1975 was 227 152 tonns. Reaserch estimation is based on information from questionairies, what was filled by municipalities about landfill situation in their territory. During the research municipalities were asked to provide information on:

- active and closed landfills names;
- years of each landfil activity;
- disposed amounts in each landfills (volume or mass);
- landfill recovery statuss;
- number in contaminated sites register;

List of landfills was selected, which was already active in 1975 and for which information was available on the active operational period and disposed waste.

[255] *"Landfill data collection and compilation for GHG estimates", 2016, LEGMC*

To perform calculations - information about 62 landfills was available in 1975. From these 62 landfills full infromation, including the amount of disposed waste and active operational period, was available for 50 landfills.

Using the information on the active operational period - it was possible to determine how much waste were landfilled by dividing the total amount of disposed waste with active years. The amount of waste disposed in accordance with the research calculations in 1975 was 227152 tons.

Amount for disposed waste 1965 – 1974 was assumed the same like in 1975. Disposed amount for years 1976 – 2001 were estimated like steady growth till year 2002 amount, when data became available from data base "3-Waste".

Table 7.5 Estimated Disposed amounts from 1965 – 2001

Year	Disposed solid waste amount (kt)	Population in rural areas (%)	Population in urban areas (%)	Disposed waste in rural areas (kt) (MCF-0.4)	Disposed waste in urban areas (kt) (MCF – 0.8)
1965-1974	227.152	39%	61%	88.589	138.563
1975	227.152	39%	61%	88.589	138.563
1976	242.016	33%	67%	79.865	162.151
1977	256.932	33%	67%	84.788	172.144
1978	271.848	33%	67%	89.710	182.138
1979	286.764	33%	67%	94.632	192.132
1980	301.68	33%	67%	99.554	202.126
1981	316.596	32%	68%	101.311	215.285
1982	331.512	32%	68%	106.084	225.428
1983	346.428	32%	68%	110.857	235.571
1984	361.344	32%	68%	115.630	245.714
1985	376.26	32%	68%	120.403	255.857
1986	391.176	31%	69%	121.265	269.911
1987	406.092	31%	69%	125.889	280.203
1988	421.008	31%	69%	130.512	290.496
1989	435.924	31%	69%	135.136	300.788
1990	450.84	31%	69%	139.760	311.080
1991	465.756	31%	69%	144.384	321.372
1992	480.672	31%	69%	149.008	331.664
1993	495.588	31%	69%	153.632	341.956
1994	510.504	31%	69%	158.256	352.248
1995	525.42	31%	69%	162.880	362.540
1996	540.336	31%	69%	167.504	372.832
1997	555.252	31%	69%	172.128	383.124
1998	570.168	31%	69%	176.752	393.416
1999	585.084	31%	69%	181.376	403.708
2000	600.000	31%	69%	186.000	414.000
2001	614.916	31%	69%	190.624	424.292

Landfills from 1970 – 2001 are assumed as unmanaged[256]. Disposed amount is divided between rural and urban areas, according to proportion of population between these areas.

[256] *"Degradable organic carbon in disposed waste", 2011, Ltd Virsma*

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 - 2015 are taken from database "3-Waste" (Table 7.6). Starting from 2002, according to data base information, biggest sites could be assuemed as managed sites (polygons) and MCF-1 was started. For each year (2002-2015) in polygons disposed amount are determined according to disposing site profile from "3-Waste" data base.

Table 7.6 Disposed solid waste amounts from 2002-2015 (kt)

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	**529.5**	525.5	1.98	1.98
2013	**534.2**	534.2	0	0
2014	**505.2**	505.2	0	0
2015	**503.9**	503.9	0	0

Two separate IPCC Waste Model calculations were used. One for unmanaged sites and other for managed (waste polygons since 2002). For unmanaged sites calculation method for bulk waste was used, because there are no correct information about disposed waste content available. According to Ltd Virsma research – DOC factor for these calculations was used as 0.17. Other factors are default from IPCC guidelines.

For managed sites method "waste by composition" in IPCC Waste Model was used. Data on waste compostion was taken from Ltd Virsma research (Table 7.7).

Table 7.7 Disposed waste compostion in Latvia waste polygons

Polygons	Samples	Organic fraction (%)					Inorganic fraction (%)		
		Paper	Plastics	Organic (food, hygiene waste, other organics)	Wood	Textile, rubber	Minerals (ceramics)	Glass	Metals
Pentuli	No1	3.8	19.5	45.4	4.1	3.6	7.2	15.6	0.8
	No2	14.3	5.2	37.8	8.3	0.6	9.4	8.2	16.2
	No3	9.7	6.9	52.9	0.5	2.2	10.4	15.5	1.9
	No4	11.6	8.7	59.5	1.5	3.7	5.3	6.1	3.6
	No5	4.6	6.5	72	0.7	0.8	8.3	5.7	1.4
	No6	4.1	23.9	42.8	3.9	2.3	7.4	14.5	1.1
Pentuli average		**8.02**	**11.78**	**51.73**	**3.16**	**2.2**	**8**	**10.93**	**4.16**

Polygons	Samples	Organic fraction (%)					Inorganic fraction (%)		
		Paper	Plastics	Organic (food, hygiene waste, other organics)	Wood	Textile, rubber	Minerals (ceramics)	Glass	Metals
Ķivites	No1	5.1	2.2	58.3	0.2	3.9	11.6	14	4.7
	No2	6.1	5.6	51.4	0.6	3.1	10.5	19.6	3.1
	No3	1.3	5	56.9	2.1	0.3	9.7	18.2	6.5
	No4	11.3	6	31	3.9	33.3	2.8	8.1	3.6
	No5	4.5	4.8	62	3.2	2.6	12.7	9.2	1
Kivites average		**5.66**	**4.72**	**51.92**	**2**	**8.64**	**9.46**	**13.82**	**3.78**
Getlini	No1	6.4	5.8	42.3	1.1	1.2	19.9	21.6	1.7
	No2	19.4	20	41	1.1	0	1.8	16.3	0.4
	No3	2.2	4.8	58.7	1.6	0.7	0.9	23.7	7.4
	No4	3.9	5.8	57.2	0	11.1	6.6	14.9	0.5
	No5	3.2	14.9	52.3	4.6	1.8	4.5	18.7	0
Getlini average		**7.02**	**10.26**	**50.3**	**1.68**	**2.96**	**6.74**	**19.04**	**2**
Daibe	No1	3.1	4.8	40.2	1.4	0.2	14.3	35.3	0.7
	No2	4.9	5.8	19.3	3.9	0.9	22.3	42.8	0.1
	No3	3.7	2.1	73.8	1.8	0.3	3.4	14.7	0.2
	No4	3	4.7	18	2.1	0.2	16.7	55.2	0.1
	No5	3.5	2.3	12.9	3.2	0.4	15.7	61.9	0.1
Daibe average		**3.64**	**3.94**	**32.84**	**2.48**	**0.40**	**14.48**	**41.98**	**0.24**
Average in Country		**6.40**	**8.54**	**47.90**	**2.11**	**3.35**	**8.69**	**20.64**	**2.36**

To determine average waste composition from 4 biggest waste polygons in Latvia - size of polygons was taken into account. In Getlini 50% of all waste are disposed. Getlini composition gives the biggest influence to determine average waste composition in country. Organic waste for IPCC Waste Model calculations is assumed as Food and Garden fractions.

Tha same waste compositon for all years since 2002 was used.

According to the Latvia`s Waste management plan 2013 – 2020, 11 waste disposing polygons are operating in Latvia. All other waste disposal sites are planned to close. In 2015 – 11 solid waste polygons are operating, all these sites are assumed as managed.

Since October 2002, CH_4 recovery from landfills was started. For 2015 only in four waste polygons (*SIA Getlini EKO, SIA Liepajas RAS, SIA ZAAO Daibe, SIA Zemgale Eko*) 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 built 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 *SIA Zemgale Eko* polygon *Brakski* methane is started to collect in year 2013. In total 7.83 kt of CH_4 was collected and recovered in 2015.

Methane recovery are distributed between Unmanaged deep (MCF – 0.8) and Managed (MCF – 1) landfills. In biggest landfill in Latvia *Getlini* CH_4 recovery occurs from old landfill part and from new disposal cells. Assumptions is done that CH_4 recovery is 50% from old landfill and 50% from new disposal cells. See distribution of CH_4 recovery in Table 7.8 .

Table 7.8 Recovered CH_4 in Latvia landfills (kt)

	Total	MCF (0.8) unmanaged	MCF 1 managed
2002	**0.859**	0.859	NO
2003	**3.016**	3.016	NO
2004	**4.507**	4.507	NO
2005	**4.687**	4.000	0.687
2006	**4.833**	2.434	2.400
2007	**5.055**	2.469	2.586
2008	**5.250**	2.474	2.776
2009	**5.847**	2.643	3.204
2010	**6.173**	2.698	3.475
2011	**6.499**	2.707	3.792
2012	**6.463**	2.836	3.627
2013	**6.917**	3.034	3.883
2014	**6.880**	2.863	4.017
2015	**7.834**	3.313	4.521

According to the Latvia's Waste Management plan 2013-2020, 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 7.4.

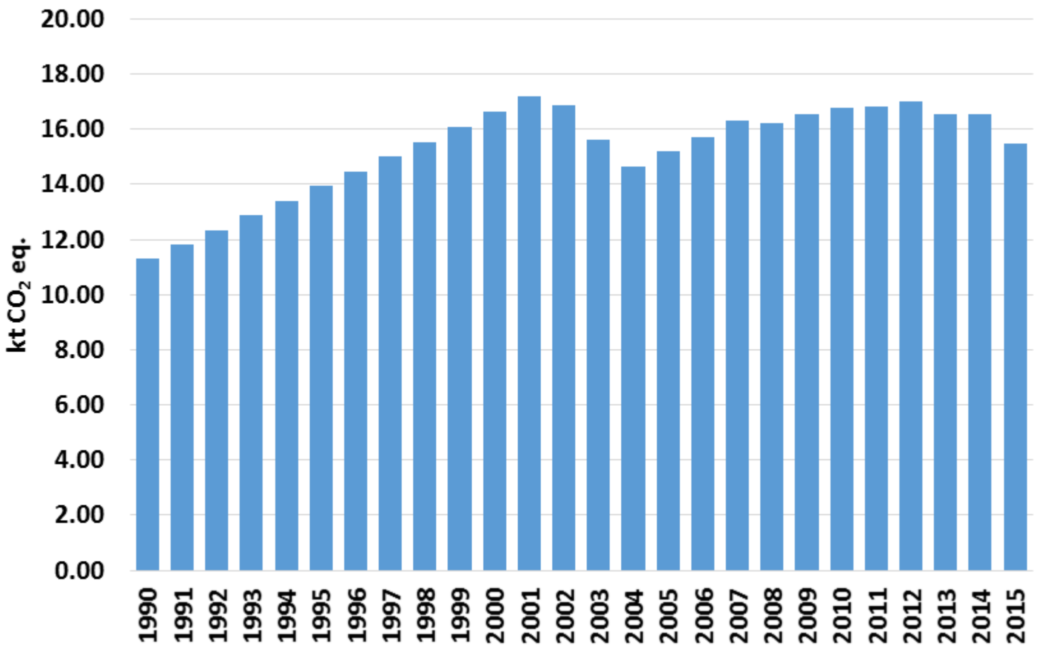

Figure 7.4 CH_4 emissions from waste disposing (kt)

7.2.2 Methodological issues

Tier 2 method from 2006 IPCC Guidelines is used for CH_4 emissions calculation and is based on IPCC Waste Model.

Emission factors used in IPCC Waste Model

Factors for managed site emissions calculations:

MCF(CH_4 correction factor) Managed sites – 1:

Table 7.9 DOC values for waste streams in managed sites (2006 IPCC Guidelines)

Food waste	0.17
Garden	0.20
Paper	0.40
Wood and straw	0.43
Textiles	0.24
Sewage sludge	0.05

Table 7.10 methane generation rate constant (k) (2006 IPCC Guidelines)

Food waste	0.185
Garden	0.10
Paper	0.06
Wood and straw	0.03
Textiles	0.06
Sewage sludge	0.185

DOCf – fraction of DOC dissimilated - 0.5
F – fraction of CH_4 landfill gas - 0.5
Delay time – 6 month

Factors for unmanaged site emissions calculations:

Deep unmanaged sites - 0.8
Shallow unmanaged sites - 0.4

DOC – degradable organic carbon - 0.17
DOCf – fraction of DOC dissimilated - 0.5
F – fraction of CH4 landfill gas - 0.5
k- methane generation rate - 0.09
OX – oxidation factor (default 0.09 – used for unamanged sites calculation since year 2007).

DOC value 0.17 is used according to research which was carried out in Latvia in 2011 ("Degradable organic carbon in disposed waste", 2011, Ltd Virsma). Other emission factors are default from 2006 IPCC Guidelines.

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.

7.2.3 Uncertainties and times-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

To calculate CH_4 emissions from SWD many emission factors are used. According to 2006 IPCC Guidelines 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 estimated as 7.25%.

Uncertainty assessment of activity data is done using the proportion between disposed amount and population (2002-2015). Uncertainty is calculated as the standard medium of the average from linear trend line.

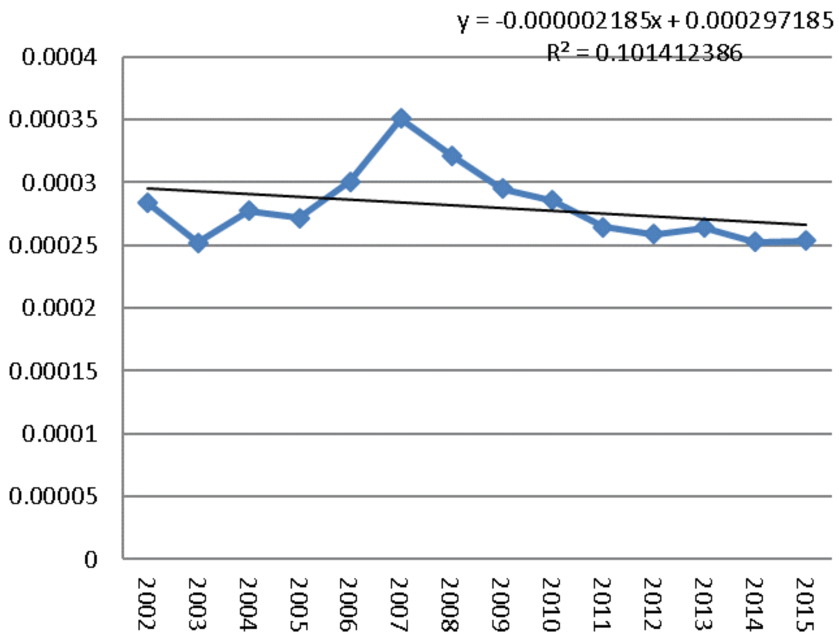

Figure 7.5 Trendline and proportion waste-to-population for waste disposal

7.2.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed

according to the QA/QC plan in the waste sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

Disposed waste amount since 2002 is taken from waste data base "3-Waste". Data in this data base are checked and approved by Regional Environmental Boards.

National factor of DOC is determined in national research "Degradable organic carbon in disposed waste", 2011, Ltd Virsma. Distribution between managed and unmanaged sites is also described in this research which is available in QA/QC documentation.

Information regarding CH_4 recovery is taken directly from waste polygon reports. These reports are collected and checked by LEGMC every year. Latvia's waste polygon report is published in LEGMC website every year.

7.2.5 Category-specific recalculations

Full recalculation is done for CH_4 emissions from SWD. New estimation for historical years disposed amount was implemented in calculations. Reestimation of CH_4 recovery distribution between managed and unmanages sites was done, according to expert judgment.

7.2.6 Category-specific planned improvements

No planned improvements.

7.3 BIOLOGICAL TREATMENT AND SOLID WASTE (CRF 5.B)

7.3.1 Composting (CRF 5.B.1)

7.3.1.1 Category description

Under 5.B.1 sector CH_4 and N_2O emissions from waste composting are calculated. Composting is set as one of priorities in waste treatment in Latvia. For composting biological degradable waste are useful. In Latvia these are mostly "park - garden" and "food production" waste.

Data about industrial composting become available since 2003, when waste treatment companies started waste composting and get IPPC permits on this activity.

Composting in private households has been very popular for many years. Composted waste amount in households is estimated according to research[257] done by Waste Management Association of Latvia in 2015. In this research total amount of composted waste in households are estimated for 2012 – 2015. Time series are extrapolated back to 1990 according to changes in population number.

Table 7.11 Reported emissions under composting

CRF	Source	Emissions reported
5.B.1.	Compost production	CH_4, N_2O

[257] *"Composting emission factor development from waste and waste water sectors and methane correction factor estimation for Latvia landfills", 2015, Waste Management Association of Latvia*

From composting CH_4 and N_2O emissions are calculated according to 2006 IPCC Guidelines. In previous IPCC Guidelines emission factors for composting were not provided. Data regarding composted waste are taken from "3-Waste" database.

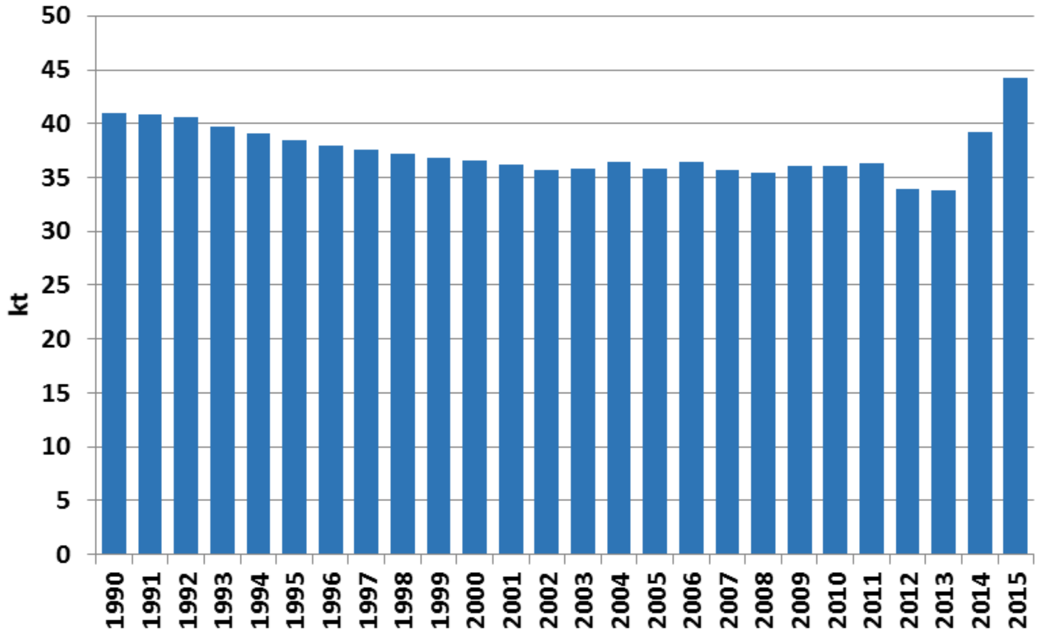

Figure 7.6 Total emissions from waste composting (kt CO_2 eq.)

7.3.1.2 Methodological issues

Default method from 2006 IPCC Guidelines is used for emission calculations from composting. Composted waste amount is multiplied with default emission factor. Composted waste amount is taken from "3-Waste" database, R3 - Recycling/reclamation of organic substances that are not used as solvents (including composting and other biological transformation processes), recovery operation for determination of composted amounts was used. Not all amounts, which are classified under recovery as R3, are composted. To determine composted waste amount, each enterprise, which reports recovery operations R3, working profile must be taken into account. From year 2014 special R code (R3A) for composting was implemented in Latvian legislation. Data selection for emission calculations became more simplified.

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

Industrial and home composting:

1. 4 g CH_4/ kg composted waste;
2. 0.24 g N_2O/ kg composted waste.

Table 7.12 Composted waste amounts and emissions (kt)

Year	Composted amounts in households (kt)	Industrial composted amount (kt)	CH_4 emission (kt)	N_2O emission (kt)
1990	239.0918253	-	0.956367301	0.057382
1991	238.1976078	-	0.952790431	0.0571674
1992	236.8390317	-	0.947356127	0.0568414
1993	231.7021428	-	0.926808571	0.0556085

Year	Composted amounts in households (kt)	Industrial composted amount (kt)	CH_4 emission (kt)	N_2O emission (kt)
1994	227.6902168	-	0.910760867	0.0546457
1995	224.0767862	-	0.896307145	0.0537784
1996	221.2944877	-	0.885177951	0.0531107
1997	219.0883809	-	0.876353524	0.0525812
1998	216.9267207	-	0.867706883	0.0520624
1999	214.9964333	-	0.859985733	0.0515991
2000	213.4253025	-	0.85370121	0.0512221
2001	210.8865637	-	0.843546255	0.0506128
2002	207.9806931	-	0.831922772	0.0499154
2003	206.0481654	2.224	0.833088662	0.0501188
2004	203.9987864	7.905	0.847615146	0.0513312
2005	201.5975989	6.564	0.832646396	0.0503526
2006	199.639622	11.698	0.845350488	0.0514229
2007	197.9339867	9.416	0.829399947	0.050329
2008	196.4079297	9.282	0.822759719	0.0499225
2009	193.8113925	15.11	0.83568557	0.0510477
2010	190.0182044	18.55	0.834272818	0.0511694
2011	185.9051984	23.699	0.838416794	0.0517269
2012	178.157	17.62	0.783108	0.0480437
2013	181.3548064	14.367	0.782887226	0.0478353
2014	184.614	40.038	0.898608	0.0563188
2015	190.730	67.577	1.033228	0.0619937

7.3.1.3 Uncertainties and times-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Emission factor uncertainties are calculated according range, which is published in 2006 IPCC Guidelines, 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%.

Time series for composting begins in 1990.

Uncertainty for households composted amounts are assumed as the same as for industrial composting.

Activity data uncertainty for industrial composting is estimated as 37%.

Uncertainty assessment of activity data for industrial composting is done using the proportion between composted amount and population (2004-2015). Uncertainty is calculated as the standard medium of the average from linear trend line.

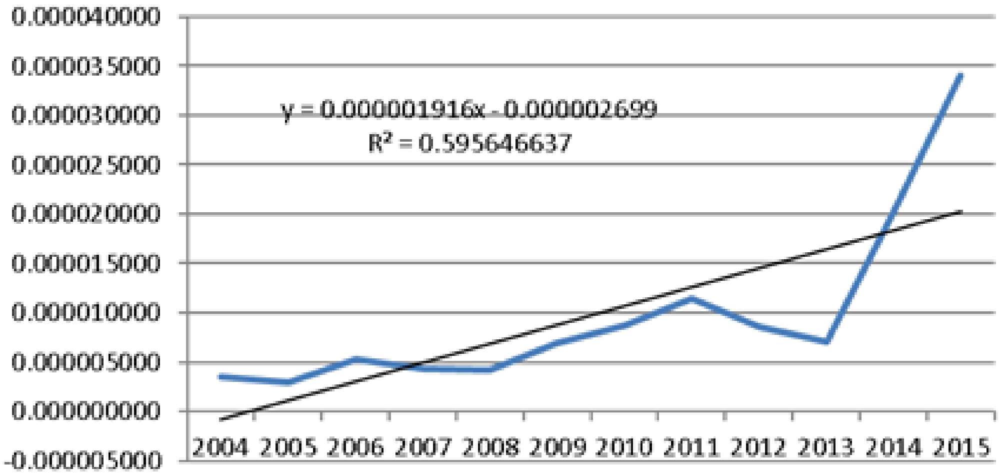

Figure 7.7 Trendline and proportion waste-to-population for waste composting

7.3.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the waste sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

Industrial composted waste amounts are taken from from "3-Waste" data base. Data in this data bases are checked and approved by Regional Environmental Boards.

7.3.1.5 Category-specific recalculations

No recalculations were done.

7.3.1.6 Category-specific planned improvements

Information about individual houses will be precised for composting emissions calculations.

7.3.2 Anaerobic Digestion at Biogas Facilities (CRF 5.B.2)

Anaerobic Digestion at biogas facilities is carried out in Latvia. All emissions are allocated under Energy sector because all biogas is used for energy production.

7.4 INCINERATION AND OPEN BURNING OF WASTE (CRF 5.C)

7.4.1 Waste Incineration (CRF 5.C.1)

7.4.1.1 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 since 1999. In the hazardous waste data base there is a separate entry for 1997-2001 on the amount of incinerated waste. Since 2002 the database also contains entries for recovery (R) and disposal (D) of waste, which is consistent with the EU Waste legislation.

Table 7.13 Reported emissions under category Waste Incineration

CRF	Source	Emissions reported
5.C 1	Biogenic (cremation)	SO_2, NMVOC, CO, NOx
5.C 2	Other – non biogenic (clinical (animal) and hazardous (industrial) waste)	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 refer 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*. Amount of incenerated animal waste (dead animals) are assumed as Clinical waste. The rest of the incinerated waste from hazardous waste database is considered as hazardous (industrial) waste.

In 2001 large increase of emissions can be observed, because one enterprise reported huge amount of incinerated waste. Incinerated amounts for 1990 – 1998 are extrapolated according to average value of incinerated amount for 2002 – 2013 which refers to disposed waste value.

In latest years incinerated amount of waste has decreased due the reason that hazardous waste incineration is not occuring in full scale. CO_2 emissions from Waste Incineration are presented in Figure 7.8.

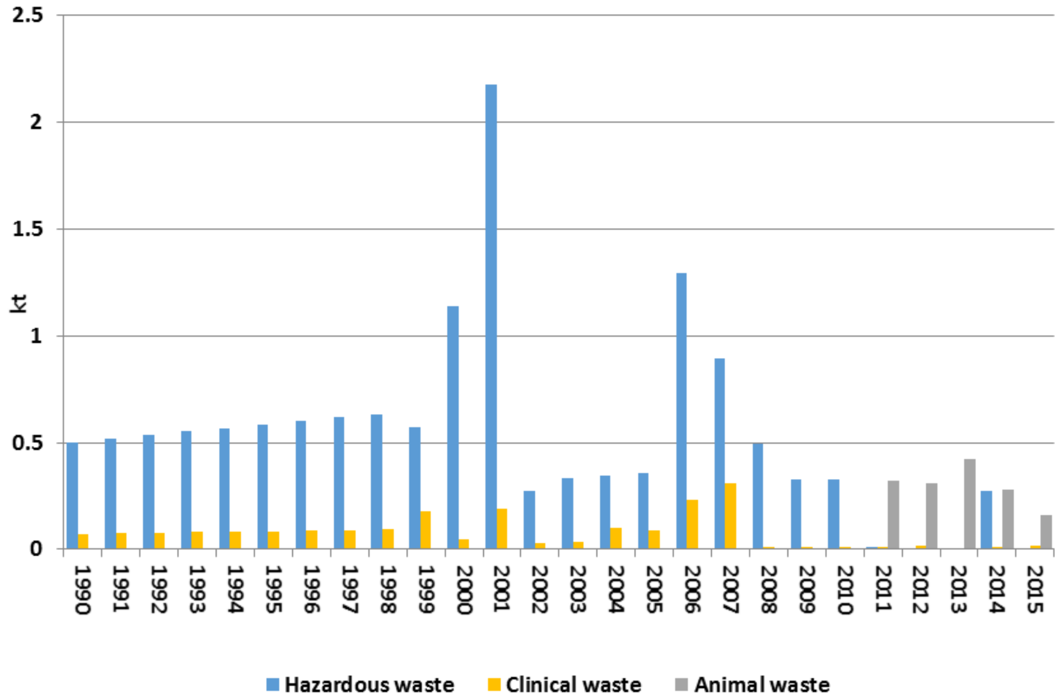

Figure 7.8 CO_2 emissions from Waste Incineration by waste type (kt)

Data about burned bodies is available from Riga crematorium since 1994. Calculations of emissions are done in accordance with the EMEP/EEA 2016 methodology. The main gases emitted during cremation are SO_x, NO_x, CO, and NMVOC, and all of them have to be reported in the inventory as indirect GHGs. These amounts are reported under general 5C sector.

Table 7.14 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
2013	2150
2014	2222
2015	2395

7.4.1.2 Methodological issues

According to the 2006 IPCC Guidelines CO_2 and N_2O emissions are calculated from the Waste Incineration. CH_4 emissions in well-functioning incinerators are usually very small. The CH_4 emissions are particularly relevant for open burning. 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 (CRF 1.A.2.f Non-metalic minerals).

CO_2 emissions were calculated using following 2006 IPCC Guidelines equation:

$$CO_{2\ emissions} = \Sigma_i[SW_{ix} \times CF_i \times FCF_i \times OX_i \times 44/12]\ kt/year$$

where:
i = waste type (hazardous waste, clinical waste)
SW_i = amounts of type i waste incinerated. (kt/year)
CF_i = carbon contents in the type i waste
FCF_i = fossil carbon contents in the type i waste
OX_i = oxidation factor 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 emission factors from 2006 IPCC Guidelines were used.

Table 7.15 Default emission factors for CO_2 emission calculation

	Clinical (animal) waste	Hazardous (industrial) waste
C contents in waste (CCW)	0.6	0.5
Fossil C contents in waste (FCF)	0.4	0.9
Oxidation factor (OX)	100%	100%

N_2O emissions from Waste incineration are calculated according to 2006 IPCC Guidelines, 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 waste are used oils, solvents and other liquids. Clinical waste is not dried before burning. The same factor also is used for N_2O emission calculation from clinical waste.

Table 7.16 Incinerated waste amounts without energy recovery

Year	Hazardous waste (kt)	Clinical waste (kt)	Animal waste (kt)	Total (kt)
1990	0.429082	0.116729	-	0.545812
1991	0.404964	0.110168	-	0.515131
1992	0.380845	0.103606	-	0.484451
1993	0.356726	0.097045	-	0.453771
1994	0.332607	0.090484	-	0.423091
1995	0.308488	0.083922	-	0.39241
1996	0.321434	0.087444	-	0.408878
1997	0.341924	0.093018	-	0.434942
1998	0.362414	0.098592	-	0.461006
1999	0.34721	0.20142	-	0.54863
2000	0.69028	0.05641	-	0.74669
2001	1.31927	0.21331	-	1.53258
2002	0.165643	0.032247	-	0.19789
2003	0.201813	0.040607	-	0.24242
2004	0.210125	0.112325	-	0.32245
2005	0.215127	0.102127	-	0.317254
2006	0.78616	0.26189	-	1.04805
2007	0.5405	0.350861	-	0.891361
2008	0.29975	0.012361	-	0.312111
2009	0.200	0.011663	-	0.211663
2010	0.200	0.012843	-	0.212843
2011	0.0063	0.012738	0.366092	0.38513
2012	NO	0.018049	0.348861	0.36691
2013	NO	0.005887	0.479833	0.48572
2014	0.166927	0.010341	0.3166033	0.493301
2015	NO	0.018498	0.18548	0.203978

Indirect GHGs (NMVOC, CO, SO_2, NOx) are calculated from waste incineration according to EMEP/EEA 2013 (Table 7.17).

Table 7.17 Emission factors for indirect GHGs

	Clinical waste (kg/Mg)	Hazardous waste (kg/Mg)
NMVOC	0.7	7.4
CO	0.19	0.07
SO_2	0.24	0.047
NOx	2.3	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 in the EMEP/EEA 2016 (Table 7.18).

Table 7.18 Emission factors for indirect GHGs from cremation

Indirect GHG	Emission factor (kg/body)
NMVOC	0.013
CO	0.140
SO_2	0.113
NO_x	0.825

7.4.1.3 Uncertainties and times-series consistency

Uncertainty analysis for 20167 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

CO_2 emission factor uncertainty is estimated as 40%, according 2006 IPCC Guidelines, because no correct information on carbon content in incinerated waste is known. Uncertainty for N_2O emission factor is 100%.

Activity data uncertainty for waste incineration is estimated as 44%.

Uncertainty assessment of activity data for waste incineration is done using the proportion between incinerated amount and population (years 2002-2015). Uncertainty is calculated as the standard medium of the average from linear trend line.

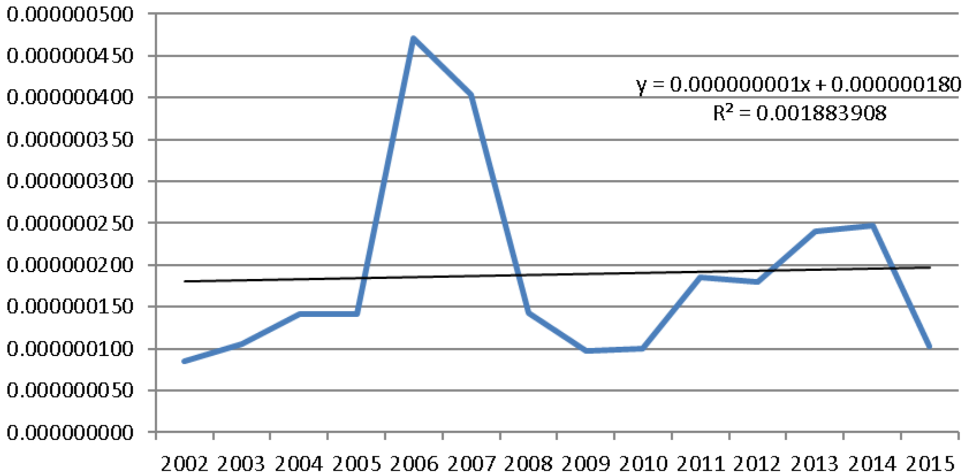

Figure 7.9 Trendline and proportion waste-to-population for waste incineration

7.4.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the waste sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

QA/QC procedures for waste incineration are done. Incinerated waste amounts are taken from "3-Waste" data base. Data in this data bases are checked and approved by Regional Environmental Boards.

7.4.1.5 Category-specific recalculations

No recalculations are done.

7.4.1.6 Category-specific planned improvements

No planned improvements.

7.4.2 Open Burning of Waste (CRF 5.C.2)

Open burning of waste is reported as NO (Not occuring). Open burning is not allowed in Latvia according to Waste Management Law.

7.5 WASTEWATER TREATMENT AND DISCHARGE (CRF 5.D)

7.5.1 Domestic Wastewater (CRF 5.D.1)

7.5.1.1 Category description

The emission sources cover handling of collected and uncollected domestic waste water for CH_4 from both waste water and sewage sludge and N_2O emissions from human sewage.

In most cases urban waste water is treated in well managed biological treatment plants in Latvia. However, certain part of national population still is not connected to a centralized collection and treatment systems and are served with septic tanks and latrines.

Data on type of treatment plant and its treatment level is available within national database on water use "2-Water", and all the treatment plants and number of population they serve is distributed by their type and level of treatment. Share of septic tank and latrine use is estimated, according to data on urbanization and default values from 2006 IPPC Guidelines.

Totally, taking into account of recovered CH_4 as well, emissions from Domestic Waste Water Handling sector made 118.1 kt CO_2 eq. in 2015, what makes decrease of 44.2% in comparison to 1990 and decrease of 9.1% in comparison to emissions of 2014 (Figure 7.10).

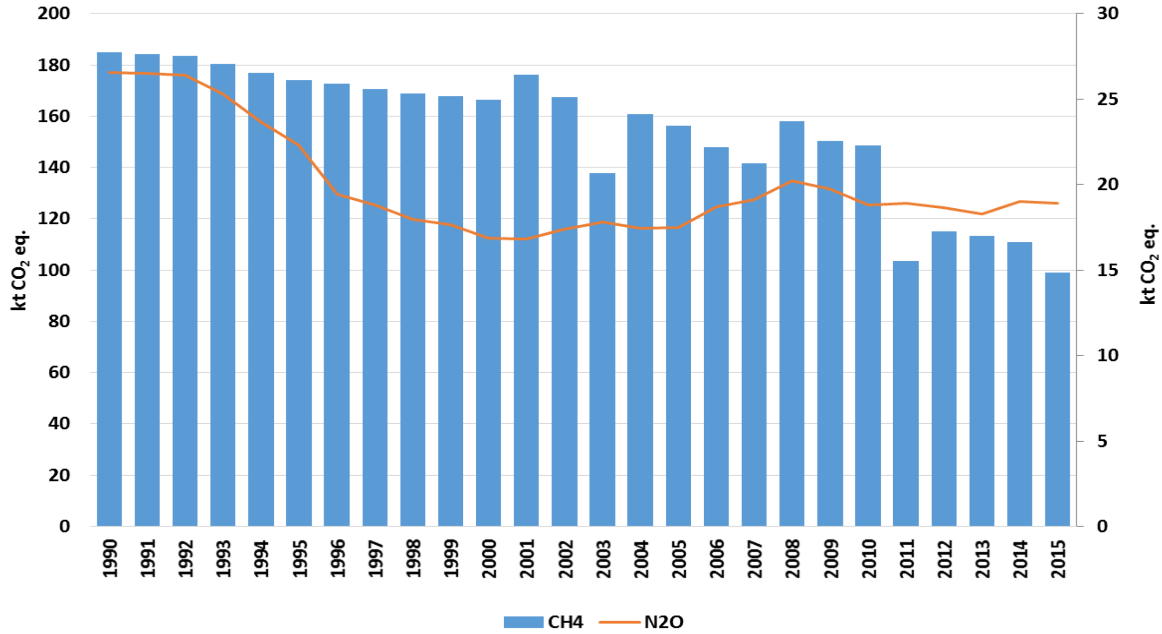

Figure 7.10 Emissions from Domestic Waste Water Handling sector[258] (kt CO_2 eq.)

7.5.1.2 Methodological issues

Calculation of CH_4 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. 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"[259], 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).

Default formula from 2006 IPCC Guidelines, chapter 6.2.2 „Domestic Wastewater" was used for calculation of CH_4 emission from Domestic Waste Water Handling sector. However, distribution of national population by treatment type and level is used instead of distribution of national population by income level.

$$CH_4 Emissions = \left[\sum_i (U_i \bullet EF_i) \right] \bullet (TOW - S) - R$$

where
CH_4Emissions – CH_4 emissions in the inventory year, kg CH_4/yr
TOW – total organics in waste water in inventory year, kg BOD/yr
S – organic component removed as sludge in inventory year, kg BOD/yr
U_i – degree of national population receiving certain waste water treatment type and level, %
i –waste water treatment type and level (well-managed biological, poor-managed biological, non-biological and no collection and no treatment)
EFi – emission factor for each treatment type fraction, kg CH_4/kg BOD
R – amount of CH_4 recovered in inventory year, kg CH_4/yr

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[258] *N_2O on secundary axis*
[259] *http://parissrv.lvgmc.lv/public_reports/#viewType=water2reports*

$$EF_i = B_o \bullet MCF_i$$

where:
EFi – emission factor for each treatment type fraction, kg CH_4/kg BOD
i –waste water treatment type and level (well-managed biological, poor-managed biological, non-biological and no collection and no treatment)
B_o – maximum CH_4 producing capacity, kg CH_4/kg BOD
MCF_i – methane correction factor for each treatment type and level

$$TOW = P \bullet BOD * 0.001 \bullet I \bullet 365$$

where
TOW – total organics in waste water in inventory year, kg BOD/yr
P – country population in inventory year, persons
BOD – country-specific per capita BOD in inventory year, g/person/day
I – correction factor for additional industrial BOD discharged into sewers

CH_4 emissions from anaerobic sewage sludge were calculated using default formula from „Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual"; chapter 6.3.5 „Methodology for Estimating Emissions from Wastewater Handling". In this case IPCC 1996 were used because 2006 IPCC Guidelines do not provide methodology to estimate emissions from anaerobic sewage sludge.

$$SM = TOS \bullet EF$$

where:
SM – total CH_4 emission from sewage sludge, kg CH_4
TOS – total organic content of sludge, kg COD/yr
EF – emission factor for sludge, kg CH_4/kg COD

$$EF = B_o \bullet MCF$$

where:
EF – emission factor for anaerobic sewage sludge, kg CH_4/kg COD
Bo – maximum CH_4 producing capacity, kg CH_4/kg COD
MCF – methane correction factor

Methane Conversion Factors (MCFs) were applied depending of treatment type and level. 2006 IPCC Guidelines were used as source of MCF values; however, expert judgment was performed to choose values applicable for Latvian conditions (Table 7.19).

Table 7.19 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	0.3
Not connected to waste water treatment plants	0.5 (septic tanks) 0.7 (latrines)

Although normally mechanical and chemical treatment is not a source of methane emissions, there are still rather large number of mechanical treatment plants in Latvia, where domestic waste water is treated; therefore it is considered that conditions in the mechanical treatment plants similar to those in the poorly managed biological treatment plants and, as result, the same value of MCF is applied. It was agreed as well in the discussion with Technical Expert Review Team (TERT) during the EU ESD voluntary review in 2015.

Typical mechanical and/or chemical treatment plants in Latvia mostly serves specific industrial waste water flows, where number of population connected and served is low or not at all, so this assumption does not affect calculations of emissions from human produced organic products in the waste water.

Organic load – so called "population equivalent" or 60 g of BOD per person per day – is determined by national legislation (Cabinet Regulation No. 34 "Regulations regarding Discharge of Polluting Substances into Water" (22.01.2002)).

Activity data, used for calculation of CH_4 emissions from domestic waste water are summarized in the following Table 7.20.

Table 7.20 Activity data for calculation CH_4 emissions from Domestic Waste Water Handling sector

Year	Population received well-managed biological treatment	Population receiving poor-managed biological treatment	Population receiving non-biological treatment	Population receiving no treatment	Amount of anaerobic sludge, t/y (dry solids)	Amount of recovered CH_4, kt/y	Total CH_4 emission produced, kt
1990	1 459 034	410 363	69 301	729 442	9 443	0	7.403
1995	1 367 407	384 592	64 949	683 633	6 719	0.344	6.969
2000	1 300 038	373 600	53 793	649 952	4 768	0.764	6.662
2001	1 271 237	287 125	40 553	754 469	6 054	0.948	7.047
2002	1 289 905	285 288	42 123	703 640	5 613	1.252	6.706
2003	1 576 709	102 260	36 631	583 790	8 052	0.801	5.511
2004	1 475 219	76 366	37 083	687 852	10 498	1.453	6.433
2005	1 455 222	82 417	37 375	674 710	9 108	1.683	6.260
2006	1 451 249	90 400	36 318	649 907	7 338	1.423	5.917
2007	1 461 489	77 278	32 294	637 779	6 337	1.489	5.665
2008	1 241 989	159 527	35 958	754 336	2 941	1.469	6.316
2009	1 362 423	125 187	19 829	655 395	7 235	1.860	6.201
2010	1 270 465	141 271	21 980	686 788	4 475	2.133	5.944
2011	1 562 500	91 688	19 403	396 780	7 075	1.870	4.146
2012	1 403 277	106 707	36 002	498 827	4 453	1.957	4.599
2013	1 414 230	94 528	31 433	483 904	5 451	1.806	4.536
2014	1 437 268	50 812	26 883	486 505	5 564	1.704	4.434
2015	1 471 005	34 294	28 545	452 252	4 026	1.858	3.963

Some assumptions are made to calculate emissions from domestic waste water handling:

- Total organically degradable carbon, removed from domestic waste water with sludge, is divided proportionally between types of treatment. Type of treatment "not connected" removes no carbon in sludge.
- Only temporal storage of sewage sludge with dry solid content less then 20% could be considered as anaerobic conditions, since all other ways or conditions of sewage sludge (for example, storage after dewatering procedures, what results in content of dry solids 20% and more) does not allow to use MCF value for "deep anaerobic lagoons", as it was recommended by TERT during 2015 trial review under the EU ESD, especially, if dewatered sewage sludge is being stored in the piles. An expert

judgment was performed and documented to establish the 20% solid content threshold value to divide sudge in anaerobic/aerobic [260].

Figure 7.11 Dewatered sewage sludge storage shed. Considered to be no source of CH_4 emissions

Figure 7.12 Liquid sewage sludge storage basin. Considered to be source of CH_4 emissions (deep anaerobic lagoon)

Example of methane emission calculation for 2015 is shown in a following Table 7.21.

[260] *Expert judgment protocol EJ_Waste_5D_2016_001*

Table 7.21 Calculation of CH_4 emission from Domestic Waste Water Handling sector (2015)

Treatment type	Population persons	Total DC (kt BOD/yr)	DC WW w/o sludge (kt BOD/yr)	Correction factor for additional industrial discharges of BOD into a sewer	Maximum CH_4 producing capacity B_o, kg CH_4/kg BOD	MCF	Emission factor	Emission (kt of CH_4)
Well managed biological	1 471 005	32.215	18.550	1.25	0.6	0	0	0
Poor managed biological	34 294	0.751	0.432	1.25	0.6	0.3	0.18	0.097
Non-biological	28 545	0.625	0.360	1.25	0.6	0.3	0.18	0.081
Not connected to treatment plants*	452 252	9.904	9.904	1				
Total:	1 986 096	43.496	29.246					**0.327**

**See detailed calculations in the Table 7.24*

Assumptions regarding sewage sludge are shown in Table 7.22.

Table 7.22 Characteristics of sewage sludge in Latvia

Characteristic	Value
Average content of dry solids in sludge, %[261]	14[262]
Average content of COD in dry solids, %	65[263]
Average content of N in dry solids, %	5.2[264]

Extrapolation was used to estimate amount of sewage sludge produced and treated anaerobically for period 1990 – 1997, where statistic data were not available. Based on statistics available (1998 – 2008), assumption was made the part of anaerobically stored sludge is 25% of all sludge produced. Emissions from sludge, used as fertilizer in agriculture or disposed in landfills, are reported under according sectors in different chapters of this NIR.

Data on recovery of CH_4 from waste water handling are plant specific data from treatment plant *"Daugavgrīva"*, operated by largest Latvian water supply and waste water Treatment Company *"Rīgas ūdens"*. Recovery of CH_4 is also performed by its daughter company *"Rigens"*, starting from 2002. 1.858 kt of CH_4 was recovered from waste water handling in 2015, and 0.011 kt of recovered CH_4 was flared. Recovered amount of CH_4 is being used as fuel in the cogeneration plant, and emissions from it are reported under the Energy sector. It is assumed, that content of the CH_4 in the recovered biogas by volume is 58%, and density of CH_4 is 0.6687 kg/m^3.

[261] *Is used to estimate content of dry solids for years where statistic data are not available (1998-2002)*
[262] *"Notekūdeņu dūņas un to izmantošana" („Sewage Sludge and Disposal of it"), Gemste I., Vucāns A., Jelgava, 2002.*
[263] *Average data of 1996*
[264] *"Notekūdeņu dūņas" ("Sewage Sludge"), Gemste I., Vucāns A., Jelgava, 2007.*

According to 2006 IPCC Guidelines, there are emissions of recovered CH_4 in the form of leakage from the recovery. Default value of 5% of leakage was used to estimate amount of CH_4 emissions of this source, thus giving emission of 5% of 1.858 kt CH_4 = 0.093 kt CH_4 in 2015.

Example of CH_4 emission calculation from sewage sludge is shown in Table 7.23.

Table 7.23 Calculation of CH_4 emission from anaerobic sewage sludge (2015)

Total DC sludge (kt COD/yr)	Maximum CH_4 producing capacity Bo, kg CH_4/kg COD	MCF for deep anaerobic lagoons	Emission factor for sludge (kg CH_4/ kg COD)	Emission of sludge (kt CH_4)
2.617	0.25	0.8	0.2	**0.523**

To estimate emission from part of national population, not connected to waste water treatment plants, recommendations from Technical Expert Review Team (TERT) during EU Effort Sharing Decision (EU ESD) voluntary review in 2015 was followed and estimation of use of septic tanks and latrines among national population was performed.

Proportion of urban (67% of national population) and rural (33%) population was taken from The World Bank data[265], default "suggested values for urbanisation and degree of utilization of treatment, pathway or method" from 2006 IPCC Guidelines were used (since there wasn't Latvia in the list, values for neighbour country Russia were used).

It was estimated, that 83.4% from national population, not connected to waste water treatment, are served by septic tanks, while 16.6% - with latrines (2015). Corresponding default MCF values from 2006 IPCC Guidelines were chosen to estimate emissions of CH_4 from this source (Table 7.24).

Table 7.24 Estimation of CH_4 emissions from national population, not connected to waste water treatment plants (2015)

Type of treatment or discharge pathway	Part of not connected national population, using treatment or discharge pathway	Population, using treatment or discharge pathway	Total DC (kt BOD/yr)	MCF	Emission factor, kg CH_4/kg BOD	Emissions of CH_4, kt
Septic tanks	83.4%	377 255	8.262	0.5	0.3	2.479
Latrines	16.6%	74 997	1.642	0.7	0.42	0.690
					Total:	**3.168**

Thus, total CH_4 emission from domestic waste water handling and sewage sludge in 2015 is 3.963 kt of CH_4, making decrease of 46.5% in comparison of emissions in 1990 and decrease of 10.6% in comparison of emissions in 2014 (Table 7.25).

Table 7.25 Total CH_4 emissions from domestic waste water handling sector (2015)

Source of CH_4 emissions	Emissions of CH_4, kt
Emissions from waste water, treated in waste water treatment plants	0.178
Emissions from leakage from recovered CH_4	0.093
Emissions from anaerobic sewage sludge	0.523
Emissions from national population, not connected to treatment plant	3.168
Total:	**3.963**

[265] *http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS*

Calculation of emissions of N_2O from Domestic Waste Water handling 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 values of protein consumption are obtained from FAOSTAT web site http://www.fao.org/faostat/en/#data/FBS (Table 7.26).

Table 7.26 Consumption of protein in Latvia per capita, sludge produced and emissions of N_2O (1990 - 2015)

Time period	g/person/day	kg/person/yr	Amount of sludge produced, t	N in the effluent, kt	Emissions of N_2O, kt
1990	102.3	39.88	36 115	27.92	0.088
1995	96.98	35.40	25 695	23.45	0.075
2000	77.08	28.13	18 234	17.78	0.057
2001	78.06	28.49	23 153	17.57	0.056
2002	81.18	29.63	21 467	18.14	0.058
2003	85.83	31.33	29 278	18.65	0.059
2004	85.99	31.39	36 164	18.13	0.058
2005	85.72	31.29	28 877	18.21	0.058
2006	90.88	33.17	23 942	19.45	0.062
2007	93.45	34.11	23 259	19.89	0.063
2008	98.13	35.82	19 258	20.98	0.067
2009	97.70	35.66	22 343	20.43	0.065
2010	94.71	34.57	21 386	19.41	0.062
2011	96.87	35.36	19 757	19.47	0.062
2012	96.87	35.36	20.134	19.20	0.061
2013	96.87	35.36	22 816	18.85	0.060
2014	96.87	35.36	22 079	18.67	0.059
2015	96.87	35.36	21 922	18.52	0.059

When compared with similar data from Latvian neighbour countries (Lithuania and Estonia), Latvian data shows consistent value (Table 7.27).

Table 7.27 Comparison of Latvian protein consumption data with data from neighbour countries

Country	g/person/day	kg/person/yr
Latvia	81.18…102.3	28.13…39.88
Lithuania	77.4…78.1* 64.38…81.92**	28.25…28.51** 23.5…29.9***
Estonia	101*	36.87**
Russia	61.0…104.7****	22.27…38.22**
Belarus	77.53…88.11**	28.30…32.16*****

**Data taken from Lithuanian and Estonian NIRs (2010)*
***Recalculated for comparison*
****Data taken from Lithuaninan NIR (2016)*
*****Data taken from Russian NIR (2016)*
******Data taken from Belarussian NIR (2016)*

Amount of N_2O emission from Domestic Waste Water Handling is calculated according to 2006 IPCC Guidelines; Chapter 6.3.1 „Methodological issues".

$$N_2O_{Emissions} = N_{Effluent} \bullet EF_{Effluent} \bullet \frac{44}{28}$$

where:

$N_2O_{Emissions}$ – N_2O emission in inventory year, kg N_2O/yr

$N_{Effluent}$ – Nitrogen in the effluent discharged to aquatic environment

$EF_{Effluent}$ – Emission factor for N_2O emissions from discharged waste water, kg N_2O-N/kg N

$$N_{Effluent} = (P \bullet \mathrm{Pr}\,otein \bullet F_{NPR} \bullet F_{NON-CON} \bullet F_{IND-COM}) - N_{Sludge}$$

where:

$N_{Effluent}$ – Total annual amount of nitrogen in waste water effluent, kg N/yr

P – National population

Protein – Annual per capita protein consumption, kg/pers/y

F_{NPR} – Fraction of nitrogen in protein, kg N/kg protein

$F_{NON-COM}$ – Factor for non-consumed protein added to waste water

$F_{IND-COM}$ – Factor for industrial and commercial co-discharged protein into a sewer system

N_{Sludge} – Nitrogen removed with sludge, kg N/y

Default value for nitrogen fraction in protein – 0.16 kg N/kg protein – is used in calculation. Default emission factor – 0.005 kg N_2O-N/kg N – was used as well. Both values were taken from 2006 IPCC Guidelines, as well as factors for non-consumed (for countries with garbage disposals) and industrial and commercial protein co-discharged in the sewer system.

Content of Nitrogen in the dry solids of sewage sludge was already shown in the table with characteristics of sewage sludge in Latvia (Table 7.22).

A small amount of N_2O is emitted during the release from the sewage system. The calculations give emission 0.059 kt N_2O (2015).

N_2O emissions from centralized waste water treatment processes are estimated as well.

$$N_2O_{Plants} = P \bullet T_{Plant} \bullet F_{IND-COM} \bullet EF_{Plant}$$

where:

N_2O_{Plants} – Total N_2O emissions from plants in the inventory year, kg N_2O/y

P – Human population

T_{Plant} – Degree of utilization of modern, centralized treatment plants, %

$F_{IND-COM}$ – Fraction of industrial and commercial co-discharged protein

EF_{Plant} – Emission factor, g N_2O/pers/y

Waste water treatment plants, providing tertiary treatment (i.e. removal of nitrogen of phosphorus), are considered to be in compliance with requirements for "modern, centralized treatment plants". Degree of their utilization is estimated based on number of national population, provided with such treatment. National waste water database "2-Water" provides according statistical data (starting from 2000). Constant value of 3% was used for years, previous to 2000.

Activity data for estimation emissions of N_2O from Domestic Waste Water Handling sector are shown in the following Table 7.28.

Table 7.28 Activity data for estimation emissions of N_2O from Domestic Waste Water Handling sector

Year	Population	Degree of utilization of modern, centralized treatment plants, %	N_2O emissions from modern, centralized treatment plants, kt
1990	2 668 140	3.0	0.00032
1995	2 500 580	3.0	0.00030
2000	2 377 383	0.8	0.00008
2001	2 353 384	4.9	0.00046
2002	2 320 956	7.6	0.00071
2003	2 299 390	4.3	0.00040
2004	2 276 520	8.9	0.00081
2005	2 249 724	8.4	0.00076
2006	2 227 874	9.2	0.00082
2007	2 208 840	9.3	0.00082
2008	2 191 810	12.0	0.00105
2009	2 162 834	14.5	0.00125
2010	2 120 504	16.4	0.00139
2011	2 070 371	18.2	0.00151
2012	2 044 813	17.7	0.00145
2013	2 023 825	17.4	0.00141
2014	2 001 468	55.9	0.00447
2015	1 986 096	57.0	0.00453

Considerable increase of share of population, served with modern, centralized treatment plants in last years can be explained by intensive implementing of Urban Waste Water Treatment Directive 91/271/EEC.

Default values from 2006 IPCC Guidelines are used for fraction of industrial and commercial co-discharged protein and emission factor (correspondingly, 1.25 and 3.2 g N_2O/pers/y). Estimation gives emission of 0.00453 kt of N_2O from this subsector in 2015. Thus, total emission of N_2O from Domestic Waste Water Handling in 2015 was 0.0589 + 0.0045 = 0.0635 kt N_2O, what makes decrease of 28.8% in comparison with emissions of 1990 and decrease of 0.6% in comparison with emissions of 2014.

7.5.1.3 Uncertainties and times-series consistency

Uncertainty analysis for 2016 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The following uncertainties were used for Domestic Waste Water Handling sector for activity data and emission factors (Table 7.29).

Table 7.29 Uncertainties for Domestic Waste Water Handling sector

Emission	Activity data	Emission factor
CH_4	6%	30%*
N_2O	8%	30%*

**30% - default uncertainty from 2006 IPCC Guidelines*

Uncertainties for activity data of each subsector are estimated using similar methodology. To estimate an uncertainty for certain subsector, its activity data are drawn on chart for each year, then the mathematical relationship of activity data timeline is found as equation of the trend line. Then "theoretical values" of activity data is calculated for each year, using the equation of the trend line, and uncertainty being calculated as deviation (in %) of "actual" value from the "theoretical" one (Figure 7.13).

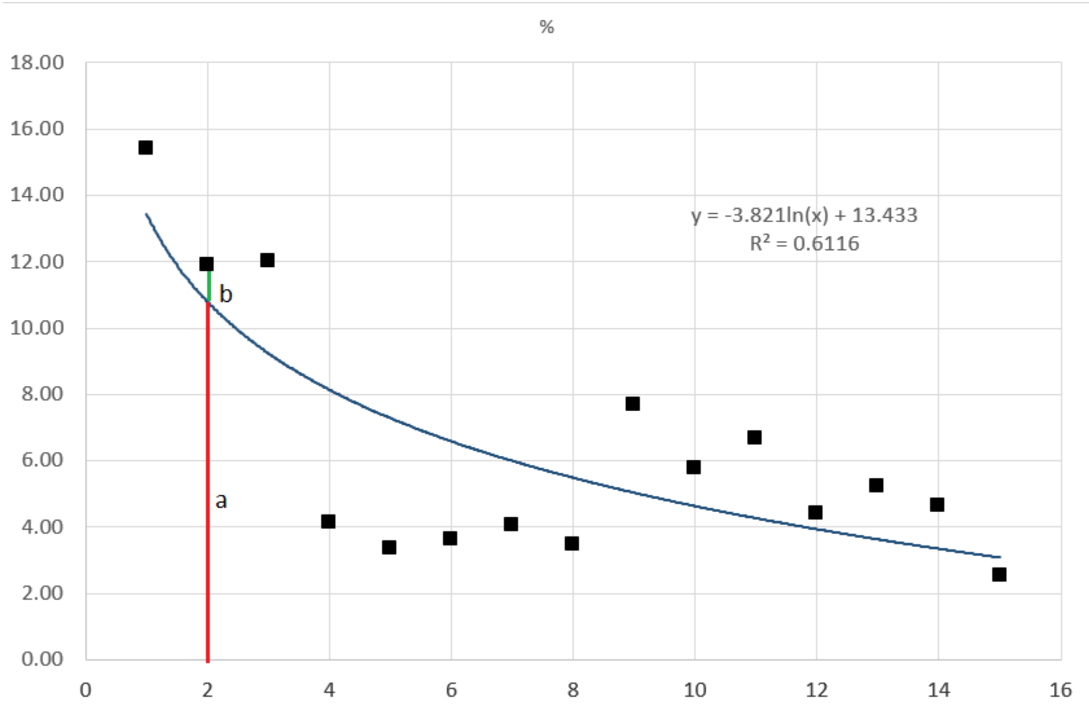

Figure 7.13 Example of estimation of uncertainties in Waste Water Handling sector

Each deviance is calculated as:

$$Uncerta\,\text{int}\ y,\% = \frac{100\bullet|b|}{a}$$

where:
a – "theoretical" value of activity data, calculated through equation of the trend line
b – difference between "theoretical" and "actual" value of activity data for certain year

Total uncertainty for certain type of activity data is calculated as average for entire timeline. Then total uncertainty U_{tot} for subsector is being calculated, using following formula of combined uncertainty:

$$U_{tot} = \frac{\sqrt{(x_1U_1)^2 + (x_2U_2)^2}}{x_1 + x_2}$$

where:
x – emissions from certain pathway/subsector
U – uncertainties for each type of activity data for certain subsector associated with emissions from the same pathway/subsector

Time series show continuous decrease of emissions in the entire timeline. Main reason of this decrease is recovery of CH_4 and implementation of more and better treatment plants also can be observed. However, the same driving force is reason for increase of N_2O emissions from subsector of modern centralized treatment plants.

Inconsistencies in data (for example, potential outlier of CH_4 emissions in 2003, as well as considerable fluctuations from 2007 to 2008 and from 2010 to 2012) can be explained with quality of activity data. Although data collection system on population, receiving certain grade of waste water treatment is generally well-designed and allows to collect data on plant level, the actual data quality still largely depends on competence of person in enterprise, responsible for reporting these data, as well as inspector of regional environmental board, who assesses and accepts the survey with plant level data. Some additional and retrospective data checks are performed occasionally, which leads to overall improvement and reliability of statistic data.

7.5.1.4 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.G. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

Following procedures of quality assurance and quality control were carried out:

- Statistic data of national population, served by certain treatment type and level, as well as amount of sludge produced and disposed are collected through annual state statistical survey "2-Water". In frames of this survey, enterprises, performing collection and treatment of waste water, submit their data using online database. Reported data are checked by Latvian State Environment Service, whose environment inspectors approve reports or return them to submitters for correcting of data;
- 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 (see Table 7.27);
- Comments in CRF tables were checked in process of entering data of calculation and recalculation results in CRF tables.

7.5.1.5 Category-specific recalculations

CH_4 emission data were recalculated in Domestic Waste Water Handling sector due to adjustment of activity data for entire reporting period.

N_2O emission data were recalculated for entire timeline due to update of activity data for entire reporting period.

7.5.1.6 Category-specific planned improvements

No improvements are planned for sector.

7.5.2 Industrial Wastewater (CRF 5.D.2)

7.5.2.1 Category description

Industrial Waste Water Handling is responsible for CH_4 and N_2O emissions. Fluctuations of methane emission from Industrial Waste Water Handling are connected with fluctuations of amount of production produced, which is activity data for this sector. Significant decrease in methane emission in period 1993 – 1999 is due to decrease of economic activity after collapse of Soviet Union. Emission of N_2O, produced by Industrial Waste Water Handling, is negligible, giving approximately 0.0003% of emission in this sector in 2015.

Totally, emissions from Industrial Waste Water Handling sector made 135.6 kt CO_2 eq. in 2015, what makes decrease of 1.1% in comparison to emissions of 1990 and increase of 3.5% in comparison to emissions of 2014 (Figure 7.14).

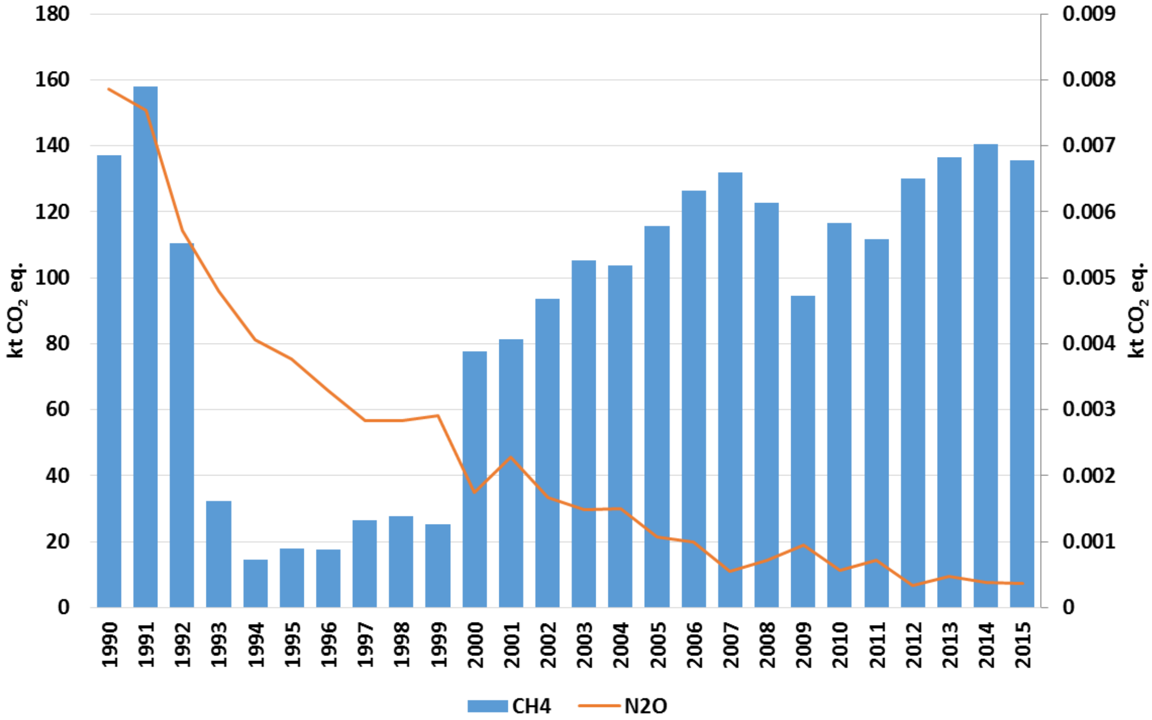

Figure 7.14 Emissions from Industrial Waste Water Handling sector[266] (kt CO_2 eq.)

7.5.2.2 Methodological issues

Emissions of CH_4 from Industrial Waste Water Handling is calculated from amount of total organic product (expressed as COD – chemical oxygen demand) and total nitrogen in waste water, generated in certain branches of industry (mostly food-processing industry).

2006 IPCC Guidelines default formula from chapter 6.2.3 „Industrial Wastewater" was used for calculation of CH_4 emission from Industrial Waste Water Handling sector.

[266] *N_2O on secundary axis*

$$CH_4 = \sum_i \left[(TOW_i - S_i) \bullet EF_i - R_i \right]$$

where:
CH_4– CH_4 emissions in inventory year, kg CH_4/yr
TOW_i – total organically degradable material in industrial waste water from industry i in inventory year, kg COD/yr
i – industrial sector
S_i – organic component removed with sludge in the inventory year, kg COD/yr
EF_i – emission factor for industry i, kg CH_4/kg COD
R_i – amount of CH_4 recovered in inventory year, kg CH_4

$$EF_i = B_o \bullet MCF_i$$

where:
EFi – emission factor for each industry i, kg CH_4/kg COD
i – each type of industry
B_o – maximum CH_4 producing capacity, kg CH_4/kg COD
MCFi – methane correction factor for each type of industry

$$TOW_i = P_i \bullet W_i \bullet COD_i$$

where:
TOW_i – total organically degradable material for industry i, kg COD/yr
i – industrial sector
P_i – total industrial product for industry i, t/yr
W_i – waste water generated for each type of industry, m^3/t product
COD_i – industrial degradable organic component in waste water, kg COD/m^3

Activity data (amount of certain industrial products) was taken from national statistics – CSB data base. Default IPCC value 0.25 kg CH_4/kg COD was used for maximum methane producing capacity, as it is recommended in 2006 IPCC Guidelines. Amount on generation of waste water per certain type of product and organic component in that waste water were taken as default values from 2006 IPCC Guidelines.

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).

Assumptions for all relevant industries are summarized in Table 7.30.

Table 7.30 Assumptions used for calculation of CH_4 emissions from Industrial Waste Water Handling

Industry type	Generation of waste water, m^3/t of product*	Organic component in waste water, kg COD/m^3*	Weighted MCF value**
Milk	7	2.7	0.10
Meat	13	4.1	0.15
Fish	13	2.5	0.05
Beer	6.3	2.9	0.04
Fruits and vegetables	20	5	0.13
Sugar	11	3.2	0.50
Paper and pulp	162	9	0.30
Plastics	0.6	3.7	0.14
Organic chemicals	67	3	0.03

**Assumptions used from 2006 IPCC Guidelines*
***rounded to 2 decimal positions*

Organic component removed with sludge and amount of recovered CH_4 under this sector is assumed to be 0 – both values are estimated and taken into account under the Domestic Waste Water Handling sector.

Activity data, used for calculation of CH_4 emissions from domestic waste water are summarized in the following Table 7.31.

Table 7.31 Activity data for calculation CH_4 emissions from Industrial Waste Water Handling sector (amount of products, th. t/yr)

Year	Milk	Meat	Fish	Beer	Fruits and vegetables	Sugar	Paper and pulp	Plastics	Organic chemicals	CH_4 emission, kt
1990	1 188	324	335	9	0	31	37	0	0	5.481
1995	353	99	114	66	0	29	1.5	0	0	0.720
2000	155	67	82	95	38	63	22	19	12	3.105
2001	181	71	107	101	43	56	23	24	14	3.251
2002	180	89	102	122	50	77	27	30	15	3.739
2003	189	105	83	139	47	75	31	38	16	4.206
2004	200	118	86	134	47	67	30	27	16	4.146
2005	221	126	88	131	48	71	34	29	4	4.625
2006	245	144	86	143	44	60	38	30	5	5.052
2007	232	151	76	143	32	0	43	33	25	5.273
2008	215	149	85	136	38	0	39	24	25	4.910
2009	192	125	55	130	28	0	30	16	51	3.780
2010	193	123	56	150	28	0	38	19	51	4.668
2011	178	125	60	150	20	0	37	20	4	4.469
2012	184	129	73	140	19	0	43	22	5	5.203
2013	193	126	72	134	21	0	46	25	5	5.455
2014	193	134	70	98	21	0	47	26	15	5.618
2015	189	126	45	90	26	0	45	27	10	5.423

Example of CH_4 emission calculation from Industrial Waste Water Handling is provided in a Table 7.32.

Table 7.32 Calculation example of emission of CH_4 from Industrial Waste Water Handling (2015)

Product name	Amount of production, th. 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, kg/m^3	Load of COD, kt	Max.CH_4 prod. capacity, kg CH_4/ kg COD	MCF	Emission of CH_4, kt
	a	b	c = a*b	d	e = c*d	f	g	h = e*f*g
Milk	189	7	1 322	2.7	3.57	0.25	0.10	0.089
Meat	126	13	1 632	4.1	6.69	0.25	0.15	0.249
Fish	45	13	580	2.5	1.45	0.25	0.05	0.018
Sugar	0	11	0	3.2	0	0.25	0.5	0
Beer	90	6.3	568	2.9	1.65	0.25	0.04	0.017
Fruits and vegetables	26	20	512	5	2.56	0.25	0.13	0.080
Paper and pulp	45	162	7 339	9	66.05	0.25	0.30	4.954
Plastics	27	0.6	16	3.7	0.06	0.25	0.14	0.002
Organic chemicals	10	67	659	3	1.98	0.25	0.03	0.014
				Total:	**84.00**		Total:	**5.423**

Thus, total emission of CH_4 from Industrial Waste Water treatment in 2015 was 5.423 kt of CH_4, what makes 1.1% decrease if compared to emission of 1990 and 3.5% decrease if compared with emission of 2014.

N_2O emission from Industrial Waste Water Handling was calculated, using Tier 1 method from 2006 IPCC Guidelines, chapter 6.3.1 "Nitrous Oxide Emissions from Wastewater". Calculation is based on load of nitrogen in the industrial waste water:

$$WM = N_{ef} \bullet EF \bullet \frac{44}{28} \bullet 10^{-6}$$

where:
WM – total emission of N_2O from industrial waste water handling in kt N_2O
N_{ef} – load of nitrogen, kg/yr
EF – emission factor, kg N_2O-N/kg N

Default value (0.005 kg N_2O-N/kg N) from 2006 IPCC Guidelines was used for calculation.

Activity data, used for calculation of N_2O emissions from Industrial Waste Water Handling, are summarized in Table 7.33:

Table 7.33 Activity data for calculation N_2O emissions from Industrial Waste Water Handling sector

Year	Load of N in industrial waste water, t/yr	Emissions of N_2O, kt
1990	1 000	0.00786
1995	480	0.00377
2000	222	0.00175
2001	290	0.00228
2002	213	0.00168
2003	189	0.00149
2004	190	0.00145
2005	136	0.00107
2006	126	0.00099
2007	70	0.00055
2008	92	0.00072
2009	121	0.00095
2010	71	0.00056
2011	92	0.00072
2012	43	0.00034
2013	60	0.00047
2014	49	0.00039
2015	47	0.00037

N_2O emission from Industrial Waste Water Handling is negligible – 0.00037 kt/yr (2015), what makes decrease of 95.3% if compared to emissions of 1990 and decrease of 4.7% if compared to emission of 2014.

7.5.2.3 Uncertainties and times-series consistency

Uncertainty analysis for 2016 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

The following uncertainties were used for Industrial Wastewater Handling sector for activity data and emission factors (Table 7.34).

Table 7.34 Uncertainties for Industrial Waste Water Handling sector

Emission	Activity data	Emission factor
CH_4	14%	30%*
N_2O	13%	30%*

**default uncertainty from 2006 IPCC Guidelines*

Uncertainties for activity data in Industrial Waste Water Handling) are estimated similarly as uncertainties for activity data for Domestic Waste Water subsector (see Chapter 7.5.1.3).

Time series of emissions are fluctuating since Industrial Waste Water Handling is significant source of CH_4 emissions 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 – 1999 can also be explained by decrease of national economic activity after collapse of Soviet Union in 1991.

N_2O emission activity data and emissions from Industrial Waste Water, despite of some small fluctuation, show trend for emissions to decrease, however its effect on total emissions from this sector is not significant, because of small amount of N_2O emitted.

7.5.2.4 Source-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.G. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

Following procedures of quality assurance and quality control were carried out:

- Statistic data of nitrogen load in waste water (including industrial waste water) are collected through annual state statistical survey "2-Water". In frames of this survey, enterprises, performing collection and treatment of waste water, submit their data using online database. Reported data are checked by Latvian State Environment Service, whose environment inspectors approve reports or return them to submitters for correcting of data;
- Units of measurement were checked during comparison with results of previous reports;
- Comments in CRF tables were checked in process of entering data of calculation and recalculation results in CRF tables.

7.5.2.5 Source-specific recalculations

Emissions of both CH_4 and N_2O were recalculated for period 2000 – 2014 due to update of activity data.

7.5.2.6 Source-specific planned improvements

No improvements are planned.

7.5.3 Other (CRF 5.D.3)

7.5.3.1 Category description

Data from annual state statistical survey "2-Water" shows there were 192 mio m^3 of waste water discharged in Latvia (2015). Most of national population (77.2%, 2015) is served by urban waste water collecting and treatment. Certain amount of NMVOC is produced from Waste Water Handling sector.

7.5.3.2 Methodological issues

Emissions of NMVOC was calculated and using default EMEP emission factor from EMEP/EEA 2016 was used for this calculation – 15 mg of NMVOC per m^3 of waste water produced, what gives 0.00288 kt of NMVOC (2015). It makes decrease of 68.0% if compared to emission of 1990 and increase of 5.5% if compared to emission of 2014.

Activity data, used for this calculation, are summarized in the following Table 7.35.

Table 7.35 Activity data for calculation NMVOC emissions from Waste Water Handling sector

Year	Amount of waste water produced, mio m^3	Emissions of NMVOC, kt
1990	600	0.00900
1995	357	0.00536
2000	257	0.00386
2001	244	0.00366
2002	243	0.00365
2003	229	0.00344
2004	211	0.00317
2005	226	0.00339
2006	196	0.00294
2007	210	0.00315
2008	191	0.00287
2009	226	0.00339
2010	222	0.00333
2011	241	0.00362
2012	234	0.00351
2013	229	0.00344
2014	182	0.00273
2015	192	0.00288

7.5.3.3 Source-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in the 2.G. sector in order to achieve these quality objectives. Quality meetings are held annually between experts.

- Statistic data of amount of waste water produced and discharged are collected through annual state statistical survey "2-Water". In frames of this survey, enterprises, performing collection and treatment of waste water, submit their data using online database. Reported data are checked by Latvian State Environment Service, whose environment inspectors approve reports or return them to submitters for correcting of data;

- Units of measurement were checked during comparison with results of previous reports.

7.5.3.4 Uncertainties and time-series consistency

Uncertainty for activity data regarding NMVOC emissions is 10%. It is calculated the same way as uncertainties for Domestic and Industrial Waste Water Handling (See Chapter 7.5.1.3 for description). EMEP/EEA 2016 does not provide uncertainty for emission factors or methodology to estimate it.

7.5.3.5 Source-specific recalculations

Emissions for year 2013 were recalculated due to update of activity data.

7.5.3.6 Source-specific planned improvements

No planned improvements.

8 OTHER (CRF 6)

Latvia does not report emissions under CRF 6 Other.

9 INDIRECT CO_2 AND NITROUS OXIDE EMISSIONS

9.1 CATEGORY DESCRIPTION

In accordance with UNFCCC reporting guidelines Annex I Parties may report indirect CO_2 from the atmospheric oxidation of CH_4, CO and NMVOCs.

Sources of indirect CO_2 emissions in Latvian inventory are indirect CO_2 from the atmospheric oxidation of CH_4 and NMVOCs under Energy and IPPU sectors.

The estimation of indirect CO_2 emissions is based on the official Latvian inventories reported under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP).

9.1.1 Methodological issues

Indirect CO_2 emissions are generally calculated using the methodology described in the 2006 IPCC Guidelines.

In order for consistency with the reporting done by Latvia under the first commitment period of the Kyoto Protocol, the indirect CO_2 emissions from NMVOCs in solvent use, road paving with asphalt, asphalt roofing and glass fibre production are reported under CRF 2.D.3 Other in accordance with UNFCCC reporting guidelines. For submission 2017, other sources of indirect CO_2 emissions occurring in Energy and Transport sectors are calculated and reported in CRF Table 6.

According to the 2006 IPCC Guidelines, there are sources in Energy sector that produce indirect CO_2 emissions from CH_4 and NMVOCs. Those sources in case of Latvia are NMVOC emissions from gasoline evaporation in road traffic cars (Transport sector) as well as CH_4 and NMVOC emissions from natural gas leakages and NMVOC emissions from gasoline distribution (Energy sector). The general formulas to calculate indirect CO_2 emissions are provided below:

$$from\ CH_4: \quad inputs_{CO_2} = emissions_{CH_4} \times \frac{44}{16}$$

$$from\ NMVOC: \quad inputs_{CO_2} = emissions_{NMVOC} \times C \times \frac{44}{12}$$

where:
c – fraction of carbon

2006 IPCC Guidelines provide a default factor – 0.6 – for the fraction of carbon in NMVOC. Separate sources and emissions are presented in Table 9.1.

Table 9.1 Indirect CO_2 emissions from Energy (kt)

	Indirect CO_2 from gas leakage (NMVOC)	Indirect CO_2 from gas leakage (CH_4)	Indirect CO_2 from gasoline distribution (NMVOC)	Indirect CO_2 from gasoline evaporation (NMVOC)
1990	6.52	27.23	2.68	6.99
1991	6.28	26.23	2.26	6.27
1992	5.73	23.92	2.17	6.44
1993	5.48	22.87	2.10	5.73
1994	5.35	22.35	2.01	5.75

	Indirect CO_2 from gas leakage (NMVOC)	Indirect CO_2 from gas leakage (CH_4)	Indirect CO_2 from gasoline distribution (NMVOC)	Indirect CO_2 from gasoline evaporation (NMVOC)
1995	5.21	21.77	1.81	5.38
1996	5.02	20.97	1.79	4.66
1997	4.69	19.58	1.65	4.57
1998	4.50	18.78	1.54	4.10
1999	4.29	17.91	1.49	4.30
2000	3.97	16.57	1.48	4.37
2001	3.87	16.07	1.55	4.44
2002	4.02	16.78	1.52	4.02
2003	3.14	13.10	1.52	3.30
2004	3.11	12.97	1.54	2.71
2005	3.51	14.65	1.51	1.96
2006	2.52	10.51	1.68	1.75
2007	4.16	10.79	1.83	1.17
2008	3.82	11.08	1.67	0.65
2009	3.98	10.46	1.40	0.50
2010	3.90	10.08	1.27	0.41
2011	1.89	6.93	1.19	0.40
2012	2.16	8.76	1.02	0.38
2013	2.83	11.11	0.93	0.29
2014	4.24	14.88	0.90	0.17
2015	4.39	11.31	0.89	0.13

As it can be seen in Table 9.1 the largest part of indirect CO_2 emissions in all years contributes to natural gas leakage. In 2015 natural gas leakages made 67.6% of total indirect CO_2 emissions.

9.1.2 Uncertainties and times-series consistency

Uncertainty analysis for 2017 submission is carried out by using Approach 1. Quantitative estimates of uncertainties are provided in Annex 2. Overall description of uncertainty analysis is included in Section 1.6.

Information regarding uncertainties for 2.D.3 sector can be found under chapter 4.5.3.3.

9.1.3 Category-specific QA/QC and verification

The quality objectives and the QA/QC plan for the Latvia's greenhouse gas inventory at the national inventory level are presented in Section 1.2.3. The QC procedures are performed according to the QA/QC plan in order to achieve these quality objectives. Quality meetings are held annually between experts.

9.1.4 Category-specific recalculations

No recalculations done in this sector.

9.1.5 Category-specific improvements

No improvements are planned for this 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:

- Recommendations by Expert review team (ERT) according to Report on the individual review of the annual submission of Latvia submitted in 2015[267];
- Recommendations by ERT according to Report on the individual review of the annual submission of Latvia submitted in 2016[268];
- Corrections of activity data and corrections of input mistakes.

Overall impacts of recalculations since 1990 are summarized in Table 10.1.

Table 10.1 Impacts of recalculations on national emissions

		Previous submission	Latest submission	Difference	Difference
		CO_2 equivalent (kt)			(%)
1990	Total CO_2 Eq Emissions with LULUCF	17932.34	17354.34	-578.00	-3.22
	Total CO_2 Eq Emissions without LULUCF	26353.97	26141.43	-212.54	-0.81
1991	Total CO_2 Eq Emissions with LULUCF	15691.37	15097.29	-594.08	-3.79
	Total CO_2 Eq Emissions without LULUCF	24373.12	24175.95	-197.17	-0.81
1992	Total CO_2 Eq Emissions with LULUCF	9568.35	8983.02	-585.33	-6.12
	Total CO_2 Eq Emissions without LULUCF	19583.51	19416.54	-166.97	-0.85
1993	Total CO_2 Eq Emissions with LULUCF	6907.48	6354.85	-552.63	-8.00
	Total CO_2 Eq Emissions without LULUCF	16149.86	16003.27	-146.58	-0.91
1994	Total CO_2 Eq Emissions with LULUCF	4182.70	3816.79	-365.90	-8.75
	Total CO_2 Eq Emissions without LULUCF	14244.25	14109.48	-134.77	-0.95
1995	Total CO_2 Eq Emissions with LULUCF	3787.07	3517.79	-269.28	-7.11
	Total CO_2 Eq Emissions without LULUCF	12824.99	12697.62	-127.37	-0.99
1996	Total CO_2 Eq Emissions with LULUCF	3152.36	2766.65	-385.71	-12.24
	Total CO_2 Eq Emissions without LULUCF	12876.02	12755.65	-120.37	-0.93
1997	Total CO_2 Eq Emissions with LULUCF	4258.63	4025.35	-233.28	-5.48

[267] *http://unfccc.int/resource/docs/2017/arr/lva01.pdf*
[268] *http://unfccc.int/resource/docs/2017/arr/lva02.pdf*

		Previous submission	Latest submission	Difference	Difference
		CO_2 equivalent (kt)			(%)
	Total CO_2 Eq Emissions without LULUCF	12312.71	12195.92	-116.79	-0.95
1998	Total CO_2 Eq Emissions with LULUCF	4622.60	4472.58	-150.02	-3.25
	Total CO_2 Eq Emissions without LULUCF	11802.14	11693.78	-108.36	-0.92
1999	Total CO_2 Eq Emissions with LULUCF	7155.98	7229.05	73.06	1.02
	Total CO_2 Eq Emissions without LULUCF	11009.66	10906.21	-103.45	-0.94
2000	Total CO_2 Eq Emissions with LULUCF	3738.52	3641.24	-97.28	-2.60
	Total CO_2 Eq Emissions without LULUCF	10434.29	10336.41	-97.88	-0.94
2001	Total CO_2 Eq Emissions with LULUCF	3524.37	3535.03	10.66	0.30
	Total CO_2 Eq Emissions without LULUCF	11034.15	10935.21	-98.94	-0.90
2002	Total CO_2 Eq Emissions with LULUCF	4968.95	4998.72	29.76	0.60
	Total CO_2 Eq Emissions without LULUCF	11005.66	10917.09	-88.57	-0.80
2003	Total CO_2 Eq Emissions with LULUCF	5602.84	5669.04	66.20	1.18
	Total CO_2 Eq Emissions without LULUCF	11164.60	11091.98	-72.62	-0.65
2004	Total CO_2 Eq Emissions with LULUCF	7078.13	7072.58	-5.55	-0.08
	Total CO_2 Eq Emissions without LULUCF	11155.28	11081.92	-73.36	-0.66
2005	Total CO_2 Eq Emissions with LULUCF	7645.41	7818.58	173.16	2.26
	Total CO_2 Eq Emissions without LULUCF	11374.30	11290.67	-83.63	-0.74
2006	Total CO_2 Eq Emissions with LULUCF	7178.18	7199.35	21.17	0.29
	Total CO_2 Eq Emissions without LULUCF	11894.92	11815.09	-79.83	-0.67
2007	Total CO_2 Eq Emissions with LULUCF	8307.61	8250.38	-57.23	-0.69
	Total CO_2 Eq Emissions without LULUCF	12359.04	12270.39	-88.65	-0.72
2008	Total CO_2 Eq Emissions with LULUCF	7507.45	7378.31	-129.14	-1.72
	Total CO_2 Eq Emissions without LULUCF	11936.77	11801.73	-135.04	-1.13
2009	Total CO_2 Eq Emissions with LULUCF	10577.07	10738.45	161.38	1.53
	Total CO_2 Eq Emissions without LULUCF	11217.47	11083.34	-134.12	-1.20
2010	Total CO_2 Eq Emissions with LULUCF	13932.26	14221.31	289.05	2.07
	Total CO_2 Eq Emissions without LULUCF	12357.47	12202.43	-155.04	-1.25

		Previous submission	Latest submission	Difference	Difference
		CO_2 equivalent (kt)			(%)
2011	Total CO_2 Eq Emissions with LULUCF	12989.25	13214.96	225.72	1.74
	Total CO_2 Eq Emissions without LULUCF	11624.15	11432.81	-191.34	-1.65
2012	Total CO_2 Eq Emissions with LULUCF	12173.06	11971.32	-201.74	-1.66
	Total CO_2 Eq Emissions without LULUCF	11513.90	11331.49	-182.41	-1.58
2013	Total CO_2 Eq Emissions with LULUCF	12644.53	12342.10	-302.43	-2.39
	Total CO_2 Eq Emissions without LULUCF	11435.77	11250.11	-185.66	-1.62
2014	Total CO_2 Eq Emissions with LULUCF	15593.23	15533.33	-59.90	-0.38
	Total CO_2 Eq Emissions without LULUCF	11373.09	11190.02	-183.08	-1.61

Recalculations made for the 2017 inventory submission by CRF category and gas and their implications to the emission level in 1990 and 2014 as well as explanations for recalculations are provided in following Table 10.2, Table 10.3, Table 10.4 and Table 10.5.

Table 10.2 Recalculations made in 2017 submission (recalculated year 2014)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
1. Energy	CO_2	6519.20	6520.79	1.60	0.02	0.02	0.02	
A. Fuel combustion activities	CO_2	6519.18	6520.78	1.60	0.02	0.02	0.02	
1. Energy Industries	CO_2	1669.29	1669.76	0.47	0.03	0.01	0.00	Corrected amount of biogass used in 1A1aii; Updated and precised information about natural gas properties and calculated new emission factor accordingly.
2. Manufacturing industries and construction	CO_2	688.59	688.69	0.10	0.01	0.00	0.00	Corrected amount of peat use in 1A2c; Updated and precised information about natural gas properties and calculated new emission factor accordingly.
3. Transport	CO_2	2893.55	2894.40	0.86	0.03	0.01	0.01	Minor correction in fuel consumption and corrected IEF for LPG; road transport.
4. Other sectors	CO_2	1258.31	1258.48	0.17	0.01	0.00	0.00	Corrected amount of biogas (1A4ai), biofuel (1A4ci) and gasoline (1A4cii) use in apropriate sectors; Updated and precised information about natural gas properties and calculated new emission factor accordingly.
2. Industrial processes and product use	CO_2	614.54	606.00	-8.55	-1.39	-0.12	-0.08	
A. Mineral industry	CO_2	568.21	568.97	0.77	0.13	0.01	0.01	Recalculations were done according to ERT recommendations during 2016 centralized review in 2.A.2 sector to recalculate CO_2 emissions from lime production from dolomite,

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
								to correct EF from lime production facility using dolomite consumption according to the 2006 IPCC Guidelines and to submit the corrected emission estimation of CO_2 from lime production using correct activity data and disaggregate the activity data from the 2.A.2 category to identify limestone and dolomite. CO_2 emissions from used limestone, dolomite and produced quicklime in steel production process were allocated from 2.A.1 to 2.C.1 sector.
C. Metal industry	CO_2	0.01	0.01	0.00	-12.77	0.00	0.00	In 2017 submission CO_2 emissions from 2.C.1 were recalculated in all time series according to 2006 IPCC Guidelines taking into account all input and output process materials (coke, limestone, dolomite, carbon electrodes and quicklime). Also the amount of limestone, dolomite and produced non-marketed lime (quicklime) used for steel production processes were allocated from 2.A.2 Lime production sector to 2.C.1 Iron & Steel production sector.
D. Non-energy products from fuels and solvent use	CO_2	46.33	37.02	-9.31	-20.10	-0.13	-0.09	Recalculations have been done for the all time series taking into account that previous reporting system for Register of Chemical Substances and Chemical Mixtures has improved. For instance, from this year electronic reporting system has implemented for the chemicals importers and producers (previous the annual reports by enterprises were submitted in paper form). In

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
								particular, now it is necessary to specify product group (request for allocation of subcategories under Solvent Use sector) for produced or imported chemical mixtures placed in territory of Latvia (previously this was done by expert judgment). The implementation of this electronic reporting system has led to an increase in the availability of information on the solvent sector as well as an improvement on data quality, in particular more accurate division by subcategories. Based on the submitted information by enterprises for the previous calendar year all historical data were reviewed and recalculated.
3. Agriculture	CO_2	24.41	23.66	-0.76	-3.10	-0.01	-0.01	
G. Liming	CO_2	19.69	18.93	-0.76	-3.85	-0.01	-0.01	Recalculation is done based on the EU Effort Sharing Decision review recommendation by TERT that Latvia should report emissions from liming separately for limestone and dolomite. The 2006 IPCC Guidelines indicate that the emissions from limestone application and dolomite application are estimated separately.
4. Land use, land-use change and forestry (net)	CO_2	3133.48	3262.45	128.97	4.12		1.24	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
A. Forestland	CO_2	-62.87	125.21	188.08	-299.17		1.81	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soilsas well as new biomass expansion factors and carbon content in wood were implemented in the calculations.
B. Cropland	CO_2	2766.46	2899.81	133.35	4.82		1.28	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soilsas well as new biomass expansion factors and carbon content in wood were implemented in the calculations.
C. Grassland	CO_2	412.71	275.72	-136.98	-33.19		-1.32	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soilsas well as new biomass expansion factors and carbon content in wood were implemented in the calculations.
D. Wetlands	CO_2	982.24	978.60	-3.64	-0.37		-0.03	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soilsas well as new biomass expansion factors and carbon content in wood were implemented in the calculations.
E. Settlements	CO_2	852.52	912.49	59.97	7.03		0.58	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors,updated activity data of organic soilsas well as new

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
								biomass expansion factors and carbon content in wood were implemented in the calculations.
G. Harvested wood products	CO_2	-1817.58	-1929.40	-111.82	6.15		-1.07	Recalculations are done due to updates of available FAOSTAT activity data and implementation of new biomass expansion factors that affects harvesting rate.
International bunkers	CO_2	1068.96	1074.56	5.60	0.52	0.08	0.05	
Aviation	CO_2	332.64	332.82	0.18	0.05	0.00	0.00	Recalculation due to correction of EF for LTO.
Navigation	CO_2	736.32	741.74	5.42	0.74	0.08	0.05	Corrected IEF for residual fuel oil (RFO)
CO_2 emissions from biomass	CO_2	6459.16	6460.21	1.05	0.02	0.01	0.01	Corrected amount of biogas use in 1A1aii, 1A4ai and biofuel use in 1A4ci.
1. Energy	CH_4	310.70	310.86	0.16	0.05	0.01	0.01	
A. Fuel combustion activities	CH_4	175.38	175.55	0.16	0.09	0.01	0.01	
1. Energy Industries	CH_4	9.50	9.50	0.00	0.00	0.00	0.00	Corrected amount of biogass used in 1A1aii.
2. Manufacturing industries and construction	CH_4	13.82	14.13	0.30	2.18	0.02	0.01	Corrected amount of peat use in 1A2c; Corrected all solid fuel emission factors.
3. Transport	CH_4	4.79	4.79	0.00	-0.04	0.00	0.00	Minor correction in fuel consumption; road transport

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
4. Other sectors	CH_4	147.24	147.11	-0.14	-0.09	-0.01	-0.01	Corrected amount of biogas (1A4ai), biofuel (1A4ci) and gasoline (1A4cii) use in apropriate sectors.
3. Agriculture	CH_4	972.19	958.18	-14.01	-1.44	-0.72	-0.60	
A. Enteric fermentation	CH_4	872.67	861.57	-11.10	-1.27	-0.57	-0.48	Recalculation is done based of implementation of new country specific values of digestibility (DE, %). Recalculation also is done due to correction of IEF for Deer.
B. Manure management	CH_4	99.52	96.61	-2.91	-2.93	-0.15	-0.12	Recalculation is done based of implementation of new country specific values of digestibility (DE, %) and updating of manure management systems share (MMS, %) based on latest country specific statistical data and research results.
4. Land use, land-use change and forestry (net) (4)	CH_4	388.88	375.96	-12.92	-3.32		-0.56	
A. Forestland	CH_4	167.80	165.66	-2.13	-1.27		-0.09	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors andupdated activity data of organic soils.
B. Cropland	CH_4	119.04	118.84	-0.20	-0.17		-0.01	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors andupdated activity data of organic soils.
C. Grassland	CH_4	73.50	62.92	-10.59	-14.40		-0.45	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors andupdated activity data of organic soils.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
5. Waste	CH_4	799.32	687.89	-111.43	-13.94	-5.69	-4.78	
A. Solid waste disposal	CH_4	528.83	414.13	-114.70	-21.69	-5.86	-4.92	Recalculated for all time series. Changes in activity data and calculation methodology
D. Waste water treatment and discharge	CH_4	248.03	251.30	3.27	1.32	0.17	0.14	Update of activity data
1. Energy	N_2O	142.59	142.59	0.00	0.00	0.00	0.00	
A. Fuel combustion activities	N_2O	142.59	142.59	0.00	0.00	0.00	0.00	
1. Energy Industries	N_2O	14.88	14.88	0.00	0.00	0.00	0.00	Corrected amount of biogass used in 1A1aii.
2. Manufacturing industries and construction	N_2O	22.47	22.47	0.00	0.00	0.00	0.00	Corrected amount of peat use in 1A2c. Corrected N_2O calculation for offroad gasoline.
3. Transport	N_2O	53.58	53.58	0.00	0.00	0.00	0.00	Minor correction in fuel consumption; road transport
4. Other sectors	N_2O	51.57	51.57	0.00	0.00	0.00	0.00	Corrected amount of biogas (1A4ai), biofuel (1A4ci) and gasoline (1A4cii) use in apropriate sectors; Corrected N20 calculation for offroad gasoline.
2. Industrial processes and product use	N_2O	2.01	3.48	1.46	72.53	0.08	0.06	
G. Other product manufacture and use	N_2O	2.01	3.48	1.46	72.53	0.08	0.06	During the 2017 submission, N_2O emissions from aerosol cans were included for the first time for the complete time series.
3. Agriculture	N_2O	1729.82	1681.49	-48.33	-2.79	-2.59	-1.88	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
B. Manure management	N_2O	104.28	98.43	-5.85	-5.61	-0.31	-0.23	Recalculation is done based on implementation of new country specific values of Nex based on national research data and updating of manure management systems share (MMS, %) based on latest country specific statistical data and research results.
D. Agricultural soils	N_2O	1625.54	1583.06	-42.48	-2.61	-2.27	-1.65	Recalculations is done based on: 1) implementation of new methodology to determine the share of grazing animals; 2) implementation of country specific value of FracLEACH-(H) or N losses by leaching/runoff; 3) implementation of updated values of N in sewage sludge, digestate and animal manure applied to soils.
4. Land use, land-use change and forestry (net)	N_2O	697.78	704.91	7.13	1.02		0.28	
A. Forestland	N_2O	640.90	639.06	-1.84	-0.29		-0.07	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors andupdated activity data of organic soils.
B. Cropland	N_2O	4.88	4.83	-0.06	-1.18		0.00	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors andupdated activity data of organic soils.
C. Grassland	N_2O	0.66	0.66	0.00	0.00		0.00	There is difference between submissions due to difference between number of decimals of imported emission data.
D. Wetlands	N_2O	3.79	3.79	0.00	0.00		0.00	There is difference between submissions due to

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
								difference between number of decimals of imported emission data.
E. Settlements	N_2O	44.56	53.55	8.99	20.17		0.35	Recalculations are done due to recalculation of the NFI data based on repeated measurement of borders of the plots and their sectors andupdated activity data of organic soils.
5. Waste	N_2O	37.10	40.31	3.21	8.66	0.17	0.12	
B. Biological treatment of solid waste	N_2O	16.07	16.78	0.72	4.46	0.04	0.03	Changes for EF in IPCC methodology (*9: Corrented chapter(s) as of July 2015).
D. Waste water treatment and discharge	N_2O	16.65	19.15	2.50	14.98	0.13	0.10	Update of activity data.
International bunkers	N_2O	33.88	33.95	0.07	0.20	0.00	0.00	
Aviation	N_2O	3.63	3.69	0.07	1.88	0.00	0.00	Recalculation due to correction of EF for LTO.

Table 10.3 Recalculations made in 2017 submission (recalculated year 1990)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
1. Energy	CO_2	18713.09	18713.38	0.29	0.00	0.00	0.00	
A. Fuel combustion activities	CO_2	18713.08	18713.37	0.29	0.00	0.00	0.00	

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
1. Energy industries	CO_2	6248.66	6248.76	0.11	0.00	0.00	0.00	Corrected amount of peat used in 1A1aiii.
3. Transport	CO_2	2930.37	2930.56	0.18	0.01	0.00	0.00	Corrected IEF for LPG
2. Industrial processes and product use	CO_2	701.26	695.10	-6.16	-0.88	-0.03	-0.06	
A. Mineral industry	CO_2	584.35	584.35	0.00	0.00	0.00	0.00	According to ERT recommendation during 2016 centralized review 2.A.1 CO_2 emissions for time period 1990-1994 were recalculated applying default CKD correction factor 1.02 as the amount of CKD was not available for these years. As well as recalculations were done according to ERT recommendation in 2.A.2 sector to recalculate CO_2 emissions from lime production from dolomite, to correct EF from lime production facility using dolomite consumption according to the 2006 IPCC Guidelines and to submit the corrected emission estimation of CO_2 from lime production using correct activity data and disaggregate the activity data from the 2.A.2 category to identify limestone and dolomite. CO_2 emissions from used limestone, dolomite and produced quicklime in steel production process were allocated from 2.A.1 to 2.C.1 sector.
C. Metal industry	CO_2	52.60	69.69	17.10	32.50	0.09	0.17	In 2017 submission CO_2 emissions from 2.C.1 were recalculated in all time series according to 2006 IPCC Guidelines taking into account all

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
								input and output process materials (coke, limestone, dolomite, carbon electrodes and quicklime). Also the amount of limestone, dolomite and produced non-marketed lime (quicklime) used for steel production processes were allocated from 2.A.2 Lime production sector to 2.C.1 Iron & Steel production sector.
D. Non-energy products from fuels and solvent use	CO_2	64.32	47.69	-16.63	-25.86	-0.08	-0.16	Recalculations have been done for the all time series taking into account that previous reporting system for Register of Chemical Substances and Chemical Mixtures has improved. For instance, from this year electronic reporting system has implemented for the chemicals importers and producers (previous the annual reports by enterprises were submitted in paper form). In particular, now it is necessary to specify product group (request for allocation of subcategories under Solvent Use sector) for produced or imported chemical mixtures placed in territory of Latvia (previously this was done by expert judgment). The implementation of this electronic reporting system has led to an increase in the availability of information on the solvent sector as well as an improvement on data quality, in particular more accurate division by subcategories. Based on the submitted information by enterprises for the previous calendar year all historical data were reviewed and recalculated.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
3. Agriculture		379.13	364.84	-14.29	-3.77	-0.07	-0.14	
G. Liming	CO_2	371.42	357.13	-14.29	-3.85	-0.07	-0.14	Recalculation is done based on the TERT recommendation that Latvia should report emissions from liming separately for limestone and dolomite. The 2006 IPCC Guidelines indicate that the emissions from limestone application and dolomite application are estimated separately.
4. Land use, land-use change and forestry (net)	CO_2	-9305.34	-9682.93	-377.59	4.06		-3.74	
A. Forestland	CO_2	-14661.36	-15041.86	-380.50	2.60		-3.76	Recalculations are done due to updated activity data of organic soils,new biomass expansion factors and carbon content in wood were implemented in the calculations.
B. Cropland	CO_2	3293.67	3298.59	4.92	0.15		0.05	Recalculations are done due to updated activity data of organic soils,new biomass expansion factors and carbon content in wood were implemented in the calculations.
C. Grassland	CO_2	901.37	900.79	-0.57	-0.06		-0.01	Recalculations are done due to updated activity data of organic soils,new biomass expansion factors and carbon content in wood were implemented in the calculations.
D. Wetlands	CO_2	1215.01	1213.07	-1.93	-0.16		-0.02	Recalculations are done due to updated activity data of organic soils,new biomass expansion factors and carbon content in wood were implemented in the calculations.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
E. Settlements	CO_2	112.33	112.60	0.27	0.24		0.00	Recalculations are done due to new biomass expansion factors and carbon content in wood were implemented in the calculations
G. Harvested wood products	CO_2	-166.36	-149.84	16.52	-9.93		0.16	Recalculations are done due to improvements of activity data, implementation of new biomass expansion factors affected harvesting rate.
5.WASTE		0.81	0.57	-0.24	-29.12	0.00	0.00	
C. Incineration and open burning of waste	CO_2	0.81	0.57	-0.24	-29.12	0.00	0.00	Developed time series for waste incineration till 1990.
1. Energy	CH_4	498.50	498.85	0.35	0.07	0.01	0.01	
A. Fuel combustion activities	CH_4	250.92	251.26	0.35	0.14	0.01	0.01	
1. Energy industries	CH_4	4.72	4.72	0.00	0.00	0.00	0.00	Corrected amount of peat used in 1A1aiii.
2.Manufacturing industries and construction	CH_4	5.48	5.83	0.35	6.35	0.01	0.01	Corrected all solid fuel emission factors.
4. Land use, land-use change and forestry (net)	CH_4	307.53	303.79	-3.73	-1.21		-0.10	
A. Forestland	CH_4	83.86	80.13	-3.73	-4.45		-0.10	Recalculations are done due to updated activity data of organic soils.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
B. Cropland	CH_4	125.10	125.10	0.00	0.00		0.00	Recalculations are done due to updated activity data of organic soils.
C. Grassland	CH_4	70.04	70.04	0.00	0.00		0.00	Recalculations are done due to updated activity data of organic soils.
5. Waste	CH_4	761.54	629.07	-132.47	-17.39	-3.74	-3.45	
A. Solid waste disposal	CH_4	392.83	283.06	-109.77	-27.94	-3.10	-2.86	Recalculated for all time series. Changes in activity data and calculation methodology.
D. Waste water treatment and discharge	CH_4	344.80	322.10	-22.70	-6.58	-0.64	-0.59	Update of activity data.
1. Energy	N_2O	174.39	174.39	0.00	0.00	0.00	0.00	
A. Fuel combustion activities	N_2O	174.39	174.39	0.00	0.00	0.00	0.00	
1. Energy industries	N_2O	11.21	11.21	0.00	0.00	0.00	0.00	Corrected amount of peat used in 1A1aiii.
2.Manufacturing industries and construction	N_2O	8.77	8.77	0.00	-0.01	0.00	0.00	Corrected N_2O calculation for offroad gasoline.
4. Other sectors	N_2O	73.98	73.98	0.00	0.00	0.00	0.00	Corrected N_2O calculation for offroad gasoline.
2. Industrial processes and product use	N_2O	1.30	3.25	1.95	149.57	0.07	0.06	
G. Other product manufacture and use	N_2O	1.30	3.25	1.95	149.57	0.07	0.06	During the 2017 submission, N_2O emissions from aerosol cans were included for the first time for the complete time series.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
3. Agriculture	N_2O	2663.75	2594.68	-69.06	-2.59	-2.45	-2.03	
B. Manure management	N_2O	323.75	307.43	-16.32	-5.04	-0.58	-0.48	Recalculation is done based on implementation of new country specific values of Nex based on national research data and updating of manure management systems share (MMS, %) based on latest country specific statistical data and research results.
D. Agricultural soils	N_2O	2340.00	2287.25	-52.75	-2.25	-1.87	-1.55	Recalculations is done based on: 1) implementation of new methodology to determine the share of grazing animals; 2) implementation of country specific value of FracLEACH-(H) or N losses by leaching/runoff; 3) implementation of updated values of N in sewage sludge, digestate and animal manure applied to soils.
4. Land use, land-use change and forestry (net)	N_2O	576.18	575.74	-0.44	-0.08		-0.01	
A. Forestland	N_2O	570.67	570.24	-0.44	-0.08		-0.01	Recalculations are done due to updated activity data of organic soils.
B. Cropland	N_2O	0.59	0.59	0.00	0.00		0.00	Recalculations are done due to updated activity data of organic soils.
C. Grassland	N_2O	0.05	0.05	0.00	0.00		0.00	Recalculations are done due to updated activity data of organic soils.
E. Settlements	N_2O	0.91	0.91	0.00	0.00		0.00	There is difference between submissions due to difference between number of decimals of imported emission data.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
5. Waste	N_2O	48.98	49.44	0.47	0.95	0.02	0.01	
C. Incineration and open burning of waste	N_2O	4.85	3.44	-1.41	-29.12	-0.05	-0.04	Developed time series for waste incineration till 1990.
D. Waste water treatment and discharge	N_2O	27.03	28.91	1.88	6.95	0.07	0.06	Update of activity data.

Table 10.4 Recalculations made in 2017 submission (F-gases) (recalculated year 2014)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
F-gases: Total actual Emissions	HFCs	212.06	205.63	-6.43	-3.03	-3.13	-3.13	
2.F.1. Refrigeration and air conditioning	HFCs	206.38	199.94	-6.43	-3.12	-3.13	-3.13	HFC-134a emissions from 2.F.1.b Domestic refrigeration were recalculated from 2011-2014 due to updated percentage of households using refrigerators and freezers 2010-2015 according to results of the CSB housholds surwey in 2015. HFCs emissions from 2.F.1.e Mobile Air-Conditioning were recalculated 1995-2014 due to revision of average percentage of vehicles equipped with air conditioning systems by vehicle type and technology according to Lithuania`s NIR 2016 .

Table 10.5 Recalculations made in 2017 submission (F-gases) (recalculated year 1995)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Gas	Previous submission (CO_2-eq, kt)	Latest submission (CO_2-eq, kt)	Difference (CO_2-eq, kt)	Difference %	Impact of recalculation on total emissions excluding LULUCF %	Impact of recalculation on total emissions including LULUCF %	Explanation for recalculations
F-gases: Total actual Emissions	HFC	11.50	2.50	-9.00	-78.27	-360.22	-360.22	
2.F.1. Refrigeration and air conditioning	HFCs	11.10	2.10	-9.00	-81.09	-360.22	-360.22	HFCs emissions from 2.F.1.e Mobile Air-Conditioning were recalculated 1995-2014 due to revision of average percentage of vehicles equipped with air conditioning systems by vehicle type and technology according to Lithuania`s NIR 2016 .

Changes in methodological descriptions for 2017 submission are summarized in Table 10.6 below.

Table 10.6 Changes in methodological descriptions

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please mark the relevant cell where the latest NIR includes major changes in methodological descriptions compared to the NIR of the previous year	**Please mark the relevant cell where this is also reflected in recalculations compared to the previous years' CRF**	**If the cell is marked please provide a reference to the relevant section or pages in the NIR and if applicable some more detailed information such as the sub-category or gas concerned for which the description was changed.**
Total (Net Emissions)	-	-	-
1. Energy	-	-	-
A. Fuel Combustion (sectoral approach)	-	-	-
1. Energy industries	-	-	-
2. Manufacturing industries and construction	-	-	-
3. Transport	-	-	-
4. Other sector	-	-	-
5. Other	-	-	-
B. Fugitive emissions from fuels	-	-	-
1. Solid fuels	-	-	-
2. Oil and natural gas and other emissions from energy production	-	-	-
C. CO_2 transport and storage	-	-	-
2. Industrial processes and product use	-	-	-
A. Mineral industry	**+**	**+**	2.A.2 Lime production, see Chapter 4.2.3, 2.A.4.b Other Uses of Soda Ash see Chapter 4.2.6 2.A.3 Glass production, see chapter 4.2.4
B. Chemical industry	-	-	-
C. Metal industry	**+**	**+**	2.C.1 Iron and Steel production, see Chapter 4.4.1
D. Non-energy products from fuels and solvent use	-	-	-
E. Electronic industry	-	-	-

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please mark the relevant cell where the latest NIR includes major changes in methodological descriptions compared to the NIR of the previous year	**Please mark the relevant cell where this is also reflected in recalculations compared to the previous years' CRF**	**If the cell is marked please provide a reference to the relevant section or pages in the NIR and if applicable some more detailed information such as the sub-category or gas concerned for which the description was changed.**
F. Product uses as substitutes for ODS	-	-	-
G. Other product manufacture and use	**+**	**+**	2.G.3, N_2O From Product Uses, see Chapter 4.8.2.2
H. Other	-	-	-
3. Agriculture	-	-	-
A. Enteric fermentation	-	+	Described in the NIR section 5.2.5 Category-specific recalculations
B. Manure management	-	+	Described in the NIR section 5.3.5 Category-specific recalculations
C. Rice cultivation	-	-	-
D. Agricultural soils	-	+	Described in the NIR section 5.4.5 Category-specific recalculations
E. Prescribed burning of savannahs	-	-	-
F. Field burning of agricultural residues	-	-	-
G. Liming	-	+	Described in the NIR section 5.6 Category-specific recalculations
H. Urea application	-	-	-
I. Other carbon containing fertilisers	-	-	-
J. Other	-	-	-
4. Land use, land-use change and forestry	-	-	-
A. Forest land	-	**+**	Described in the NIR section 6.4 Forest land, sub-section 6.4.5 Category-specific recalculations
B. Cropland	-	**+**	Described in the NIR section 6.5 Cropland, 6.5.5 Category-specific recalculations
C. Grassland	-	**+**	Described in the NIR section 6.6 Grassland, sub-section 6.6.5 Category-specific recalculations
D. Wetlands	-	**+**	Described in the NIR section 6.7 Wetland, sub-section 6.7.5 Category-specific recalculations

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please mark the relevant cell where the latest NIR includes major changes in methodological descriptions compared to the NIR of the previous year	**Please mark the relevant cell where this is also reflected in recalculations compared to the previous years' CRF**	**If the cell is marked please provide a reference to the relevant section or pages in the NIR and if applicable some more detailed information such as the sub-category or gas concerned for which the description was changed.**
E. Settlements	-	**+**	Described in the NIR section 6.8 Settlements, sub-section 6.8.5 Category-specific recalculations
F. Other land	-	**-**	-
G. Harvested wood products	-	**+**	Described in the NIR section 6.11 Harvested wood products, sub-section 6.11.5 Category-specific recalculations
H. Other	-	-	-
5. Waste	-	-	
A. Solid waste disposal	+	+	NIR Chapter 7.2.2 Two IPCC waste model 2006 calculations are used. For unmanaged sites as bulky waste and for managed sites waste by composition calculation methods used. Recalculation done for all time series.
B. Biological treatment of solid waste	-	-	-
C. Incineration and open burning of waste	-	-	-
D. Wastewater treatment and discharge		**+**	NIR Chapter 7.5.1.5. and 7.5.2.5. CH_4 and N_2O emissions from Domestic Waste Water Handling recalculated for entire reporting period due to adjustment of activity data; CH_4 and N_2O emissions from Industrial Waste Water Handling recalculated for period 2000 - 2014 due to adjustment of activity data.
E. Other	-	-	-
6. Other (as specified in Summary 1.A)	-	-	-
KP LULUCF	-	-	-
Article 3.3 activities	-	-	-

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**DESCRIPTION OF METHODS**	**RECALCULATIONS**	**REFERENCE**
	Please mark the relevant cell where the latest NIR includes major changes in methodological descriptions compared to the NIR of the previous year	**Please mark the relevant cell where this is also reflected in recalculations compared to the previous years' CRF**	**If the cell is marked please provide a reference to the relevant section or pages in the NIR and if applicable some more detailed information such as the sub-category or gas concerned for which the description was changed.**
Afforestation/reforestation	+	+	Described in the NIR section 11.KP-LULUCF, sub-section 11.3.1.4 Changes in data and methods since the previous submission (recalculations)
Deforestation	+	+	Described in the NIR section 11.KP-LULUCF, sub-section 11.3.1.4 Changes in data and methods since the previous submission (recalculations)
Article 3.4 activities	-	-	-
Forest management	+	+	Described in the NIR section 11.KP-LULUCF, sub-section 11.3.1.4 Changes in data and methods since the previous submission (recalculations)
Cropland management (if elected)	-	-	-
Grazing land management (if elected)	-	-	-
Revegetation (if elected)	-	-	-
Wetland drainage and rewetting (if elected)	-	-	-
NIR Chapter	**DESCRIPTION**		**REFERENCE**
	Please mark the cell where the latest NIR includes major changes in descriptions compared to the previous year NIR		**If the cell is marked please provide some more detailed information for example reference to pages in the NIR**
Chapter 1.2 Description of national inventory arrangements	-	-	-

10.1.2 KP-LULUCF inventory

Recalculations are done due to implementation of country specific biomass expansion factors and carbon content in wood.

10.2 IMPLICATION FOR EMISSION LEVELS

10.2.1 GHG inventory

See section 10.1.

10.2.2 KP-LULUCF inventory

Recalculations reduced total cumulative net removals in 1990-2014 in the KP-LULUCF inventory by 12.6%, but significant change in 2014 is related to cumulative change due to recalculation of NFI data. Impact of recalculation of each separate carbon pool is negligible. The most impacted carbon pool is living biomass that is calculated using new country specific biomass expansion factors.

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.

Table 10.7 shows the sector specific improvements needs for the forthcoming inventories. More detailed information about planned improvements can be found under sectoral chapters.

Table 10.7 Sector specific planned improvements for Latvia`s national GHG inventory

	Planned improvement	**Tentative time schedule**	**Progress**
General	Develop an integrated database for climate change and air quality data aggregation and preparation of GHG inventory (NIR) and other reports to different international institutions.	From 2017	Within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy "the integrated database was established in 2016. During the implementation phase several expert training seminars were held. It is planned to continue and finish launching of database in 2017 in order to use it starting from 2018 submission.

	Planned improvement	Tentative time schedule	Progress
1A Energy	It is planned to estimate resource flow in energy balance (lubricants and used oils).	2017-2018	Will be implemented in 2018 submission.
IPPU/F-gases	Evaluation study regarding F-gases in stocks (HFCs in operating systems)	2017	Study is ongoing in 2017. Results planned to implement into next submission.
Agriculture 3.A.2. Manure management	Strengthening Tier 2 methodology for indirect emissions calculations from manure management to force development of national ammonia model. Straitening the consistency of GHG and ammonia emissions reporting.	2017-2018	Improvement planned within activities supported by funding of Ministry of Environmental Protection and Regional Development.
Agriculture 3.G Liming	The TERT recommends that Latvia explore the possibilities of obtaining statistical data separately for limestone and dolomite.	2017	Planned to investigate this issue and include results into next submission.
LULUCF - overview	Evaluation of carbon stock changes in croplands and grasslands.	2017	Improvement planned within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy ". Field data collection and analyses are done, scientific publication is under preparation. After publishing the results will be implemented in the GHG calculations.
LULUCF Direct and Indirect N_2O emissions from managed soils	N_2O emissions might be considerable part of emissions from wetlands, therefore, it is necessary to develop method for estimation impact of drainage on N_2O emissions, and it is important to be able to separate wetlands on nutrients rich organic soils (high N_2O emissions) and poor organic soils (low N_2O emissions). Information on land use changes, particularly, distribution of nutrients rich and poor organic and losses of organic carbon due to land use changes should be updated. Country specific C/N ratio will be introduced for calculation of N_2O emissions from forest land, cropland and grassland in 2017.	2016-2020	Demonstration project application for LIFE+ program "LIFE Restore - Support tools for sustainable and responsible management and re-use of degraded peatlands in Latvia" proposed in 2015. The project is started in September, 2015 and the outputs (emission factors) will be available in 2019.
LULUCF 4.A Forest Land	Estimation of decay period for dead wood (harvesting residues and below-ground biomass, planned to complete until report 1990-2014);	2017	Research project on this issue is completed. The results will be used in the GHG calculations after publishing results.
	Estimation of carbon stock changes in	2017	The research completed for

	Planned improvement	Tentative time schedule	Progress
	drained organic soils in forest lands (2015);		fertile organic soils and emission factors are elaborated; scientific publication is under preparation and will be delivered to peer reviewed magazine.
	Development of production version of EPIM tool, including broader representation of land use change, integration of land use change and GHG calculation modules and integration of Kyoto protocol and the UNFCCC reporting modules.	2017	Technical work and quality assurance still ongoing in 2017.
LULUCF 4.B.1 Cropland remaining cropland	Updated area of organic soil in cropland according to the NFI study started in 2012 and soil map digitilizing project results[269].	2016-2020	Results will be available in 2017 after publishing of soil mapping project results in statistically representative set of NFI plots on cropland and grassland on organic soils.
	Tier 3 methodology to estimate carbon stock changes in cropland considering changes of cropping practices since 1970.	2017	It is proposed to implement Yasso model in forest land and cropland to obtain information on carbon stock changes in soil, the implementation is planned in 2017, forest lands on dry mineral soils, cropland and grassland will be covered by the estimation. Results should be prepared for publication until the end of 2017.
LULUCF Direct and Indirect N_2O emissions from managed soils	N_2O emissions might be considerable part of emissions from wetlands, therefore, it is necessary to develop method for estimation impact of drainage on N_2O emissions, and it is important to be able to separate wetlands on nutrients rich organic soils (high N_2O emissions) and poor organic soils (low N_2O emissions). Information on land use changes, particularly, distribution of nutrients rich and poor organic and losses of organic carbon due to land use changes should be updated. Country specific C/N ratio will be introduced for calculation of N_2O emissions from forest land, cropland and grassland in 2017.	2016-2020	Demonstration project application for LIFE+ program "LIFE Restore - Support tools for sustainable and responsible management and re-use of degraded peatlands in Latvia" proposed in 2015. The project is started in September, 2015 and the outputs (emission factors) will be available in 2019.

[269] *https://geolatvija.lv/geo/p/247*

	Planned improvement	Tentative time schedule	Progress
LULUCF 4.B.1 Cropland remaining cropland	Updated CO_2 emissions from organic soil 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".	2016-2020	Demonstration project application for LIFE+ program "LIFE Restore - Support tools for sustainable and responsible management and re-use of degraded peatlands in Latvia" is started in 2015, updated emission factors will be available in 2019.
LULUCF 4.D Wetlands	Elaboration of emissions factors for N_2O, CH_4 and CO_2 for wetlands converted to peat extraction sites, as well as for wetlands converted to cropland, grassland, forest land after peat extraction	2016-2019	Planned within the LIFERestore project which is already started.

Response to the review (Table 10.8) includes:

- Recommendations by Expert review team (ERT) according to Report on the individual review of the annual submission of Latvia submitted in 2015[270] (Published on 07/03/2017);
- Recommendations by ERT according to Report on the individual review of the annual submission of Latvia submitted in 2016[271] (Published on 07/03/2017);

[270] http://unfccc.int/resource/docs/2017/arr/lva01.pdf
[271] http://unfccc.int/resource/docs/2017/arr/lva02.pdf

Table 10.8 Response to the review process

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
General	QA/QC and verification	The ERT identified several areas where strengthening QA/QC procedures for the inventory is still required (e.g. completeness of the NIR tables and explanations for the use of notation keys in several sectors)	FCCC/ARR/2015/ LVA #G4; FCCC/ARR/2016/ LVA #G4	QA/QC procedures are strengthened, QA/QC manager has checked the completeness.	Chapter 1.2.3
General	QA/QC and verification	The ERT recommends that Latvia strengthen its QA/QC procedures by ensuring the completeness of all elements included in the appendix to annex I to decision 24/CP.19	FCCC/ARR/2015/ LVA #G11; FCCC/ARR/2016/ LVA #G11	Latvia has strengthened QA/QC procedures, the completeness of all elements included in the appendix to annex I to decision 24/CP.19 is ensured by QA/QC manager.	Chapter 1.2.3
General	QA/QC and verification	The ERT recommends that Latvia include a specific QC procedure in its QA/QC plan that monitors the use of notation keys and will ensure that the use of the notation key "IE" is explained transparently in the NIR and CRF table 9	FCCC/ARR/2015/ LVA #G12; FCCC/ARR/2016/ LVA #G12	Latvia has included such specific QC procedure in QA/QC plan.	Chapter 1.2.3
General	National Registry	The ERT recommends that Latvia establish a PPSR as soon as technically possible, which the ERT assumes will be prior to the 2017 annual submission.	FCCC/ARR/2015/ LVA #G14; FCCC/ARR/2016/ LVA #G13	Since 16 November 2016 the Union Registry provides the technical possibility to open a PPSR account. However, prior to opening it, the PPSR account type must be first introduced into the EU legislative framework. This was done by the Annex of Commission Delegated Regulation 2015/1844. This provision, however, will become applicable, according to Article 2 of the Delegated Regulation, on "the date of publication by the Commission in the Official Journal of the European Union of a communication on the entry into force of the Doha Amendment to the Kyoto Protocol". Consequently, for the	-

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
				moment and until the Doha Amendment enters into force, we are not in a position to open the PPSR account in our National Registry.	
ENERGY					
Energy	General	The ERT recommends that Latvia provide a reference to documented expert judgement from data providers and transparently explain in the 2017 NIR why, although the source of AD remained the same, the AD uncertainty was significantly decreased in response to the consultation process with data providers.	FCCC/ARR/2015/ LVA #E10; FCCC/ARR/2016/ LVA #E10	Activity data uncertainties for natural gas is provided by only natural gas distributor in Latvia. Activity data for residential sector biomass use is gathered by CSB. IT is small source combustion and data collection is based on surveys. In 2006 IPCC Guidelines Table 2.15 Biomass in small sources data collected by surveys uncertainties are between 10-30%. That is the reason why this value was changed. Emission factor uncertainties for 1.A.2.a (Solid fuels) and 1.A.5.b (Liquid fuels) have not changed for at least last 3 submissions.	Chapters 3.2.4.3; 3.2.5.3; 3.2.7.3; 3.2.8.3; 3.3.2.3
Energy	Comparison with international data (34, 2014) (33, 2013) Accuracy	Use data from both the Statistical Office of the European Union (Eurostat) and IEA to conduct QC of the CRF tables, and provide a clear explanation for any differences. According to the information provided by the Party during the review, a comparison of the data from the two sources was made as part of QC procedures, but the results are not described in the NIR.	FCCC/ARR/2015/ LVA #E3; FCCC/ARR/2016/ LVA #E3	To improve the transparency, a table with comparison and explanation of differences is provided in 2017 submission.	Annex 3.4
Energy	1.B.2.b Natural gas – gaseous fuels – CH_4 (41, 2014) (41, 2013)	Describe methods and data used in the NIR, including more detailed background information, such as on the length of the pipeline and the materials used for the distribution network, on the pressure conditions of the different parts of the	FCCC/ARR/2015/ LVA #E8; FCCC/ARR/2016/ LVA #E8	Information about pipeline length is provided in 2017 submission and can be found in Table 3.52.	Chapter 3.3.2.1

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
	Transparency	network, on flow rates and on annual reconstruction rates to explain the improvements undertaken in the network.			
Energy	Fuel combustion-reference approach – diesel fuel – CO_2	The ERT recommends that Latvia investigate the reasons for the difference in diesel oil statistics from CSB data and consumption data and provide a transparent explanation as to why real consumption of diesel fuel in the country is higher than apparent consumption	FCCC/ARR/2015/ LVA #E11; FCCC/ARR/2016/ LVA #E11	In Annex 3.1 Energy losses, statistical differences, transfers and secondary production of products in Energy sector quite large statistical differences for liquid fuels can be seen, that are not taken into account when reference approach is calculated. The differences in real and apparent consumption can be explained with smuggling of diesel oil from neighboring countries outside EU where its price is considerably lower than in EU. Therefore the real consumption is higher than apparent consumption.	Chapter 3.2.1.1
Energy	Fuel combustion-reference approach – other fuels – CO_2	The ERT recommends that Latvia ensure that CO_2 emissions from biomass combustion are not included in total GHG emissions from the sectoral approach, and correct the reference approach CO_2 emission calculation from other fuels	FCCC/ARR/2015/ LVA #E12; FCCC/ARR/2015/ LVA #E12	There was recalculation done to ensure that biomass fraction is not included in Reference approach other fuels. In Table 3.8 it can be seen that differences in CO_2 emissions from other fuels vary between -1.77% and 4.25%	Chapter 3.2.1
Energy	Feedstocks, reductants and other NEU of fuels – all fuels	The ERT recommends that Latvia recalculate excluded carbon in accordance with the 2006 IPCC Guidelines (volume 2, chapter 6.6, equation 6.4) for the entire time series	FCCC/ARR/2015/ LVA #E13; FCCC/ARR/2016/ LVA #E13	The recalculations were done in accordance with 2006 IPCC Guidelines in 1AD Feedstocks and new values can be found in CRF tables.	
Energy	1.A. Fuel Combustion-Sectoral Approach – CO_2 (37, 2014) Accuracy	The ERT commends Latvia for updating the NCVs, but recommends the Party provide transparent information in the NIR for the NCVs used for all types of fuels, as well as any changes made since previous submissions. The ERT recommends that Latvia consider shifting to a Tier 2 methodology given that stationary	FCCC/ARR/2015/ LVA #E5; #E14 FCCC/ARR/2016/ LVA #E5; #E14;	NCV used for emission factor calculation can be found in Table 3.16, Table 3.17 and Annex 3.2. As a planned improvement, a research to obtain latest NCV values for widely used fuels is in progress. One of the fuels in this list is coal and as soon as this research is done, the results will be implemented in NIR.	NIR Chapter 3.2.4.2 Annex 3.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
		combustion of solid fuel is a key category.			
Energy	1.A. Fuel Combustion-Sectoral Approach – all fuels – CO_2	The ERT recommends that Latvia update the text in the 2017 NIR to document the application of the default oxidation factor of 1	FCCC/ARR/2015/ LVA #E15; FCCC/ARR/2016/ LVA #E15	Recalculated emission factors can be found in Table 3.16. These emission factors were used to recalculate all appropriate emissions from fuel burning.	NIR Chapter 3.2.4.2
Energy	1.A. Fuel Combustion-Sectoral Approach – gaseous fuels – CO_2	The ERT recommends that Latvia transparently report all parameters used for calculation of the country-specific EFs as well as provide a rationale for large inter-annual fluctuations in the trend and all recalculations made since the previous submission	FCCC/ARR/2015/ LVA #E17; FCCC/ARR/2016/ LVA #E17	Information about natural gas properties is reported in NIR Table 3.17. As previously stated differences can be explained with changes in natural gas properties (natural gas is received from different providers). That's why company responsible for natural gas distribution perform regular measurements to determine real values.	NIR Chapter 3.2.4.2
Energy	1.A. Fuel Combustion-Sectoral Approach – gaseous fuels – CO_2	The ERT recommends that Latvia present the NCVs used for natural gas in the NIR	FCCC/ARR/2015/ LVA #E18; FCCC/ARR/2015/ LVA #E18	Revised natural gas NCVs are provided in NIR Table 3.17.	NIR Chapter 3.2.4.2
Energy	1.B.2.b Natural gas – gaseous fuels– CH_4	The ERT recommends that Latvia revise the AD for this category and report the relevant AD for gas volumes in CRF table 1.B.2 in accordance with the 2006 IPCC Guidelines so that the AD values in this table are consistent with the natural gas volumes reported in the reference approach. The ERT also recommends that detailed individual data be aggregated and presented in the NIR so as to highlight the information that is important for	FCCC/ARR/2015/ LVA #E19; FCCC/ARR/2016/ LVA #E19	Information regarding fugitive emissions is received directly from only natural gas provider "Latvijas Gāze".	NIR Chapter 3.3.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
		transparency of the inventory without disclosing individual data that would compromise confidentiality (2006 IPCC Guidelines, volume 1, chapter 2.2)			
IPPU					
IPPU	2. General (IPPU) (46, 2014) Consistency	Implement the planned improvement to undertake capacity-building projects to achieve better time-series consistency for several categories in the early years of the time series	FCCC/ARR/2015/ LVA #I1; FCCC/ARR/2016/ LVA #I1	Within the project of EEA Financial Mechanism 2009-2014 Programme "National Climate Policy "the integrated database was established in 2016. It is planned to continue and finish launching of database in 2017 in order to use it starting from 2018 submission hence time-series consistency will be ensured for IPPU categories.	Chapter 4
IPPU	2.A.1 Cement production – CO_2	The ERT recommends that Latvia transparently report how the amount of clinker production has been estimated by providing a clear methodological description and the sources of data used in its annual submission	FCCC/ARR/2015/ LVA #I3; #I10; FCCC/ARR/2016/ LVA #I3; #I10	Cement producer does the mass balance approach calculation according to their methodology at plant site. Cement production activity data from plant is available according to annual EU Emissions Trading System (EU ETS) GHG report by plant. Link to the AD used in the GHG inventory is provided in NIR.	Chapter 4.2.2.2
IPPU	2.A.1 Cement production – CO_2	Latvia recalculated CO_2 emissions from cement production according to the 2006 IPCC Guidelines tier 2 approach, using the default CKD correction factor of 1.02 for the period 1990–1994 as the CKD amount for Latvia for this period is not available The ERT recommends that Latvia update the explanation in the NIR to reflect the modified approach to estimating CKD emissions for the period 1990–1994.	FCCC/ARR/2015/ LVA #I11; FCCC/ARR/2016/ LVA #I11	CO_2 emissions for time period 1990-1994 were recalculated applying default CKD correction factor 1.02 as the amount of CKD was not available for these years. Information has been provided in 2017 submission.	Chapter 4.2.2.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
IPPU	2.A.2 Lime production – CO_2	The ERT recommends that Latvia update the text in the NIR to reflect the revised EF calculation and AD for CO_2 emissions from lime production.	FCCC/ARR/2015/ LVA #I12; FCCC/ARR/2016/ LVA #I12	Information has been provided in 2017 submission.	Chapter 4.2.3.2 Chapter 4.2.3.4 Chapter 4.2.3.5
IPPU	2.A.3 Glass production – CO_2	The ERT recommends that Latvia develop efforts to collect the necessary data and ensure that the tier 2 is properly calculated or estimate CO_2 emissions by applying a tier 1 method from the 2006 IPCC Guidelines, using a default cullet ratio and national-level AD.	FCCC/ARR/2015/ LVA #I13; FCCC/ARR/2016/ LVA #I13	Previously it was mistakenly described in NIR, that Latvia uses default 2006 IPCC Gudeline`s method for emission calculation from glass production. CO_2 emissions are already calculated by using Tier 3 method from 2006 IPCC Guidelines. Latvia uses plant specific data of used carbonates which are multiplied with emission factors from 2006 IPCC Guidelines or Commission Regulation (EU) No 601/2012. Fraction of calcination is default from 2006 IPCC Guidelines (1.00). Description of this category is improved in this submission therefore it is not necessary to switch to Tier 1 or Tier 2.	Chapter 4.2.4.6
IPPU	2.C.1 Iron and steel production – CO_2	The ERT recommends that Latvia estimate CO_2 emissions for this category by applying the methodology and EFs from the 2006 IPCC Guidelines, and clearly specify in the NIR to which categories the emissions were allocated.	FCCC/ARR/2015/ LVA #I14; FCCC/ARR/2016/ LVA #I14	CO_2 emissions for this category are calculated by applying the methodology and EFs from the 2006 IPCC Guidelines. The amount of limestone, dolomite and produced non-marketed lime (quicklime) used for steel production processes were allocated from 2.A.2 Lime production sector to 2.C.1 Iron & Steel production sector.	Chapter 4.4.1.2 Chapter 4.4.1.5
IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs	The ERT recommends that Latvia ensure the proper use of notation keys in accordance with decision 24/CP.19, annex I, paragraph 37, and, if appropriate, ensure that a complete and consistent time series is reported for this gas. The ERT believes that this issue should be considered further in future reviews to confirm there is not an underestimate of emissions	FCCC/ARR/2015/ LVA #I15; FCCC/ARR/2016/ LVA #I15	Proper use of notation keys in accordance with decision 24/CP.19, annex I, paragraph 37 has been done.	Chapter 4.7

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
IPPU	2.G.3 N_2O from product uses – N_2O	N_2O emissions continue to be reported as "NO". The NIR does not provide any information in section 4.8.2 to clarify whether this category, which was previously reported as "NE", occurs or not	FCCC/ARR/2015/ LVA #I9; FCCC/ARR/2016/ LVA #I9	During the 2017 submission, N_2O emissions from aerosol cans were included for the first time for the complete time series.	Chapter 4.8.2.
AGRICULTURE					
Agriculture	3.A.1 Cattle – CH_4	The ERT recommends that Latvia incorporate the parameters for forage quality in the annual submission and ensure that time-series consistency for all years is maintained	FCCC/ARR/2015/ LVA #A5; FCCC/ARR/2016/ LVA #A5	Inter-annual changes of CH_4 EF values for cattle are primarily a result of changes in the activity data that occur in response to agricultural policy, the economic situation and market demands. The higher CH_4 EF for dairy cows comparing to IPCC default values in recent years could be explained due to increased milk yields and specifics of dairy cattle feeding in the country. Parameters for forage quality and feed digestibility are included in 2017 submission.	Chapter 5.2.2
Agriculture	3.A.1 Cattle – CH_4	The ERT recommends that the Party transparently describe both qualitatively and quantitatively all improvements and subsequent recalculations that are implemented in the annual submission in the next inventory	FCCC/ARR/2015/ LVA #A6; FCCC/ARR/2016/ LVA #A6	Activity data for non-dairy are divided in seven groups of cattle types. These groups: 1) in the inventory are strongly linked to data base of Central Statistical Bureau of Latvia and therefore provide consistency with EUROSTAT and other official statistical data; 2) promote easer reporting of cattle weights and identify feeding situation; 3) facilitating proper estimation of MMS, because MMS significantly differs by defined cattle types in the herd. Recalculations of CH_4 emissions from enteric fermentation based on the implementation of new reporting categories for non-dairy cattle were included in the inventory only for	Chapter 5.2.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
				submissions 2016, based on latest research activities for improvement of the inventory quality according to outcomes of pre-defined project "Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections" under 2009 – 2014 EEA Grants Programme National Climate Policy.	
Agriculture	3.A.1 Cattle – CH_4	The ERT recommends that Latvia report in the NIR the methodology used to estimate the annual average weight of dairy cattle, including the results of the expert analysis of the proportion of different breeds of dairy cattle and data on cattle weight in the Agricultural Data Centre animal and herd register	FCCC/ARR/2015/ LVA #A7; FCCC/ARR/2016/ LVA #A7	Methodology used to estimate the average weight is based on agriculture expert analysis of the proportion of different breeds of dairy cattle and data on cattle weight in the Agricultural Data Centre animal and herd register. Detailed description is included in 2017 NIR.	Chapter 5.2.2
Agriculture	3.A.1 Cattle – CH_4	The ERT recommends that Latvia report the findings on digestibility of feed in the country, providing documentation in the NIR regarding the development and rationale for selection of a country-specific digestibility coefficient of 65%, as well as data to substantiate its use	FCCC/ARR/2015/ LVA #A8, FCCC/ARR/2016/ LVA #8	Parameters for forage quality and feed digestibility are included in 2017 NIR.	Chapter 5.2.2
Agriculture	3.A.4 Other livestock	The ERT recommends that Latvia report in the NIR on the possibility of obtaining separate EFs for deer and reindeer based on data from the Agricultural Data Centre, and use the latest research results related to emissions from deer and reindeer in Nordic countries	FCCC/ARR/2015/ LVA #A9; FCCC/ARR/2016/ LVA #A9	As response to ERT recommendation Latvia considered that emissions from deer are not key category for the state that could be main reason to facilitate for obtaining separate EFs for deer and reindeer and included for CH_4 emission calculations default IPCC EF for deer.	Chapter 5.2.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
Agriculture	3.B Manure management – CH_4 and N_2O	The ERT recommends that Latvia describe in the NIR the methodology used for the distribution of manure management systems, including references to relevant research on the development of the methodology	FCCC/ARR/2015/ LVA #A10; FCCC/ARR/2016/ LVA #A10	Description in the NIR of the methodology used for the distribution of manure management systems is included in 2017 submission.	Chapter 5.3.2
Agriculture	3.B.1 Cattle – CH_4	The ERT recommends that Latvia provide documentation in the NIR to support the use of a relatively high CH_4 IEF value for dairy cattle for the years 1990 to 2002	FCCC/ARR/2015/ LVA #A11; FCCC/ARR/2016/ LVA #A11	Information is included in 2017 submission.	Chapter 5.3.2
Agriculture	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O	The ERT recommends that Latvia include the results of the project under the EEA financial mechanism 2009–2014 Programme in the submission, specifically the results of the analyses on the Bo values and country-specific methane conversion factor for anaerobic digesters.	FCCC/ARR/2016/ LVA #A12	Country specific distribution of manure management systems and the excretion of nitrogen by type of livestock are included in the inventory for submission 2017. However results of a project "Development of the national system for greenhouse gas inventory and reporting on policies, measures and projections", under the EEA financial mechanism 2009–2014 Programme National Climate Policy shows that it is recommended for Latvia to use default Bo values. Description of country-specific methane conversion factor for anaerobic digesters are prepared as scientific article and will be included in 2018 submission.	Chapter 5.3.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
LULUCF					
LULUCF	4.A.1 Forest land remaining forest land – CO_2	The ERT considers that a stock-change method could provide additional benefits for the accuracy of the estimates, once reliable data from successive (and methodologically compatible) NFI cycles and years are available, and encourages the Party to consider the stock-change method	FCCC/ARR/2015/ LVA #L12; FCCC/ARR/2016/ LVA #L13	Estimation of decay period for dead wood (harvesting residues and below-ground biomass), planned to be implemented in following GHG inventories.	Chapter 6.4.6
LULUCF	4. General (LULUCF) – CO_2, CH_4, N_2O	In order to transparently explain the abrupt changes from 2008 onwards, the ERT encourages the Party to include in the inventory more detailed information on the methodological changes between two NFI cycles. It is the ERT view that in a broader perspective, given the recent move to a floating NFI cycle, and assuming further methodological changes in the ongoing NFI cycles, the current forest land and forest management estimates could be accepted only as provisional. Therefore, the ERT recommends that the Party recalculate the entire time series for future submissions	FCCC/ARR/2016/ LVA #L12	The entire time series are recalculated using updated information by the NFI on land use, increments and mortality; however no significant changes took place due to the recalculation every single factor, in spite their totals resulted in sometimes significant changes. Explanation of application of the "floating cycle" is provided in the NIR.	Chapters 6.1 and 11.3.1.4
LULUCF	4.A.1 Forest land remaining forest land – CO_2	The ERT recommends that Latvia either provide additional information supporting the use of an average value of 0.58 for the biomass ratio for spruce trees overall, or implement a biomass expansion factor for spruce that is stratified, for example, by species volume distribution by age class or	FCCC/ARR/2015/ LVA #L13; FCCC/ARR/2016/ LVA #L14	National biomass expansion factors is in accordance with a doctoral thesis to be completed in 2018. The biomass equations for use in the NFI are already validated and published. Recalculation following to the new equations were done.	6.4.2, Table 6.17

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
		growing stock level			
LULUCF	4.A.2 Land converted to forest land – CO_2	The ERT recommends that Latvia provide in the NIR the following information provided during the review to support the use of a 150-year transition period: (1) the reasoning as to why two generations of trees (150 years) was considered appropriate to properly encompass carbon stock in harvesting residues, stumps and the above-ground fraction of dead trees; and (2) progress on, or results of, implementation of the Yasso model for afforestation, to evaluate actual carbon stock changes in deadwood and soil in afforested lands (the model has been implemented already for cropland, grassland and forest land)	FCCC/ARR/2015/ LVA #L14; FCCC/ARR/2016/ LVA #L15	Explanations are provided into 2017 submission.	Chapters 6.4.2.2 and 6.4.6
LULUCF	4.A.2 Land converted to forest land – CO_2	The ERT recommends that Latvia continue the methodological work for estimating carbon stock changes in living biomass, deadwood and litter for cropland converted to forest land, wetlands converted to forest land and settlements converted to forest land as well as in mineral soils (cropland converted to forest land and settlements converted to forest land) and organic soils (wetlands converted to forest land), and report the estimates in the annual submission	FCCC/ARR/2015/ LVA #L15; FCCC/ARR/2016/ LVA #L16	NE notation key will be replaced with actual values of CO_2 removals and GHG emissions after completion of the spatial analysis of digitalized information of the NFI sample plots and extrapolation of obtained data to the time period not covered by the NFI (1990-2003).	Chapter 6.4.2.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
LULUCF	4.B.1 Cropland remaining cropland – CO_2	The ERT encourages Latvia to continue its work on the implementation of the Yasso model results in order to monitor, in the designated plots, the carbon stock changes in soils over time	FCCC/ARR/2015/ LVA #L16; FCCC/ARR/2016/ LVA #L17	It is proposed to implement Yasso model in cropland to obtain information on carbon stock changes in soil, the implementation is planned in 2017, cropland will be covered by the estimation. Results should be prepared for publication until the end of 2017.	Chapter 6.5.2.1
LULUCF	4.B.2.2 Grassland converted to cropland – CO_2	The ERT recommends that Latvia ensure consistency in reporting between the NIR and CRF table 4.B regarding CO_2 emissions and removals from the conversion of grassland to cropland	FCCC/ARR/2015/ LVA #L17; FCCC/ARR/2016/ LVA #L18	Reason of discrepancy was revealed. Information in the NIR was clarified, no conversion of grassland to cropland is reported in the current NIR.	Chapter 6.5.2.2
LULUCF	4.C.2 Land converted to grassland – CO_2	The ERT recommends that Latvia ensure consistency in reporting between the NIR and CRF table 4.C regarding emissions from lands converted to grassland, including the description of the methodology implemented and the data used to estimate the emissions	FCCC/ARR/2015/ LVA #L18; FCCC/ARR/2016/ LVA #L19	Reason of discrepancy was revealed. Information in the NIR was clarified, as well as consistency between the NIR and CRF table 4.C is ensured.	Chapter 6.6.1
LULUCF	4.C.2 Land converted to grassland – CO_2	The ERT recommends that Latvia continue the methodological work for estimating carbon stock changes in living biomass, deadwood and litter for forest land converted to grassland, wetlands converted to grassland and settlements converted to grassland as well as in mineral soils (forest land converted to grassland and settlements converted to grassland) and organic soils (wetlands converted to grassland), and report the estimates in the annual submission	FCCC/ARR/2015/ LVA #L19; FCCC/ARR/2016/ LVA #L20	The "NE" notation key will be replaced with actual values for CO_2 removals and GHG emissions after completion of the third NFI cycle in 2018.	Chapter 6.6.2.2

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
LULUCF	4.C.2.2 Cropland converted to grassland – CO_2	The ERT recommends that Latvia update the carbon stock change figures for soil based on national studies as soon as feasible after scientific validation	FCCC/ARR/2015/ LVA #L20; FCCC/ARR/2016/ LVA #L21	Scientific publication "Carbon stock in mineral soil in cropland and grassland in Latvia" has been submitted for review. The results of published work will be implemented in the next GHG inventory submission. It is proposed to implement Yasso model to obtain additional information on carbon stock changes in soil.	Chapter 6.6.2.2
LULUCF	4.D.1 Wetlands remaining wetlands – CO_2	The ERT recommends that Latvia describe clearly the methodology, AD and definitions used to report CO_2 emissions and removals from wetlands remaining wetlands. In addition, the ERT encourages the Party to use the Wetlands Supplement in preparing its annual inventories in for future annual submissions	FCCC/ARR/2015/ LVA #L21; FCCC/ARR/2016/ LVA #L22	Reason of discrepancy was revealed. Information in the NIR was clarified. Non-managed wetlands is only reported in land-use matrix to avoid misunderstanding.	Chapter 6.7.1
LULUCF	4.E.2 Land converted to settlements – CO_2	The ERT recommends that Latvia continue the methodological work for estimating carbon stock changes in living biomass and deadwood for cropland converted to settlements and grassland converted to settlements and report the estimates in the annual submission	FCCC/ARR/2015/ LVA #L22; FCCC/ARR/2016/ LVA #L23	Planned to implement in following submissions after completion of the spatial analysis of digitalized information of the NFI sample plots and extrapolation of obtained data to the time period not covered by the NFI (1990-2003). Both, land use estimates (previously based on Landsat 30 x 30 m resolution images) will be replaced by data obtained during manual evaluation of high resolution photographies. Average losses in dead and living biomass will be extrapolated from the NFI plots.	Chapter 6.8.2.2
WASTE					
Waste	5.A Solid waste disposal on land – CH_4	The ERT recommends that Latvia provide justification in the NIR and the CRF tables for reporting that there is no significant underestimation of emissions resulting from Latvia's use of solid waste disposal data from the year 1970, using as a proxy	FCCC/ARR/2015/ LVA #W9; FCCC/ARR/2016/ LVA #W9	Implemented into 2017 submission.	Chapter 7.2.

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
		for this significance determination the values contained in decision 24/CP.19, annex I, paragraph 37(b)			
Waste	5.A.1 Managed waste disposal sites – CH_4	The ERT recommends that Latvia present DOC values for the different waste fractions in the NIR for the entire time series	FCCC/ARR/2015/ LVA #W10; FCCC/ARR/2016/ LVA #W10	Implemented into submission 2017. IPCC waste model 2006 is used for calculations. For managed sites calculation type for waste composition is used with default DOC values from IPCC 2006.	Chapter 7.2.
Waste	5.C.2 Open burning of waste – N_2O	The ERT recommends that Latvia use the appropriate notation key for reporting N_2O emissions from 1999 to 2007, and implement a QA/QC procedure that will ensure the proper use of notation keys	FCCC/ARR/2015/ LVA #W11; FCCC/ARR/2016/ LVA #W11	Implemented in 2017 submission. Correction in CRF was done.	CRF issue only
Waste	5.D.2 Industrial wastewater – CH_4, CO_2	The ERT recommends that Latvia use the appropriate notation key for the amount of CH_4 flared and the amount of CH_4 for energy recovery, and to strengthen the QA/QC procedures so as to ensure the proper use of notation keys	FCCC/ARR/2015/ LVA #W13; FCCC/ARR/2016/ LVA #W13	Notation key changed to NO in 2017 submission.	CRF issue only
KP-LULUCF					
KP-LULUCF	General (KP-LULUCF) (96, 2014) (110, 2013) (88, 2012) (119, 2011) (113, 2010)	Improve the transparency of reporting on the uncertainty analysis	FCCC/ARR/2015/ LVA #KL2; FCCC/ARR/2016/ LVA #KL2;	Implemented into 2017 inventory.	Chapter 11.3.1.5

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
KP-LULUCF	Afforestation and reforestation – CO_2 (100, 2014)	Provide figures in the NIR that demonstrate no statistically significant difference in the carbon stock in mineral soils in historical grassland and afforested land	FCCC/ARR/2015/ LVA #KL3; FCCC/ARR/2016/ LVA #KL3;	Explanation provided in 2017 inventory.	Chapter 11.3.1.2
KP-LULUCF	Forest management – CO2 (108, 2014) (125, 2013)	Estimate the carbon losses due to harvesting that took place on afforested/reforested areas and on forest management areas separately and report this transparently in the NIR	FCCC/ARR/2015/ LVA #KL8; FCCC/ARR/2016/ LVA #KL8;	No commercial harvesting takes place in afforested lands due to small age of trees (it is explained in chapter 11.3.1.1). Trees extracted during pre-commercial thinning (trees left in forest) are reported together with mortality in afforested lands and lands under forest management. More detailed reporting of harvests is planned in future inventory reports, when grey alder and birch stands will reach age when commercial roundwood production is feasible. Carbon stock changes in living biomass in afforested lands are estimated using stock change method, therefore any possible uses of wood in afforested lands is already accounted as a stock change.	Chapter 11.3.1.1
KP-LULUCF	Afforestation and reforestation – CO_2	The ERT, noting the explanation provided by Latvia for the inclusion of natural expansion and regrowth of forests under afforestation, recommends that the Party include detailed information explaining the link between the definition for afforestation in the NIR and AD trends in KP-LULUCF tables 4(KP-I)A.1 and 4(KP-I)B.1 in order to allow a thorough assessment of changes to be made	FCCC/ARR/2015/ LVA #KL10; FCCC/ARR/2016/ LVA #KL10	Extrapolation is provided in 2017 inventory.	Chapter 11.1.1

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
KP-LULUCF	Forest management – CO_2	The ERT, acknowledging the relatively large and frequent recalculations made for the LULUCF sector in the past, recommends that Latvia transparently describe both qualitatively and quantitatively in the NIR the recalculation of forest land estimates in conjunction with technical corrections to FMRLs	FCCC/ARR/2015/ LVA #KL11; FCCC/ARR/2016/ LVA #KL11	The reasons for recalculations are provided in 2017 submission. The main reasons for recalculations are implementation of IPCC 2014: Wetlands supplement and application of the NFI data on harvests and mortality instead of official statistics representing merchantable wood.	Chapters 6.4.5, 6.4.2 and 11.3.1.1
KP-LULUCF	Forest management – CO_2	The ERT recommends that Latvia review the calculation of the technical correction to the FMRL already made, including the apparent mismatch between the time series presented during the review and the values presented in CRF table 4(KP-I)B.1.1	FCCC/ARR/2015/ LVA #KL12; FCCC/ARR/2016/ LVA #KL12	Technical correction is reviewed following to updated information in the GHG inventory. Recalculated values are provided in 2017 submission.	Chapter 11.5.2.3
KP-LULUCF	Forest management – CO_2	The ERT recommends that Latvia more accurately estimate emissions/removals in forest land and forest management by including, and where necessary revising, soil and litter estimates, based on the ongoing monitoring of NFI plots. The ERT also recommends, if the gain–loss method for forest management estimates is maintained, that the Party consider the use of a matrix indicating the impacts of disturbances on different pools, as per the methodology included in the 2006 IPCC Guidelines (volume 4, chapter 2, table 2.1)	FCCC/ARR/2015/ LVA #KL13; FCCC/ARR/2016/ LVA #KL13	The implementation of Yasso model and continuous forest soil carbon monitoring system is proposed in the research plans. The initial results on naturally dry soils approves that the data obtained earlier by repeated measurement in BioSoil plots are correct, in spite the uncertainty in both case is too high to provide reliable figures of CO_2 removals in soil and litter	Chapter 6.4.6

Sector	CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	LV Response (status of implementation)	Chapter/Section in the NIR
KP-LULUCF	Biomass burning – CO_2, CH_4, N_2O	The ERT recommends that Latvia include complete information demonstrating that all woody biomass harvesting, including burnt residues, are included in the losses in the biomass estimates in the LULUCF sector	FCCC/ARR/2015/ LVA #KL9, #KL14; FCCC/ARR/2016/ LVA #KL9,#KL14	Explanation is provided in 2017 submission.	Chapter 6.10.1.3

PART 2: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 KP-LULUCF

11.1 GENERAL INFORMATION

11.1.1 Definition of forest and any other criteria

The applied forest definition for the reporting is harmonized with the definition used within the NFI. The same forest definition is used in relevant chapters of the UNFCCC LULUCF reporting. The selected parameters are presented in Table 11.1. Additional criteria defined by the Forest Law of Latvia[272] are width of rows of trees of artificial or natural origin – they should be at least 20 m wide to be accounted as a 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 in FAO definition	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 with permanently removed vegetation and/or fertile soil layer are excluded from forest and are accounted under settlements; respectively, building of the forest road or drainage system is accounted as deforestation. Forest definition for the 2nd commitment period is not changed since the 1st commitment period.

11.1.2 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

Latvia reported Forest management in the 1st commitment period and all lands reported under forest management in the 1st commitment are included in the Forest management accounting in 2nd commitment period, except deforested lands reported under activities of Article 3, paragraph 3, of the Kyoto Protocol. All afforested and deforested lands reported in the 1st commitment periods are represented in the 2nd commitment period as afforestation, deforestation or forest management. The latest category consists of naturally afforested lands, which are reported as land converted to forest land under the UNFCCC and forest management under the KP reporting. Afforested lands, where natural forest regeneration methods are applied, active forest management takes place and forest owner completed legal procedure of the land use change, are reported under the Afforestation activity. The process of recalculation will be completed in 2018. Activity data for this category is delivered by the State forest service (stand wise forest register) and National forest inventory (land use history). Considering uncertain status of recently afforested areas reported by the NFI (legal land use changes or management activities characteristic for the forest management

[272] *Latvijas Republikas Saeima, "Meža likums, 2000. (Forest law)", published in 24.02.2000.*

may follow several years after the land parcel fulfils the threshold values of the forest land criteria), the decisions on reporting of the land as purposefully afforested is done after the first management activity or legal conversion of the area to forest land. Therefore the afforestation rate in recent years is considerably smaller than it is reported by the NFI. The afforestation trend in recent years is also reduced by implementation the rural development plan supporting maintenance of grasslands in temporarily abandoned farmlands instead of their afforestation.

Latvia reports mandatory land activities of ARDFM. It elected to report forest management under the KP 3.4 activities for the 2nd commitment period.

11.1.3 Application of natural disturbance provision on Article 3.3 activities and Forest Management

Latvia is not reporting natural disturbances; therefore, accounting of lands reported under natural disturbances is not necessary, neither for AR nor for FM.

11.1.4 Description of how the definitions of each activity under Article 3.3 and each mandatory and elected activity under Article 3.4 have been implemented and applied consistently over time

On the basis of the definitions provided in the Decision 19/CMP.136, afforestation and reforestation that take place on agricultural land 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). However, only planted trees and managed forest stands, where natural regeneration is applied as the afforestation method, are reported under afforestation. The information is provided by the NFI and State forest service. The rest of afforested lands are reported under forest management in the KP reporting.

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 agricultural land occurs to less extent and generally is associated with removal of woody vegetation from abandoned farmlands and it was more common in 1990s.

Latvia does not apply carbon equivalent forest conversion (CEFC).

11.1.5 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

Under Article 3.4 activities Latvia reports only forest management; respectively, there is no need to build up a hierarchy between forest management and other Article 3.4 activities (i.e. forest has anyway higher hierarchical position in classification of activities on land).

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 explicit approach (Reporting approach 3 according to the 2006 IPCC Guidelines Chapter 3.3.1 and Reporting method 1 according to 2013 KP supplement) 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 UNFCCC LULUCF reporting. The spatial assessment units for the submission of the Kyoto Protocol and LULUCF sector report cover the entire territory of Latvia. Latvia is mapping land use to 0.1 ha for afforestation, reforestation and deforestation.

11.2.2 Methodology used to develop the land transition matrix

The land use matrix is based on the results of land use changes to forest derived from the NFI of the period 2004-2008, 2009-2013, 2010-2014 and 2011-2015. Methodology for estimation of earlier land use changes, including deforestation activities is under development in the LSFRI Silava as a part of the NFI. The assessment methods at the NFI grid points are described above. Estimation of afforested and deforested area in 2015 is based on extrapolation of the NFI data and the research results.

Historical figures of deforestation were estimated using remote sensing methods. LANDSAT satellite image series from 1990, 1995 and 2000 were geographically referenced to fit to the actual location of sample plots before satellite image analysis and non-guided classification of vegetation types.

Cumulative information on area accounted under forest management, deforestation, afforestation and reforestation is provided in Table 11.2.

Table 11.2 Summary of area under forest management, afforestation & reforestation and deforestation accounting (kha)

[7. KP LULUCF][NIR-2]	Remaining afforestation and reforestation	Remaining deforestation	Remaining forest management
1990	0.23	2.50	3119.56
1991	0.96	5.00	3117.06
1992	2.91	7.50	3114.56
1993	5.29	10.00	3112.06
1994	6.83	12.50	3109.56
1995	8.79	14.99	3107.06
1996	11.33	16.26	3105.80
1997	13.74	17.52	3104.54
1998	15.25	18.78	3103.28
1999	15.93	20.04	3102.01
2000	17.53	21.30	3100.75
2001	18.92	22.88	3099.17
2002	19.57	24.46	3097.60
2003	21.57	26.04	3096.02
2004	23.06	27.62	3094.44
2005	24.66	29.19	3092.86
2006	26.52	30.77	3091.28
2007	27.40	32.35	3089.71

[7. KP LULUCF][NIR-2]	Remaining afforestation and reforestation	Remaining deforestation	Remaining forest management
2008	32.36	33.93	3088.13
2009	34.58	37.51	3084.54
2010	37.38	41.10	3080.96
2011	39.98	44.68	3077.37
2012	40.94	48.27	3073.79
2013	40.94	51.85	3070.20
2014	40.94	55.44	3066.62
2015	40.94	59.02	3063.04

11.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

Since the geographical location of NFI sample plots is known, the results can be computed for geographically referenced areas. Geographical locations are identified by the coordinates of centres of the NFI sample plots.

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 (Figure 11.1) were used for calculations of land use and carbon stock changes in living and dead biomass. 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. 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 do not mean afforestation, but delayed grass cutting, as well as AR, if human induced afforestation cannot be approved (the main criteria are planting of trees or other early management activities targeted on increase of growing potential of the forest stand, afforestation is also considered in areas, where legal procedure of land use change is completed). 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 cycle, it is kept.

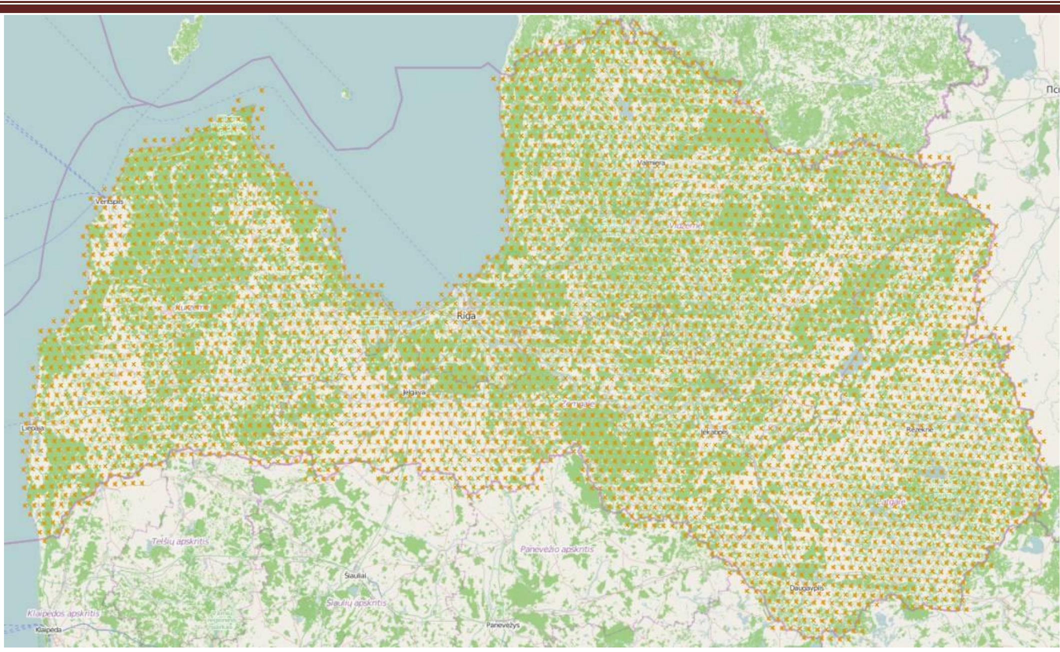

Figure 11.1 Permanent grid of the forest inventory plots

During the 2nd 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). GIS tools will be used in further inventories to process land use information as well as information on destiny of every single tree – if it is cut due to deforestation or just accounted under another land use category. So the calculation will be done in 2 levels – land use and destiny of trees.

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 grassland;
- abandoned grassland which are afforested and converted to forest lands.

In Latvia all land use categories (cropland, grassland, forest, settlements and wetlands) are considered managed; therefore any land use change occurs between in lands and, consequently, is direct human-induced.

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.

11.3 ACTIVITY-SPECIFIC INFORMATION

11.3.1 Methods for carbon stock change and GHG emission and removal estimates

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.

Soil properties (carbon stock in litter and mineral soil) in forest lands was determined in permanent 16 x 16 km grid of 95 sample plots of the 1st level forest monitoring programme (Figure 11.2). The results of forest soil monitoring demonstrate that mineral soils in forest lands are not a source of emissions, but can be a net sink. However, number of plots is insufficient to finalize conclusions about carbon stock change in forest lands. The increase of number of plots to 210 is proposed in the Forest monitoring programme providing more accurate data on soil carbon stock changes in forest lands. No soil carbon stock changes are considered in afforested lands, according to research data demonstrating insignificant carbon stock differences in forest land and grassland.

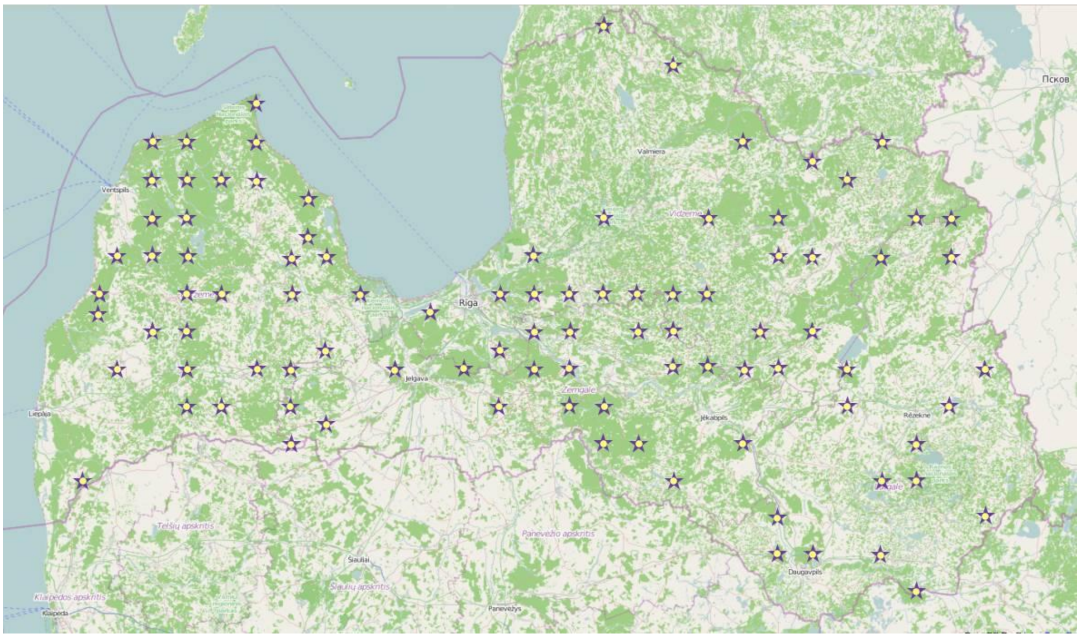

Figure 11.2 Permanent grid of the Level 1 forest monitoring plots

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, deforestation and Article 3.4 forest management) are the same as those used for the UNFCCC LULUCF inventory reporting. Estimations of carbon stock changes in living biomass on forest land remaining forest in the 1st cycle of the NFI are based on measurements of radial increment of growing trees and calculation of actual potential increment of timber volume of all living trees; in the second period, increment is calculated as stock difference of living trees; mortality is accounted as the stock of trees changing status (destiny) from living trees to dead and left in the stand; harvesting stock is accounted as stock of trees changing status (destiny) to dead and extracted. The NFI data are harmonized with the State forest service data provided information by application of linear factor (+26 %) to the whole accounting period, because the basics of the methodology used for calculation of harvesting stock in SFS is not changed for several decades.

The destiny of trees or change of status of tree is classified as follows:

- Living trees:
    - Still growing (trees remaining alive since the previous NFI cycle),
    - Ingrowth (new trees appearing in the NFI plot, measured first time),

- Commercial harvesting:
    - Harvested and extracted (living trees in previous NFI cycle, removed from the plot between previous and current measurement),
    - Diseased and extracted (mostly dead standing or laying trees in previous NFI cycle, removed from the plot between previous and current measurement),
- Mortality:
    - Harvested and left (living trees in previous NFI cycle, cut but left in the plot between previous and current measurement, mostly undergrowth trees),
    - Diseased (dry) and left (living trees in previous NFI cycle),
    - Thrown out (by wind) and left (living trees in previous NFI cycle, uprooted by wind),
    - Broken, dead (living trees in previous NFI cycle),
    - Damaged by beavers (living trees in previous NFI cycle, specific and common type of damages),
    - Broken top, living tree (such trees are accounted as 2 pieces – as living tree and dead wood).

There are 3 categories of dead trees, including dead standing trees, which might change their destiny to dead laying trees or rotten parts of trees. This conversion is excluded from mortality accounting.

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 1970-2015. 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.

The difference between the SFS and NFI is not due to illegal felling. The permissions for timber extraction are given for area and the area of final felling is the same in NFI and SFS reports. There is considerably higher growing stock reported under the NFI and, respectively, extracted volumes. 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.

No harvesting takes place in afforested; therefore no emissions in living biomass due to sted lands commercial harvesting 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 and dead biomass due to deforestation are reported based on average growing stock in forest land. The method as well as the values used in calculations is explained in details in previous sections. 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 oxidizing during conversion, but carbon soil in mineral soils stabilizes in 20 years. For conversion to settlements it is assumed that 20 % of carbon in 0-30 cm deep soil layer turns into emissions in 20 years. The methods are described in previous sections under Croplands and Settlements categories.

The most important changes due to implementation of the 2006 IPCC Guidelines and IPCC Wetlands Supplement are changes in emission factors for CO_2, N_2O and CH_4 for drained organic soils, updates in calculation of harvested wood products and carbon losses in soil due to disturbances caused by land use conversion from forest land to settlements and cropland. In forest management significant changes was implemented by application of the NFI data on harvest rate and mortality instead of the official statistics representing merchantable wood and underestimated mortality figures.

11.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected and mandatory activities under Article 3.4

According to the NFI conversions to forestland that can be classified as afforestation/reforestation take place only on grasslands. The soil monitoring study initiated in 2012 by the Joint stock company "Latvia state forests" and Ministry of Agriculture demonstrates no statistically significant difference in carbon stock in mineral soil in grassland, forest land remaining forest in fertile stand types and in afforested lands, i.e. no changes appear in soil organic matter (SOM) due to afforestation[273]. 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 research on comparison of carbon stock and density of soil in forest, cropland and grassland is not yet completed, therefore more update estimates will be provided in further inventory reports, after completion and publishing of the research results.

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). The rationale behind selection of 150 long transition period is decomposition of dead wood, which reach equality with forest lands at the end of the second rotation; however, this expert judgement will be evaluated in future using field measurement data.

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, respectively no carbon stock changes in these pools can be reported. This represents a quantitative demonstration that soil is neither sink nor a source of CO_2 on short term.

[273] *https://drive.google.com/open?id=0Bxv4jQ_04jXZM1VDZHA1elVwV2M; https://drive.google.com/open?id=0Bxv4jQ_04jXZc3FBSENMNDZfLUU*

The litter and soil pools have been analyzed altogether since the separation of humic layers in the year 2006 and in the year 2012 have not been done following the same methodology, so that data on litter and data on soil cannot be compared among those 2 years. However, the accumulation of litter is always associated with increase of humic layer, and, 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 2006 IPCC Guidelines. 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. if the sum of litter and soil is not a source then both, the litter and the soil are not a source.

Emissions from natural and controlled biomass burning due to are estimated according to methodology described in section Biomass Burning.

11.3.1.3 Information on whether or not indirect and natural GHG emissions and removals have been factored out

It is recognized that:

- 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;
- for Article 3, paragraph 3 activities, the dynamic effect of age is not relevant since all these activities have occurred after 1990;
- 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 cropland are reported using the methodology provided in the 2006 IPCC Guidelines and IPCC Wetlands Supplement, for organic soil. Carbon stock changes for calculation of the emission factor are taken from losses of soil organic carbon stock due to conversion for mineral soils and constant emissions factor (7.9 tonnes C ha^{-1}) is used for organic soils[274]. Also for grasslands and wetlands (accounted as rewetted non-forest lands) the default emission factors are used, respectively 6.1 and 0.5 tonnes C ha^{-1}.

11.3.1.4 Changes in data and methods since the previous submission (recalculations)

Implementation of changes due to use of 2006 IPCC Guidelines and IPCC Wetlands Supplement for certain categories and implementation of the 2nd cycle and floating cycle of the NFI for 2014 continued this year, particularly area of forest land is recalculated due to review of land use categories in the NFI plots. The most important improvements in this report are implementation of country specific biomass expansion factors according to the

[274] *According to 2013 SUPPLEMENT, TABLE 2.1 TIER 1 CO2 EMISSION/REMOVAL FACTORS FOR DRAINED ORGANIC SOILS IN ALL LAND-USE CATEGORIES (Cropland, drained, boreal and temperate).*

study by J. Liepiņš[275] and carbon content in wood according to the study by E. Muižnieks et al.[276].

Methodological consistency between the reference level and reporting for forest management during the 2nd commitment period, including the area accounted for the treatment of harvested wood products is secured by implementation of the same methodological approaches for the whole reporting period and recalculation of the whole time series according to a new methodology. A technical correction to FMRL would be recalculated because of reasons highlighted above, in a consistent way.

It is planned to implement country specific method for estimation of FMRL and recalculation of historical data affecting the FMRL.

11.3.1.5 Uncertainty estimates

Uncertainty estimates are described under corresponding LULUCF chapters of NIR. It was assumed that uncertainty estimates developed for the UNFCCC LULUCF reporting apply also for lands under the Kyoto Protocol reporting (see Section 6.4.3, Section 6.5.3, Section 6.8.3, Section 6.10.3, Section 6.11.3). Uncertainties calculated according to 2006 IPCC Guidelines Volume 1, Chapter 3 as twice the relative standard error. Combined category uncertainty is calculated according to 2006 IPCC Guidelines TIER 1 – simple propagation of errors.

Uncertainty of annual increment of growing stock of trees in forest lands is 0.9 %, uncertainty of increment on afforested lands 16 %. The uncertainty of carbon stock change of afforested lands is substantially larger due to higher sampling error for activity data. 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 average according to the study results.

Uncertainty of soil carbon (CO_2) emissions are estimated according to data obtained within the scope of the international forest soil monitoring project BioSoil and values provided in the IPCC Wetlands Supplement. The uncertainty of CO_2 emission factor according to IPCC Wetlands Supplement for organic soil in forest land is 25 %.

The estimated change of carbon stock on afforestation sites is practically the same as that on Land Converted to Forest Land. Hence the uncertainty assessment in Section 6.4.3 applies also here.

For the deforestation areas, the uncertainty of land area range from 22 to 114 % depending from soil type. The uncertainty for HWP is assumed 15 % for the whole time series.

[275] *Liepiņš, J., Lazdiņš, A., Liepiņš, K., 2015. Above- and below-ground biomass functions for four most commonn trees species in Latvia, in: Abstracts. Presented at the International Scientific Conference Knowledge based forest sector, Riga, Latvia, pp. 51–53.*
Liepins, J., Liepins, K., Lazdins, A., 2015. Biomass equations for the most common tree species in Latvia. Presented at the Adaptation and mitigation: strategies for management of forest ecosystems, Airport hotel ABC, pp. 47–50.
Liepiņš, J., Liepiņš, K., Lazdiņš, A., 2016. Estimation of the biomass stock from growing stock volume, in: Collection of Abstracts. Presented at the 11th International Scientific Conference Students on Their Way to Science, Jelgava, p. 120.
[276] *Muiznieks, E., Liepins, J., Lazdins, A., 2015. Carbon content in biomass of the most common tree species in Latvia. Presented at the Latvia University of Agriculture 10th International Scientific Conference „Students on their way to science", Jelgava.*

Table 11.3 Combined uncertainties for Kyoto Protocol activities 3.3 and 3.4

KP LULUCF category	Emissions 2015, kt CO_2 eq.	Combined uncertainty, %
KP.A Article 3.3 Activities		
KP.A.1 Afforestation and Reforestation	**-77.1**	**± 51.1**
Carbon stock change	-79.4	± 47.6
CH_4 and N_2O emissions from drained and rewetted organic soils	2.3	± 119.7
KP.A.2 Deforestation	**1756.5**	**± 268.7**
Carbon stock change	1667.1	± 273.9
CH_4 and N_2O emissions from drained and rewetted organic soils	79.1	± 134.3
N_2O emissions from N mineralization/immobilization due to carbon loss/gain associated with land-use conversions and management change in mineral soils	10.3	± 165.1
KP.B Article 3.4 Activities		
KP.B.1 Forest Management	**-2534.4**	**± 52.8**
Carbon stock change	-3388.2	± 18.1
CH_4 and N_2O emissions from drained and rewetted organic soils	775.8	± 116.6
Biomass burning	78.0	± 48.2
Carbon stock changes in the harvested wood products pool	**-1859.6**	**± 15.0**

11.3.1.6 Information on other methodological issues

The methodology used for reporting under the Kyoto Protocol is described in detail in previous sections.

11.3.1.7 The year of the onset of an activity, if after 2013

The starting year of the activities reported can directly be derived from the land-use change matrix (Table 6.9). The activities in the 2nd commitment period are reported starting with 2013.

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:

- trees planted or sown on grassland or abandoned cropland;
- afforested lands where management activities (tending, thinning, soil scarification) are identified by the NFI teams;

- grassland, where natural regeneration methods are used to proceed afforestation and human induced forest management is approved by official land use transformation in land use register.

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 on 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 conversion to non-forest land can be easily identified. In all other cases 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 recorded. Identification of transition in such cases takes 10 years, which complies with the legally permitted forest regeneration period for the most of forest stand types. Afforested areas fulfil the criteria for the forest definition used in the Latvia's NFI, which besides other threshold values is minimum width of 20 m.

Deforested areas can be detected by two combined characteristics:

- the forest definition of Latvia's NFI does not apply (as described above within 2 NFI cycles, the identification of conversion takes 10 years);
- there are significant visible changes in soil structure or ground vegetation which do not complies 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, the identification of conversion 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.

Deforestation and relevant land use changes (construction of forest roads) are regulated by national laws.

Restocking is assumed for forest areas that have lost forest cover through harvesting or forest disturbance, unless there is deforestation as described above.

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

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.

11.4.4 Information related to the natural disturbances provision under Article 3.3

Latvia is decided not to report natural disturbances, because trees diseased due to natural disturbances are usually extracted in salvage logging (sanitary clear-felling or thinning); therefore, reporting of lands reported under natural disturbances is not necessary or even possible due to salvage logging, neither for AR nor for FM.

11.4.5 Information on Harvested Wood Products under Article 3.3

The emissions from the harvested wood products pool that have been accounted during the 1st commitment period were not accounted on the basis of instantaneous oxidation; respectively, they should not be excluded from the reporting for the 2nd commitment period.

Harvested wood products resulting from deforestation have been accounted on the basis of instantaneous oxidation using proportion approach; respectively, if the projected felling stock in deforested areas is 1 % of the total felling stock, the proportion of harvested wood products to which the instant oxidation approach is applied is 1 %.

The carbon dioxide emissions from harvested wood products in solid waste disposal sites are not accounted, and the carbon dioxide emissions from wood harvested for energy purposes have been accounted on the basis of instantaneous oxidation under carbon losses from living biomass.

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

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 1990-1993 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 1990-1995 are reported in 2010-2015 under the forest land remaining forest land category. In the Kyoto protocol reporting transition period is not considered; therefore, afforested lands will always be afforested lands, except the case if they are deforested in future. The total area of forest lands, however, is the same in the both reports. All land use changes from and to forests take place on managed lands and therefore are considered to be human induced.

All forests are considered as managed land. Forest management activity is practised on the forest area as defined above.

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.

11.5.2 Information relating to Forest Management

According to the Forest law[277] forest management in Latvia is sustainable utilization and management of forests and forest resources to preserve biodiversity, productivity and

[277] *Latvijas Republikas Saeima, "Meža likums, 2000."*

vitality of forests as well as ability to regenerate, while providing economic, social and cultural opportunities for the benefit of present and future generations. Consequently, all forests, as well as all forest lands according to national definitions are considered as managed land. Forest management activity is practiced on the forest area (forest stands) as defined above. The area of forest land and the area under forest management (forest land remaining forest) in the end of 2015 decreased in comparison to 1989 because of deforestation; however, total area reported under forest management is increasing due to reporting of naturally lands, where no commercial activities takes place, under forest management.

The Forest law lays down provisions on management and utilization 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 Law is to promote economically, ecologically and socially sustainable management and utilization of the forests in such a way that forests provide a sustainable satisfactory yield while biological diversity is being maintained.

11.5.2.1 Conversion of natural forest to planted forest

No emissions arising from the conversion of natural forests to planted forests are accounted for, because no such kind of activities takes place in Latvia in accordance with any supplementary methodological guidance developed by the IPCC.

11.5.2.2 Forest Management Reference Level (FMRL)

Latvia's forest management reference level is -16.302 Mt CO_2 eq. and -14.255 Mt CO_2 eq. (including harvested wood products) as inscribed in the appendix to the annex to decision 2/CMP.7. Latvia will make technical corrections for the forest management reference level according the requirements of decision 2/CMP.7 and 2/CMP.8.

11.5.2.3 Technical Corrections of FMRL

The need for Technical Correction is determined by following reasons:

- The method used for GHG reporting changed after the adoption of FMRL as part of improving inventory quality and due to conversion of calculations from the IPCC GPG LULUCF 2003 to 2006 IPCC Guidelines and IPCC Wetlands Supplement. For instance, emission factors for organic soil (CO_2 and N_2O) are changed. Emission factors for biomass burning are also changed due to implement of the new guidelines. The inconsistency in calculation of the dead wood stock is found in the previous inventory report during the quality assurance procedures, leading to considerable overestimation of carbon stock changes in dead wood due to deforestation and afforestation, as well as biomass burning. These changes lead to a recalculated time series that also lead to an inconsistency between FMRL and reporting of FM in the second commitment period;
- New non-CO_2 GHG sources are included in reporting for FM in the second commitment period. For instance, calculation of CH_4 emissions from drained organic soils, drainage systems and rewetted soils are introduced in the current inventory;

- Recalculated historical data was done for the most important parameters, like increment of living biomass, mortality and commercial felling due to availability of data from the NFI 2nd cycle. Commercial felling stock was increased by 26 %, mortality – by 21 %, increment of living biomass was reduced by 0.1 %. The NFI data are compiled once in a 5 year period. Since the data on land use changes from the 2nd NFI cycle is available in this inventory, deforested area for the last 5 years period, as well as distribution of drained and rewetted soils is recalculated and Technical Correction is necessary to include new information in the FMRL;
- The reporting of HWP has been also improved since estimation of the FMRL which was submitted before Decision 2/CMP.7 and Technical Correction related to HWP are also necessary.

In 2015 the Technical Correction of Latvia`s FMRL was 11703.39 kt CO_2 eq., respectively estimated FMRL reduced by the specified value.

Technical Correction is done on the basis of the FMRL considering instantaneous oxidation for HWP. Tehnical Correction for this submission was recalculated based on a model re-calibration. Re-run of the model will be carried out in 2017 to implement a complete Technical Correction.

11.5.2.4 Information related to the natural disturbances provision under Article 3.4

Latvia does not intend to apply the Natural Disturbance provision, respectively, annual emissions resulting from natural disturbances and the subsequent removals during the commitment period in those areas are not estimated and not excluded from the accounting for forest management under Article 3, paragraph 4, of the Kyoto Protocol during the second commitment period.

11.5.2.5 Information on Harvested Wood Products under Article 3.4

Current forest management reference level (FMRL) is based on a projection; the emissions from harvested wood products originating from forests prior to the start of the second commitment period have been included in the reporting.

The emissions and removals resulting from changes in the harvested wood products pool do not include imported harvested wood products, irrespective of their origin. FAOSTAT data are used to identify share of imported harvested wood products. Calculations are done according to IPCC KP Supplement and scientifically verified methodology[278].

Emissions from harvested wood products originating from forests prior to the start of the 2nd commitment period have been calculated in the reference level in accordance with decision 2/CMP.7, annex, paragraph 16. The methodology for calculation of harvested wood products is based on IPCC KP Supplement[279] and earlier studies on the forest management

[278] *T. Hiraishi et al., eds., "Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol" (IPCC, Switzerland, 2013), http://www.ipcc-nggip.iges.or.jp/public/kpsg/pdf/KP_Supplement_Entire_Report.pdf; Andis Lazdiņš and Līga Strūve, "Contribution of Harvested Wood Products to Greenhouse Gas Emissions due to Forest Management in Latvia," in Mežzinātne. Special Issue. Abstracts for International Conferences Organized by LSFRI Silava in Cooperation with SNS and IUFRO, vol. 25 (58) (presented at the OSCAR 2012, Riga: LSFRI Silava, 2012), 79–82; Sebastian Rüter, Projection of Net-Emissions from Harvested Wood Products in European Countries (Hamburg, 2011), Hamburg.*

[279] *T. Hiraishi et al., eds., "Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol" (IPCC, Switzerland, 2013), http://www.ipcc-nggip.iges.or.jp/public/kpsg/pdf/KP_Supplement_Entire_Report.pdf.*

reference level[280]. Half-lives are based on table 3a.1.3 of the IPCC GPG LULUCF 2003 of two years for paper, 25 years for wood panels and 35 years for sawn wood. Instant oxidation is considered for biomass originated in deforested areas.

Activity data for the harvested wood products categories used for estimating the harvested wood products pool removed from domestic forests, for domestic consumption and for export are obtained in FAOSTAT and verified by internal research data and expert judgements.

Half-lives used in estimation of the emissions and removals for these categories are in accordance with decision 2/CMP.7, annex; respectively 2 years for pulp-wood, 25 years for plate-wood and 35 years for sawn-wood.

11.5.3 Information relating to Cropland Management, Grazing Land Management, Revegetation and Wetland Drainage and Rewetting if elected, for the base year

Not relevant.

11.6 OTHER INFORMATION

11.6.1 Key category analysis for Article 3.3 activities, forest management and any elected activities under Article 3.4

In 2015, net annual emissions from forest management, afforestation, reforestation and deforestation activities were -854.99 kt CO_2 eq. This value is the total of all emissions and removals from activities under Article 3.3 (Figure 11.3 and Figure 11.4) and forest management activity under Article 3.4 (Figure 11.5) of the Kyoto Protocol and includes: removals from the growth of forest and emissions from the conversion of land to forest after 1989; emissions from harvesting of forest remaining forest since 1990; emissions and removals from harvested wood products from forest land; emissions from deforestation; emissions from biomass burning due to natural forest fires and incineration of harvesting residues, mineralization of soil nitrogen associated with afforestation or deforestation since 1990 and management of organic soils in forest land, afforested or reforested land and deforested land.

[280] *Sebastian Rüter, Projection of Net-Emissions from Harvested Wood Products in European Countries (Hamburg, 2011), Hamburg; Andis Lazdiņš and Līga Strūve, "Contribution of Harvested Wood Products to Greenhouse Gas Emissions due to Forest Management in Latvia," in Mežzinātne. Special Issue. Abstracts for International Conferences Organized by LSFRI Silava in Cooperation with SNS and IUFRO, vol. 25 (58) (presented at the OSCAR 2012, Riga: LSFRI Silava, 2012), 79–82.*

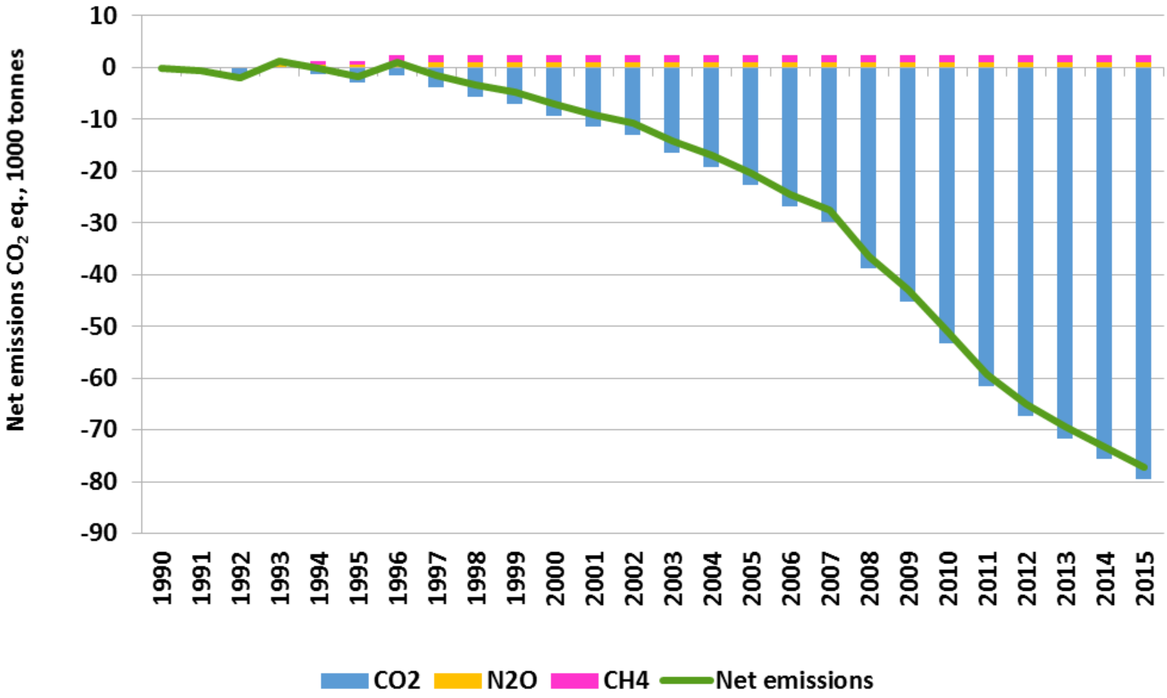

Figure 11.3 GHG emissions due to afforestation

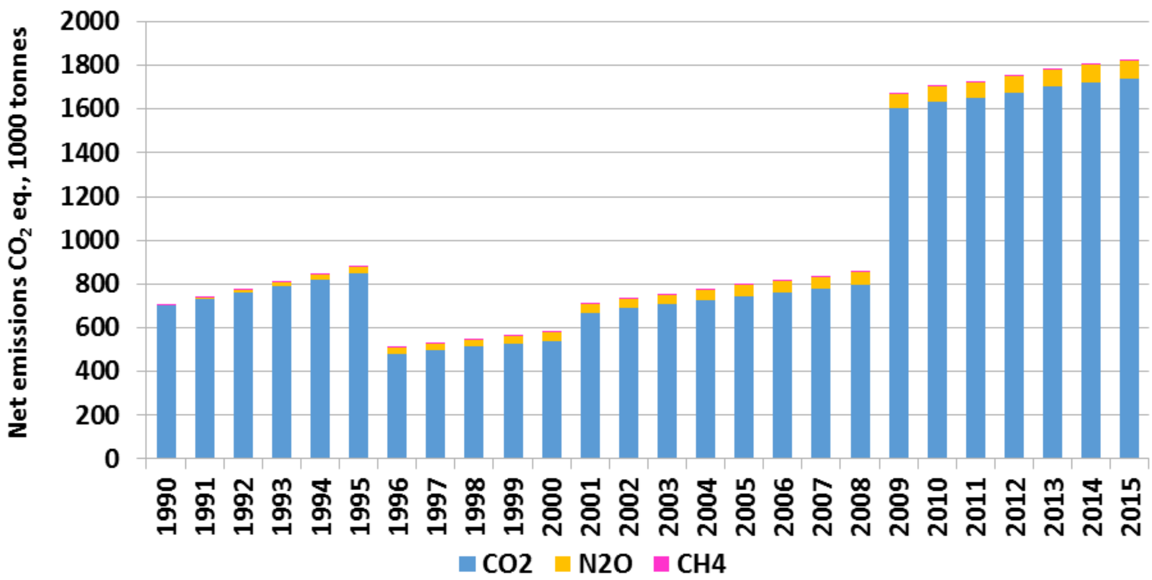

Figure 11.4 GHG emissions due to deforestation

Removals of CO_2 in living biomass is the most significant driver to have negative balance of the net GHG emissions during the reporting period; however, with reduction of CO_2 removals the role of other GHGs increases, particularly, N_2O emissions from organic soil is a key category of emissions (Figure 11.5).

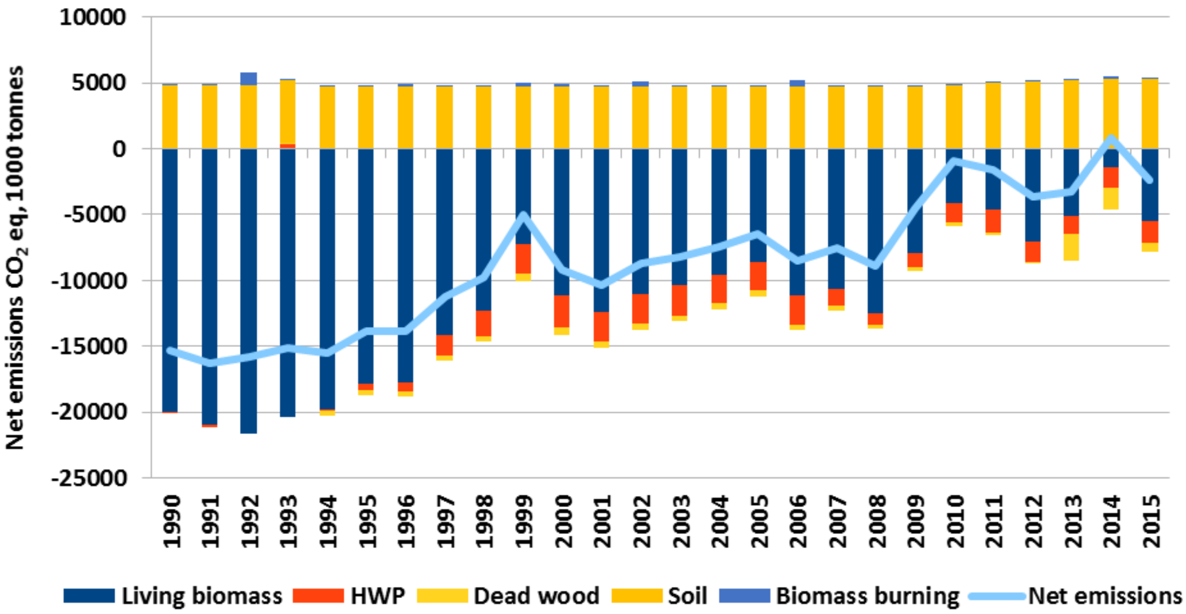

Figure 11.5 GHG emissions due to forest management

11.7 INFORMATION RELATING TO ARTICLE 6

There are no lands subject to Article 3.3 and Article 3.4 activities which are also subject to projects under Article 6.

12 INFORMATION ON ACCOUNTING OF KYOTO UNITS

12.1 BACKGROUND INFORMATION

Chapter 12 and 14 include information on the Latvia's emission trading registry. The accounting on Kyoto units and the public available information is described in chapter 12. Any significant changes in the national registry are reported in chapter 14.

The standard electronic format tables are included in the submission (see "ITL_LV_2016_1_1 and ITL_LV_2016_2_1" 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 2016-12-31 , information on transfers of the units in 2016 to and from other Parties of the Kyoto Protocol and carry over.

12.2 SUMMARY OF INFORMATION REPORTED IN THE SEF TABLES

According to decision 15/CMP.1, annex, part 1, section E each Party must include information on its aggregate holdings and transactions of Kyoto units in its annual report. The information has to be reported in the Standard Electronic Format (SEF), which is an agreed format, embodied in a special report, for reporting on Kyoto units.

The SEF for 2016 was generated on 3 January 2017 with the Union registry in version 8.0.7, build on 2016-10-14_16-18-05 and the SEF application version 3.6.1, provided by the secretariat at 2015-11-23.

At the beginning of the 2016 there were 28 249 726 AAUs in the Party holding accounts, 5 317 ERUs, 21 550 CERs were held in entity holding accounts, and 6 224 420 RMUs in the Article 3.3/3.4 net source cancellation accounts. At the beginning of 2016 there were 48 478 397 AAUs, 490 531 ERUs, 6 233 333 RMUs and 1 251 640 CERs were stored in Retirement account.

At the end of 2016 there were 28 249 726 AAUs were left in National holding accounts and 21 550 CERs and 5 317 ERUs were held in the entity holding accounts. 6 224 420 RMUs were held in Article 3.3/3.4 net source cancellation accounts. 48 478 397 AAUs, 490 531 ERUs, 6 233 333 RMUs and 1 251 640 CERs were left in Latvia's national retirement account.

The registry did not contain any t-CERs or l-CERs and no units were in t-CER and l-CER replacement accounts.

Total of Kyoto protocol units 76 728 123 AAUs, 495 848 ERUs, 12 457 753 RMUs and 1 273 190 CERs were stored in the ETR accounts at the end of 2016.

Latvia's assigned amount for 2nd commitment period of Kyoto Protocol is 76 633 439 tonnes CO_2 eq.

Full details are available in the SEF tables.

In year 2016 there were received the SEF comparison report "RREG1_LV_2015" prepared by the international transaction log (ITL) administrator that provides information on the outcome of the comparison of data contained in the LV SEF tables with corresponding records contained in the ITL. There were not provided reports R2-R5 as there were no discrepancies in this report in 2015.

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 2016 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 not received in the reporting period 2016.

12.3.3 List of non-replacements

No non-replacement occurred during reporting period 2016.

12.3.4 List of invalid units

There weren't any invalid units in Latvia's ETR in the reporting period from 1st January 2016 to 31st December 2016.

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 2016.

12.4 PUBLICLY ACCESSIBLE INFORMATION

According to Article 44-48 of the decision 13CMP.1 Annex E the following information has to be publicly available on the national administrator of Emission registry web page: http://www.meteo.lv/en/lapas/submission-under-unframework-of-climate-change-convention-conference-?id=1476&nid=646:

- Article 45 – Information about the accounts opened in Latvia's Emission trading registry, account types, account holders and contact persons has been published the national administrator of Emission registry web page in file "Latvia's registry publicly accessible information".
- Article 46 – Information about Article 6 project against which the Party has issued ERUs.
- Article 47 – Information of the Kyoto Protocol units in the Latvia's Emission Trading registry opened accounts as well as transactions of Kyoto Protocol units is submitted in Standard Electronic Format.
- Article 48 - Legal entities authorized to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol. This information is provided in Annex 6.

Information is publicly available also on the Emission Registry of Latvia public webpage: https://ets-registry.webgate.ec.europa.eu/euregistry/LV/public/reports/publicReports.xhtml

The information on the accounts is also available on the European Commission webpage: http://ec.europa.eu/environment/ets/account.do;EUROPA_JSESSIONID=zyE_PpHqLkqmy0r

OOeWALmfWfvpML4wVYw-l5j2-LwzuDy-fQcAX!-198553537?languageCode=lv&account.registryCodes=LV&accountHolder=&search=Search&searchType=account&currentSortSettings=

12.5 CALCULATION OF THE COMMITMENT PERIOD RESERVE (CPR)

Parties are required by decision 11/CMP.1 under the Kyoto Protocol and paragraph 18 of Decision 1/CMP.8 to establish and maintain a commitment period reserve as part of their responsibility to manage and account for their assigned amount. The commitment period reserve equals the lower of either 90% of a Party's assigned amount pursuant to Article 3(7bis), (8) and (8bis) or 100% of its most recently reviewed inventory, multiplied by 8.

Both methods are used for calculation of commitment period reserve.

1) 100% of most recently reviewed inventory, multiplied by 8:

CPR = 11,319,390 tonnes CO_2 eq. * 8 = 90,555,120 tonnes CO_2 eq.

2) 90% of a Latvia`s assigned amount pursuant to Article 3(7bis), (8) and (8bis):

CPR = 76,633,439 tonnes CO_2 eq. * 90% = 68,970,096 tonnes CO_2 eq.

The commitment period reserve equals the lower figure from both calculated, therefore Latvia`s commitment period reserve is 68,970,096 tonnes CO_2 eq.

12.6 KP-LULUCF ACCOUNTING

Latvia has chosen accounting of all KP-LULUCF activities regarding Articles 3.3. (Aforestation, Reforestation and deforestation) and 3.4 (Forest Management) at the end of commitment period. Latvia has not elected any voluntary Kyoto Protocol LULUCF activities for the second commitment period.

Additions to the assigned amount resulting from forest management under Article 3, paragraph 4 (FM cap) in the second commitment shall not exceed 3.5 per of the base year emissions.

Latvias FM cap is calculated following:

26,187,533 tonnes CO_2 eq without LULUCF, with indirect CO_2* 3,5 /100 = 916,563 t CO_2 eq.

For the whole second commitment period the additions to the assigned amount resulting from Forest management can be 7,332,509 tonnes CO_2 eq.

13 INFORMATION ON CHANGES IN NATIONAL SYSTEM

In 2017 the amendment of national Regulation No. 217 of Cabinet of Ministers (27.03.2012.) is planned.

In order to improve quality of Baltic states (Latvia, Lithuania, Estonia) GHG inventories and to exchange experience between GHG inventory experts, the Baltic Expert Network on GHG Inventories (BENGGI) was established in 2016.

14 INFORMATION ON CHANGES IN NATIONAL REGISTRY

The following changes to the national registry of Latvia have therefore occurred in 2016.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	No changes of name or contact information in the registry following 32(a) during the reported period and previous period.
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	New tables were added to the CSEUR database for the implementation of the CP2 SEF functionality. Versions of the CSEUR released after 6.7.3 (the production version at the time of the last Chapter 14 submission) introduced other minor changes in the structure of the database. These changes 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. The database model, including the new tables, is provided in Annex A. 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 since version 6.7.3 of the national registry are listed in Annex B. 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 completed in January 2017 and the test report is provided. 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 paragraph 32.(f) Change regarding security	The mandatory use of hard tokens for authentication and signature was introduced for registry administrators.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the reporting period.
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.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced since version 6.7.3 of the national registry are listed in Annex B. 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 January 2017 and the test report is provided.

In response to the previous Annual Review recommendations and to the Standard Independent Assessment Report (SIAR/2016/LVA/1/1 and SIAR/2016/LVA/2/1), the following document was submitted as a second addendum to Chapter 14: 'Information on changes in national registry 'of the Annual Inventory Submission for the reporting year 2015.

Reference	Recommendation description	Response
P1.3.11	1/CMP.8 paragraph 23 PPSR account Has the Party established a previous period surplus reserve (PPSR) account in its national registry?	Since 16 November 2016 the Union Registry provides the technical possibility to open a PPSR account. However, prior to opening it, the PPSR account type must be first introduced into the EU legislative framework. This was done by the Annex of Commission Delegated Regulation 2015/1844. This provision, however, will become applicable, according to Article 2 of the Delegated Regulation, on "the date of publication by the Commission in the Official Journal of the European Union of a communication on the entry into force of the Doha Amendment to the Kyoto Protocol". Consequently, for the moment and until the Doha Amendment enters into force, we are not in a position to open the PPSR account in our National Registry.
P1.4.1	13/CMP.1 Annex paragraph 45 Account information provided?	The Publicly accessible information according to 13/CMP.1 Annex E requirements is updated on a web page http://www.meteo.lv/en/lapas/submission-under-unframework-of-climate-change-convention-conference-?id=1476&nid=646. In future this information will be updated more frequently.
P1.4.2	13/CMP.1 Annex paragraph 46 Article 6 project information provided?	The public information according to 13/CMP.1 Annex paragraph 46(c) Article 6 and explanation about projects occurring in Latvia in 2015 is updated on a web page http://www.meteo.lv/en/lapas/submission-under-unframework-of-climate-change-convention-conference-?id=1476&nid=646 . In future this information will be updated more frequently.

15 INFORMATION ON MINIMIZATION OF ADVERSE IMPACTS IN ACCORDANCE WITH ARTICLE 3, PARAGRAPH 14

Latvia as Annex 1 country provides the following information how Latvia is striving, under Article 3, paragraph 14, minimize adverse social, environmental and economic impacts on developing countries in accordance with the guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol (Decision 15/CMP.1, paragraph 24).

Latvia is acting together with other Parties in the EU to fulfil the commitments under the Protocol.

Parties included in Annex I that are in the position to do so, shall incorporate information on how they give priority, in implementing their commitments under Article 3, paragraph 14, to the following 6 actions, based on relevant methodologies referred to in paragraph 11 of decision 31/CMP.1

(a)The progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities.

Energy sector

1) Latvia is a country where are many different renewable sources, of which can be produced energy. Increasing renewable resource in total consumption reduces energy dependence from imported fossil energy resources from 63,9 % in 2005 to 40,6 % in 2014. The share of natural gas in heat and power production gradually decreases – in 2013 it was 69,8%, in 2014 – 64,3%, in 2015 – 63,5%. According to Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources, Latvia has got one of the highest individual targets for the share of renewable energy by 2020, namely 40% from total gross final energy consumption. In 2013, the rate was 37,08 %, in 2014, this rate was already 38, 65%.
2) The share of renewable energy in the transport sector must reach at least 10% by 2020 of gross final energy consumption for transport (4.03% in 2013, 4.08% in 2014 and 3.92% in 2015). Electromobility development plan 2014-2016 has been approved by the Cabinet of Ministers on 26 March 2014 (order Nr. 129). In 2015, the share of biodiesel and bioethanol in the transport sector in Latvia was 1.95%, in 2014 it was 1.99% although final consumption of biodiesel and bioethanol have increased in 2014 it was 923 TJ and in 2015 – 954 TJ. Latvia developing the infrastructure of electric vehicle charging stations – there were around 27 electric vehicle charging stations at the end of 2015 in Latvia. By 2020 it is planned to complete the Latvian national charging network by installing 235 charging stations. The number of registered electric cars (commercial vehicles and passenger cars) in Latvia in 2014 were 194, but in 2015 – 218.
   Latvia has several plans also about the alternative fuel implementation using in the public transport system.
3) Hydrogen was identified as one of the principal alternative fuels with a potential for long-term oil substitution. The use of hydrogen could be an effective solution because of the abundant water resources in Latvia. In respect of the Directive 2014/94/EU, the Municipality of Riga has joined the Hydrogen Fuel cells and Electro-

mobility in European regions (HyER) and participates to several international projects, including the creation of a hydrogen fuel station in the capital of Riga. Several national-level programs in research on hydrogen fuel cells have been launched in cooperation with the local universities.

4) On 1st January 2015, the electrical energy market was opened also for households, as it is required by the amendments of the Energy Market Law of 20 March 2014. Along with the opening of the electricity market for households, approximately 847 300 users entered the market, representing about 90% of the total amount of users. The reduced price of electricity is provided at the most vulnerable groups of society – poor or low income families, families with disabled children, persons with disabilities, and large families (the electricity price difference is subsidized).
5) The Ministry of Economics in cooperation with the Danish Energy Agency are the Energetics policy coordinators in the context of the European Union Strategy for the Baltic Sea Region (EUSBSR). Strategy's main targets are to save the Baltic Sea, unite the region and raise the prosperity. In June 2015, there has been made a new Strategic and Action plan 2015-2020. It is closely related to Baltic Energy Market Interaction Plan. In 5 June 2015 Ministers of Energetics signed a memorandum, confirming the wish to work together on the problems in the energetics sector.

Environmental taxes

Environmental taxes are intended to grow in the years to follow: according to European Commission *Study on Environmental Fiscal Reform Potential in 14 EU Member States,* the potential revenue generated from the increase of the environmental taxes could reach 2.47% from the Latvian GDP by 2025, comparing to 2.42% in 2012. In the terms of money, it could reach 642 millions of euros by 2025.

Since the 1st July 2015 excise duty rate for oil products was increased. The tax for unleaded petrol is €411,21 per 1000 liters, for leaded petrol - €455,32 per 1000 liters, for diesel - €332,95 per 1000 liters, for diesel, which is used in agriculture and which contain biodiesel - €50 per 1000 liters fuel.

CO_2 emissions are included in Latvia's Natural resources tax which includes all forms of taxation on resource usage as well as pollution of the environment. Law on Natural Resources Tax in Latvia was adopted in 1995, but CO_2 levy in Natural resources tax was introduced with amendments in law on natural resources in 2004 and it was related to stationary technological installation operators – 0,30LVL for each tonne of CO_2 emissions generated from a combustion installation. Over time there has been made different amendments in CO_2 rates - 2014 rate: €2.85 per ton; 2015 rate: €3.50 per ton. Operators who participate in EU Emission trading System (ETS) or which are using renewable energy or peat are excluded from this tax.

CO_2 was taken into account also in the Passenger Vehicle and Motorcycle tax (for vehicles first registered abroad after 1 January 2009) and was paid at the first vehicle registration in Latvia.

(b) Removing subsidies associated with the use of environmentally unsound and unsafe Technologies.

No changes in subsidies for environmentally unsound and unsafe technologies have been identified in 2015.

(c) Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end.

The technological development of non-energy uses of fossil fuels is not a priority for Latvia at this moment.

(d) Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort.

Each year there is a new Development Cooperation Policy Plan worked out by the Ministry of Foreign Affairs. In 2015, the budget funding for the bilateral development assistance was 413 813 EUR. It is about 200 000 EUR more than in 2014. In 2014, Latvia implemented seven grant projects in Georgia, Moldova, Belarus and Uzbekistan. In 2015, was planned to announce a call for project proposals for implementation of projects in Georgia, Ukraine and Moldova.

(e) Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities.

In 2014, Riga Technical University from Latvia collaborated with Urgench State University from Uzbekistan to educate professors and students about alternative energy resources, waste-free production, energy efficiency and climate changes. Gained knowledge after project could be used in countries development.

(f) Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies.

There have not been assistance projects in 2015 to diversify developing countries economies.

16 REFERENCES

Energy

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 *Energy*:
    - Chapter 2 *Stationary combustion*;
    - Chapter 3 *Mobile combustion*;
    - Chapter 4 *Fugitive emissions*.
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 *Agriculture, Forestry and Other Land Use*:
    - Chapter 1 *Introduction*;
    - Chapter 4 *Wetlands*.
- EMEP/EEA air pollutant emission inventory guidebook 2016, Part B: sectoral guidance, Volume 1 *Energy*, 1A *Combustion*, 1B *Fugitive emissions from fuels*:
    - 1.A.1 *Energy industries*;
    - 1.A.2 *Manufacturing industries and construction*;
    - 1.A.3.a *Aviation*;
    - 1.A.3.d *Navigation (shipping)*;
    - 1.A.4 *Small combustion*;
    - 1.A.4 *Non-road mobile sources and machinery*;
    - 1.B.2.a.v *Distribution of oil products*;
- EMEP/EEA air pollutant emission inventory guidebook 2016, Part B: sectoral guidance, Volume 5 *Waste*:
    - 5.C.1.a *Municipal waste incineration*;
    - 5.C.1.b *Industrial waste incineration including hazardous waste and sewage sludge*.
- 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.
- Физико-химические свойства природного газа: http://dolgikh.com/index/0-31
- CSB. Annual Eurostat Energy Questionnaire, 2015.
- Annual Energy data, CSB, 2015:

  http://data.csb.gov.lv/pxweb/lv/vide/vide__ikgad__energetika/?tablelist=true&rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0
- EU ETS data:
    - 2005-2007: http://www.meteo.lv/lapas/uznemumi-kuriem-izsniegtas-siltumnicefekta-gazu-emisijas-atlaujas-?id=1255&nid=574
    - 2008.-2012: http://www.meteo.lv/lapas/uznemumi-kuriem-izsniegtas-siltumnicefekta-gazu-emisijas-atlaujas-2-pe?id=1253&nid=575
    - 2013-2020: http://www.vvd.gov.lv/atlaujas-un-licences/seg-atlaujas/
- Average temperature and HDD data in 1990-2015, LEGMC.

- Average retail prices of selected commodity (gasoline): http://data.csb.gov.lv/pxweb/lv/ekfin/ekfin__ikgad__PCI/PC0030_euro.px/?rxid=82b01970-a284-45b9-9139-695dcd477492
- Nulle, U., Nulle, I. Potential sites for CO_2 geological storage in Latvia. LEGMC. Available on: http://meteo.lv/fs/CKFinderJava/userfiles/files/Geologija/Potential%20sites.pdf
- CO_2GeoNet brochure "*What does* CO_2 *geological storage really mean?*"

Industrial Processes and Product Use

- 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. Volume 3 "IPPU"
- EMEP/EEA air pollutant emission inventory guidebook 2013
- EMEP/EEA air pollutant emission inventory guidebook 2016
- Register of Chemical Substances and Chemical Mixtures;
- Database "2-Air";
- Data from State Agency of Medicines;
- Data from Central Statistical Bureau data bases;
- COMMISSION REGULATION (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Available in http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012R0601;
- Project report "SF_6, HFC and PFC emission inventory in Latvia 1995-2003", Riga 2004;
- EU Regulation (EU) No 517/2014 of The European Parliament and the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. Available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517&from=EN;
- Regulation No.563 of the Cabinet of Ministers of Latvia on special restrictions and prohibitions regarding activities with ozone-depleting substances and fluorinated greenhouse gases. Available at http://likumi.lv/ta/id/233736-noteikumi-par-ipasiem-ierobezojumiem-un-aizliegumiem-attieciba-uz-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumn...;

Agriculture

- 2006 IPCC Guidelines. Volume 4 "Agriculture, Forestry and Other Land Use"
- 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Chapter 2
- Gemste I., Vucāns A. (2010) Notekūdeņu dūņas. Jelgava, LLU, 276 lpp.
- Litiņa I. (2013) Digestāta kā mēslošanas līdzekļa efektivitātes novērtējums kukurūzas sējumā. Zinātniski praktiskā konference LAUKSAIMNIECĪBAS ZINĀTNE VEIKSMĪGAI SAIMNIEKOŠANAI. Jelgava, LLU, 206-209 lpp.

- Agriculture in Latvia. Collection of statistical data. Central Statistical Bureau of Latvia, 2015
- Priekulis J., Āboltiņš A. (2015) Calculation Methodology for Cattle Manure Management Systems Based on the 2006 IPCC Guidelines. Proceedings of the 25th NJF Congress Nordic View to Sustainable Rural Development. Riga, pp.274-280
- Fertiliser Recommendations for Agricultural Crops (2013) Ed.A. Karklins and A.Ruza. Jelgava:LLU, 55 p.
- Latvietis J. (1994) Govju ēdināšanas normas. Jelgava: LLU, p.102
- EMEP/EEA Air pollutant emission inventory guidebook (2013) 3.B Manure management. European Environment Agency. Table 3.7, page 27
- Norwegian NIR (2015) Available at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php
- Estonian NIR (2015). Available at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php
- Jonerholm K., Lundborg H. (2012) Methane losses in the biogas system. Available at http://www.balticbiogasbus.eu/web/Upload/Supply_of_biogas/Act_4_6/Annex/Methane%20losses.pdf
- Greenhouse gas emission in Norway 1990-2011, National inventory report, 2013, p. 238, Table 6.3
- Национальный доклад о кадастре антропогенных выбросов из источников и абсорбции поглотителями парниковых газов не регулируемых Монреальским протоколом за 1990-2011 г. Москва, 2013. Часть 1, С. 175, Таблица 6.5
- IPCC GPG 2000 - IPCC Good Practice Guidance and Uncertainty Management in NationalGreenhouse Gas Inventories (2000)
- Agriculture, Forestry and Fishery. http://data.csb.gov.lv/pxweb/en/lauks/?rxid=a79839fe-11ba-4ecd-8cc3-4035692c5fc8
- Agriculture in Latvia. Collection of Statistical Data. Rīga: 2014. 64 pp
- Ministry of Agriculture. Available at: https://www.zm.gov.lv/lauksaimnieciba/statiskas-lapas/lauksaimniecibas-gada-zinojumi?nid=531#jump
- Wild Animal Breeders Association. Available at: http://www.losp.lv/sites/default/files/articles/attachments/publications/22.12.2011_-_1500/17_savvalas_dzivnieki.pdf

LULUCF

- Ektleston, S., Buendia, L., Miwa, K., Ngara, T. & Kiyoto, T. (Eds.) (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Agriculture, Forestry and Other Land Use. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. p 678. Japan: Institute for Global Environmental Strategies (IGES). ISBN 4-88788-032-4.

- Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. & Troxler, T. G. (Eds.) (2013). Revised Supplementary Methods and Good Practice Guidance

Arising from the Kyoto Protocol. IPCC, Switzerland. Available from: http://www.ipcc-nggip.iges.or.jp/public/kpsg/pdf/KP_Supplement_Entire_Report.pdf.

- Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Fukuda, M., Troxler, T. & Jamsranjav, B. (2013). *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* [online]. Switzerland.
- Andis Lazdiņš and Ainārs Lupiķis, Hidrotehniskās Meliorācijas Ietekme Uz CO_2 Emisijām Mežaudzēs Uz Susinātām Augsnēm (Salaspils, 2014), Salaspils.
- 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).
- Andis Lazdiņš and Mihails 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 (Salaspils, 2013), Salaspils.
- Andis Lazdiņš et al., Atbalsts Klimata Pētījumu Programmai (Pārskats Par Projekta 2013. Gada Darba Uzdevumu Izpildi) (Salaspils, 2013), Salaspils;
- 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).
- Andis Lazdiņš et al., Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2013. Gada Darba Uzdevumu Izpildi) (Salaspils, 2013), Salaspils.
- Andis Lazdiņš, Aldis Butlers, and Ainārs Lupiķis, "Case Study of Soil Carbon Stock Changes in Drained and Afforested Transitional Bog," in Forest Ecosystems and Its Management: Towards Understanding the Complexity (presented at the 9th Baltic theriological conference, Ilgas: Latvian State Forest Research Institute "Silava," 2014);
- Andis Lazdiņš, Atbalsts Klimata Pētījumu Programmai (starpziņojums Par 2012. Gada Darba Uzdevumu Izpildi) (Salaspils, 2012), Salaspils.
- 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;
- FAO Forestry Department, *Global Forest Resources Assessment 2000*, FAO Forestry Paper (Food and Agriculture Organization of the United Nations, 2000).
- 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);
- Jānis Donis, *Latvijas Meža Resursu Ilgtspējīgas, Ekonomiski Pamatotas Izmantošanas Un Prognozēšanas Modeļu Izstrāde* (Salaspils: LVMI Silava, 2011).
- Jansons, Methods Utilized to Recalculate Historical Forest Increment Data.

- 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.
- 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, "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 and Zariņš, Vēsturiskās (1990. Gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana.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.
- Lazdiņš and Zariņš, Vēsturiskās (1990. Gada) Apsaimniekoto Aramzemju Platības Noteikšana Un Līdz 2009. Gadam Notikušo Aramzemju Platības Izmaiņu Novērtēšana.
- 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).
- Lazdiņš et al., *Mežsaimniecisko Darbību Ietekmes Uz Siltumnīcefekta Gāzu Emisijām Un CO_2 Piesaisti Novērtējums (pārskats Par 2013. Gada Darba Uzdevumu Izpildi)*;
- 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, 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. *Proceedings of 6th Internationasl Scientific Conference Students on Their Way to Science*, Jelgava, Maj 27 2011. p 10. Jelgava: Latvia University of Agriculture, Faculty of Social Sciences, Faculty of Engineering, Forest Faculty.
- Lazdiņš, A. & Zariņš, J. (2010). 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;

- Lazdiņš, A. & Zariņš, J. (2012). *Vēsturiskās (1990. gada) apsaimniekoto aramzemju platības noteikšana un līdz 2009. gadam notikušo aramzemju platības izmaiņu novērtēšana*. Salaspils. (2/27.01);
- 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.
- 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.Lazdiņš et al., *Atbalsts Klimata Pētījumu Programmai (Pārksats Par Projekta 2013. Gada Darba Uzdevumu Izpildi)*.
- 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., 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.
- Lazdiņš, Bārdule, and Stola, "Preliminary Results of Evaluation of Area of Organic Soils in Arable Lands in Latvia"
- Lazdiņš, Donis, and Strūve, 2012. *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)*.
- Leonards Līpiņš, "Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resursu un to izmantošanas efektivitātes novērtējums)" (LLU, 2004).
- LSFRI Silava, "Methods utilized to recalculate historical forest increment data" (LSFRI Silava, 2007).
- 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).
- 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.

- Zariņš, J. Meža Statistiskās Inventarizācijas Parauglaukumu Mērījumu Interpolācijas Projekts, Izmantojot Satelītu Uzņēmumu Analīzes Iespējas (pāskats Par Meža Attīstības Fonda Pasūtīto Pētījumu);
- Zemkopības ministrija, "Meža statistiskās inventarizācijas veikšanas un mežaudzes sekundāro parametru aprēķināšanas metodika (instrukcija Nr. 10 no 17.03.2004.)" (Latvijas Republikas Zemkopības ministrija;
- Zigurds Saliņš, *Mežs - Latvijas Nacionālā Bagātība* (Jelgava: Jelgavas tipogrāfija, 2002); Zigurds Saliņš, *Meža izmantošana Latvijā: stāvoklis, perspektīvas* (Jelgava [Latvia]: LLU Meža izmantošanas katedra, 1999).

Waste

- 2006 IPCC Guidelines. Volume 5 "Waste";
- EMEP/EEA air pollutant emission inventory guidebook 2013;
- http://www.meteo.lv/public/28759.html;
- http://parissrv.lvgmc.lv/public_reports;
- "Research about solid waste management in Latvia", 1998, Ltd GEO Consultants;
- http://www.lvgmc.lv/fs/CKFinderJava/userfiles/files/Vide/Atkritumi/statistika/Rokas gramata_atkr_faktori.pdf ;
- Statistical Yearbook of Latvia 2004, CSB, 2005;
- "Degradable organic carbon in disposed waste", 2011, Ltd Virsma
- "Composting emission factor development from waste and waste water sectors and methane correction factor estimation for Latvia landfills", 2015, Waste Management Association of Latvia
- http://parissrv.lvgmc.lv/public_reports/#viewType=water2reports
- Gemste I., Vucāns A., Jelgava, 2002."Notekūdeņu dūņas un to izmantošana" („Sewage Sludge and Disposal of it")
- Gemste I., Vucāns A., Jelgava, 2007 "Notekūdeņu dūņas" ("Sewage Sludge")
- http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

Information on minimization of adverse impacts in accordance with article 3, paragraph 14

- Central Statistical Bureau of Latvia. Energy Balance in 2015.(http://www.csb.gov.lv/en/dati/e-publikacijas/energy-balance-2015-only-latvian-45357.html)
- Central Statistical Bureau of Latvia. Registered motor vehicles by type of fuel at the end of 2015.(http://www.csb.gov.lv/sites/default/files/nr_29_transports_latvija_2016_16_00_lv_en.pdf)
- Society Zala Briviba. Environmental tax efficiency and the further development of the evaluation report.(http://www.zalabriviba.lv/wp-content/uploads/P%C4%93t%C4%ABjums_2016-v6.pdf)
- Legislation of the Republic of Latvia. Natural Resources Tax Law. (http://likumi.lv/doc.php?id=124707)

- Ministry of Foreign Affairs of the Republic of Latvia. Development Cooperation Policy Plan for 2015. (http://www.mfa.gov.lv/images/Grozitais_Attistibas_sadarbibas_plans_2015.gadam.pdf)
- The European Union Strategy for the Baltic Sea Region. EUSBSR Action Plan (http://www.balticsea-region-strategy.eu/communication/news/590704-updated-eusbsr-action-plan)
- Ministry of Foreign Affairs of the Republic of Latvia. Development cooperation projects in 2014 (http://www.mfa.gov.lv/arpolitika/attistibas-sadarbiba/latvijas-attistibas-sadarbibas-politika/finansejums/attistibas-sadarbibas-projekti-2014-gada)

ANNEXES TO THE NATIONAL INVENTORY REPORT

ANNEX 1: KEY CATEGORIES

A.1.1. Spreadsheet for the Approach 1 analysis for 1990 – level assessment with LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-19460.504	19460.504	0.342	34%
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4125.549	4125.549	0.072	41%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	3078.955	0.054	47%
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2761.365	2761.365	0.049	52%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	2657.607	0.047	56%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	2117.989	0.037	60%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1967.300	0.035	64%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	1723.750	0.030	67%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	1410.785	0.025	69%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	1017.269	0.018	71%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	1016.928	1016.928	0.018	73%
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	924.833	924.833	0.016	74%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	806.130	0.014	76%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	803.741	0.014	77%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	782.443	0.014	78%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	700.654	0.012	80%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	616.136	0.011	81%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	605.818	0.011	82%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	567.422	567.422	0.010	83%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	531.380	0.009	84%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	526.803	0.009	85%
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	382.478	382.478	0.007	85%
3.G. Liming	CO_2	357.133	357.133	0.006	86%
2.A.1. Cement Production	CO_2	345.783	345.783	0.006	87%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	335.687	0.006	87%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	332.334	0.006	88%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	319.950	0.006	88%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	316.064	0.006	89%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	283.062	0.005	89%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	279.473	0.005	90%
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	0.005	90%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	276.247	0.005	91%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	235.643	0.004	91%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	220.705	0.004	92%
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	218.068	218.068	0.004	92%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	218.053	0.004	92%
5.D.1 Domestic Wastewater	CH_4	185.075	185.075	0.003	93%
1.B.2.b Natural Gas	CH_4	177.238	177.238	0.003	93%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	175.098	0.003	93%
2.A.2. Lime Production	CO_2	169.024	169.024	0.003	94%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	150.166	0.003	94%
4. G. Harvested wood products	CO_2	-149.836	149.836	0.003	94%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	145.786	0.003	94%
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	143.035	143.035	0.003	95%
5.D.2 Industrial Wastewater	CH_4	137.025	137.025	0.002	95%
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	125.098	125.098	0.002	95%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	120.666	0.002	95%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	119.570	0.002	96%
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	118.735	118.735	0.002	96%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	110.967	0.002	96%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	103.071	0.002	96%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	102.282	0.002	96%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	96.425	0.002	97%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	94.194	0.002	97%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	77.978	77.978	0.001	97%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	75.346	0.001	97%
1.B.2.c Venting and Flaring	CH_4	70.344	70.344	0.001	97%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	69.988	69.988	0.001	97%
2.C.1 Iron and Steel Production	CO_2	69.692	69.692	0.001	97%
2.A.4. Other process uses of carbonates	CO_2	69.185	69.185	0.001	97%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	-66.910	66.910	0.001	98%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	66.886	0.001	98%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	65.378	0.001	98%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	61.352	0.001	98%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	61.201	0.001	98%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	56.126	56.126	0.001	98%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	52.541	0.001	98%
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	-49.115	49.115	0.001	98%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	48.030	0.001	98%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	44.924	0.001	98%
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	44.403	44.403	0.001	99%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	43.267	0.001	99%
1.A.4.b Residential - Peat	CO_2	42.549	42.549	0.001	99%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	40.269	0.001	99%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	39.135	0.001	99%
1.A.3.b Road Transportation - LPG	CO_2	37.141	37.141	0.001	99%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	32.920	0.001	99%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CH_4	28.534	28.534	0.001	99%
1.A.2.g Other - Solid Fuels	CO_2	27.263	27.263	0.000	99%
5.D.1 Domestic Wastewater	N_2O	26.564	26.564	0.000	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	25.015	0.000	99%
2.D.3. Solvent Use	CO_2	24.434	24.434	0.000	99%
5.B.1. Composting	CH_4	23.909	23.909	0.000	99%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	23.542	0.000	99%
2.D.1 Lubricant Use	CO_2	23.251	23.251	0.000	99%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	22.276	0.000	99%
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	21.455	21.455	0.000	99%
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-19.648	19.648	0.000	99%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	18.091	0.000	99%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	17.617	0.000	99%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	17.155	0.000	99%
5.B.1. Composting	N_2O	17.100	17.100	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	16.429	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	15.704	0.000	100%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-14.143	14.143	0.000	100%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	13.074	0.000	100%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	12.485	0.000	100%
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	12.456	12.456	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	9.150	0.000	100%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.944	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	8.109	0.000	100%
3.H. Urea Application	CO_2	7.709	7.709	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	7.163	0.000	100%
4.B.2 Land converted to Cropland –Mineral soil	CO_2	6.935	6.935	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	6.666	0.000	100%
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.589	6.589	0.000	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-6.274	6.274	0.000	100%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	6.220	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	5.594	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	5.286	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	4.652	0.000	100%
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.389	4.389	0.000	100%
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	0.000	100%
4.E.2 Land converted to Settlements – Organic soils	CO_2	3.766	3.766	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	3.728	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	3.495	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	3.463	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	3.436	0.000	100%
2.G.3. N_2O from product uses	N_2O	3.250	3.250	0.000	100%
1.A.4.b Residential - Peat	CH_4	3.188	3.188	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	3.079	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	3.023	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	3.005	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	2.863	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	2.692	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	CH_4	2.544	2.544	0.000	100%
4.A.1 Forest land remaining forest land - Controlled burning	N_2O	2.516	2.516	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	2.412	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	2.341	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	2.265	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	2.149	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	1.879	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	1.774	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	1.454	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	1.437	0.000	100%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-1.403	1.403	0.000	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – dead organic matter	CO_2	-1.402	1.402	0.000	100%
4.E.2 Land converted to Settlements – Mineral soils	CO_2	1.400	1.400	0.000	100%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-1.382	1.382	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	1.205	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.108	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	1.030	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.998	0.000	100%
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.911	0.911	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	0.868	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	0.833	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.789	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.782	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.761	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.745	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.702	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.651	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.641	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.628	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.616	0.000	100%
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.590	0.590	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.575	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	0.520	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.501	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.483	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.478	0.000	100%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	0.455	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.450	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.423	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.356	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	0.327	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.318	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.298	0.298	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.296	0.000	100%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	0.287	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.285	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.273	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.273	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.272	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.269	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.267	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.239	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.233	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.218	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.186	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.181	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.173	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.171	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.171	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.168	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	0.164	0.000	100%
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-0.162	0.162	0.000	100%
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	0.160	0.160	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.143	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.127	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.125	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.124	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.119	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.107	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	0.101	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.095	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.091	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.081	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.079	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.076	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.069	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.069	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.068	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.058	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	0.055	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.054	0.054	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.054	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.050	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.050	0.050	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.043	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.036	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.034	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.032	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.025	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.024	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.024	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.023	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.020	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.018	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.015	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.014	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.013	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.013	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.011	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.011	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.009	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	0.008	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.007	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.005	0.000	100%
4.C.2 Land converted to Grassland –Mineral soil	CO_2	-0.003	0.003	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.003	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.003	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.003	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.001	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.001	0.000	100%
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	0.001	0.001	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	0.000	100%

A.1.2. Spreadsheet for the Approach 1 analysis for 1990 – level assessment without LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	3078.955	0.118	12%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	2657.607	0.102	22%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	2117.989	0.081	30%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1967.300	0.075	38%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	1723.750	0.066	44%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	1410.785	0.054	50%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	1017.269	0.039	53%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	806.130	0.031	57%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	803.741	0.031	60%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	782.443	0.030	63%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	700.654	0.027	65%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	616.136	0.024	68%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	605.818	0.023	70%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	531.380	0.020	72%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	526.803	0.020	74%
3.G. Liming	CO_2	357.133	357.133	0.014	75%
2.A.1. Cement Production	CO_2	345.783	345.783	0.013	77%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	335.687	0.013	78%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	332.334	0.013	79%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	319.950	0.012	80%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	316.064	0.012	82%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	283.062	0.011	83%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	279.473	0.011	84%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	276.247	0.011	85%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	235.643	0.009	86%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	220.705	0.008	87%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	218.053	0.008	87%
5.D.1 Domestic Wastewater	CH_4	185.075	185.075	0.007	88%
1.B.2.b Natural Gas	CH_4	177.238	177.238	0.007	89%
1.A.2.e Food Processing, Beverages	CO_2	175.098	175.098	0.007	90%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
and Tobacco - Gaseous Fuels					
2.A.2. Lime Production	CO_2	169.024	169.024	0.006	90%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	150.166	0.006	91%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	145.786	0.006	91%
5.D.2 Industrial Wastewater	CH_4	137.025	137.025	0.005	92%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	120.666	0.005	92%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	119.570	0.005	93%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	110.967	0.004	93%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	103.071	0.004	94%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	102.282	0.004	94%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	96.425	0.004	94%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	94.194	0.004	95%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	75.346	0.003	95%
1.B.2.c Venting and Flaring	CH_4	70.344	70.344	0.003	95%
2.C.1 Iron and Steel Production	CO_2	69.692	69.692	0.003	96%
2.A.4. Other process uses of carbonates	CO_2	69.185	69.185	0.003	96%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	66.886	0.003	96%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	65.378	0.003	96%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	61.352	0.002	97%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	61.201	0.002	97%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	52.541	0.002	97%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	48.030	0.002	97%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	44.924	0.002	97%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	43.267	0.002	97%
1.A.4.b Residential - Peat	CO_2	42.549	42.549	0.002	98%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	40.269	0.002	98%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	39.135	0.001	98%
1.A.3.b Road Transportation - LPG	CO_2	37.141	37.141	0.001	98%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	32.920	0.001	98%
1.A.2.g Other - Solid Fuels	CO_2	27.263	27.263	0.001	98%
5.D.1 Domestic Wastewater	N_2O	26.564	26.564	0.001	98%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	25.015	0.001	99%
2.D.3. Solvent Use	CO_2	24.434	24.434	0.001	99%
5.B.1. Composting	CH_4	23.909	23.909	0.001	99%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	23.542	0.001	99%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
2.D.1 Lubricant Use	CO_2	23.251	23.251	0.001	99%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	22.276	0.001	99%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	18.091	0.001	99%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	17.617	0.001	99%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	17.155	0.001	99%
5.B.1. Composting	N_2O	17.100	17.100	0.001	99%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	16.429	0.001	99%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	15.704	0.001	99%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	13.074	0.001	99%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	12.485	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	9.150	0.000	99%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.944	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	8.109	0.000	100%
3.H. Urea Application	CO_2	7.709	7.709	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	7.163	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	6.666	0.000	100%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	6.220	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	5.594	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	5.286	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	4.652	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	3.728	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	3.495	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	3.463	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	3.436	0.000	100%
2.G.3. N_2O from product uses	N_2O	3.250	3.250	0.000	100%
1.A.4.b Residential - Peat	CH_4	3.188	3.188	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	3.079	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	3.023	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	3.005	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	2.863	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid	CO_2	2.692	2.692	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
Fuels					
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	2.412	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	2.341	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	2.265	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	2.149	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	1.879	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	1.774	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	1.454	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	1.437	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	1.205	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.108	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	1.030	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.998	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	0.868	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	0.833	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.789	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.782	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.761	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.745	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.702	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.651	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.641	0.000	100%
1.A.2.a Iron and Steel - Other fossil Fuels	CH_4	0.628	0.628	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.616	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.575	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	0.520	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.501	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.483	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.478	0.000	100%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	0.455	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.450	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries	N_2O	0.423	0.423	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
- Gaseous Fuels					
2.A.3. Glass production	CO_2	0.356	0.356	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	0.327	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.318	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.296	0.000	100%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	0.287	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.285	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.273	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.273	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.272	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.269	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.267	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.239	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.233	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.218	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.186	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.181	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.173	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.171	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.171	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.168	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	0.164	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.143	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.127	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.125	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.124	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.119	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.107	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	0.101	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.095	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.091	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.081	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.079	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.076	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.069	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.069	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.068	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.058	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	0.055	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.054	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.050	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.043	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.036	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.034	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.032	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.025	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.024	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.024	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.023	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.020	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.018	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.015	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.014	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.013	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.013	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.011	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.011	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.009	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	0.008	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.007	0.000	100%
1.A.2.f Non-metallic Minerals -	CH_4	0.005	0.005	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Absolute value of Base year	Level assessment	Cumulative total of Level assessment
Biomass Fuels					
2.D.3.c Asphalt roofing	CO_2	0.003	0.003	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.003	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.003	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.001	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.001	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	0.000	100%

A.1.3. Spreadsheet for the Approach 2 analysis for 1990 – level assessment with LULUCF

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1967.300	25%	50%	0.559	0.035	0.019	0.103	10%
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4125.549	4125.549	5%	25%	0.256	0.072	0.019	0.099	20%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	567.422	567.422	44%	119%	1.269	0.010	0.013	0.068	27%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-19460.504	19460.504	2%	3%	0.035	0.342	0.012	0.064	33%
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2761.365	2761.365	13%	18%	0.227	0.049	0.011	0.059	39%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	2117.989	2%	20%	0.201	0.037	0.007	0.040	43%
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	118.735	118.735	20%	334%	3.349	0.002	0.007	0.037	47%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	782.443	2%	50%	0.500	0.014	0.007	0.037	51%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	3078.955	2%	10%	0.102	0.054	0.006	0.029	54%
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	382.478	382.478	53%	60%	0.803	0.007	0.005	0.029	56%
4.D.1 Wetlands remaining Wetlands	CO_2	-66.910	66.910	6%	448%	4.475	0.001	0.005	0.028	59%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
– Carbon stock change – living biomass										
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	924.833	924.833	26%	19%	0.319	0.016	0.005	0.028	62%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	1410.785	2%	20%	0.201	0.025	0.005	0.027	65%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	1016.928	1016.928	24%		0.242	0.018	0.004	0.023	67%
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	-49.115	49.115	9%	420%	4.197	0.001	0.004	0.019	69%
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	218.068	218.068	93%	6%	0.928	0.004	0.004	0.019	71%
3.G. Liming	CO_2	357.133	357.133	5%	50%	0.502	0.006	0.003	0.017	73%
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	125.098	125.098	115%	71%	1.349	0.002	0.003	0.016	74%
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	24%	55%	0.604	0.005	0.003	0.016	76%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	319.950	2%	50%	0.500	0.006	0.003	0.015	77%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	283.062	7%	52%	0.525	0.005	0.003	0.014	79%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	2657.607	2%	5%	0.054	0.047	0.003	0.013	80%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	605.818	2%	20%	0.201	0.011	0.002	0.011	81%
1.A.4.a Commercial/Institutional -	CO_2	1017.269	1017.269	2%	10%	0.102	0.018	0.002	0.010	82%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Liquid Fuels										
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	143.035	143.035	53%	39%	0.659	0.003	0.002	0.009	83%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	806.130	2%	11%	0.111	0.014	0.002	0.008	84%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	803.741	2%	10%	0.102	0.014	0.001	0.008	85%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	700.654	2%	11%	0.109	0.012	0.001	0.007	85%
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	69.988	69.988	61%	82%	1.017	0.001	0.001	0.007	86%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	119.570	25%	50%	0.559	0.002	0.001	0.006	87%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	56.126	56.126	44%	105%	1.137	0.001	0.001	0.006	87%
1.B.2.b Natural Gas	CH_4	177.238	177.238	32%	0%	0.322	0.003	0.001	0.005	88%
5.D.1 Domestic Wastewater	CH_4	185.075	185.075	6%	30%	0.306	0.003	0.001	0.005	88%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	102.282	2%	50%	0.500	0.002	0.001	0.005	89%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	1723.750	2%	2%	0.028	0.030	0.001	0.005	89%
5.D.2 Industrial Wastewater	CH_4	137.025	137.025	14%	30%	0.331	0.002	0.001	0.004	90%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-6.274	6.274	3%	701%	7.007	0.000	0.001	0.004	90%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	218.053	2%	20%	0.201	0.004	0.001	0.004	90%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	120.666	25%	20%	0.320	0.002	0.001	0.004	91%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	110.967	25%	20%	0.320	0.002	0.001	0.003	91%
2.A.4. Other process uses of carbonates	CO_2	69.185	69.185	8%	50%	0.506	0.001	0.001	0.003	91%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	332.334	2%	10%	0.102	0.006	0.001	0.003	92%
2.A.1. Cement Production	CO_2	345.783	345.783	8%	5%	0.094	0.006	0.001	0.003	92%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	61.201	2%	50%	0.500	0.001	0.001	0.003	92%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	279.473	2%	10%	0.102	0.005	0.001	0.003	93%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	526.803	2%	5%	0.054	0.009	0.000	0.003	93%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	276.247	2%	10%	0.102	0.005	0.000	0.003	93%
5.B.1. Composting	CH_4	23.909	23.909	37%	100%	1.066	0.000	0.000	0.002	93%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	77.978	77.978	2%	31%	0.310	0.001	0.000	0.002	94%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	48.030	2%	50%	0.500	0.001	0.000	0.002	94%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CH_4	28.534	28.534	24%	81%	0.842	0.001	0.000	0.002	94%
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-19.648	19.648	5%	122%	1.222	0.000	0.000	0.002	94%
4. G. Harvested wood products	CO_2	-149.836	149.836	15%	0%	0.150	0.003	0.000	0.002	95%
1.A.4.c Agriculture/Forestry/Fisheries -	N_2O	43.267	43.267	2%	50%	0.500	0.001	0.000	0.002	95%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Liquid Fuels										
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	21.455	21.455	93%	36%	0.994	0.000	0.000	0.002	95%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	65.378	25%	20%	0.320	0.001	0.000	0.002	95%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	103.071	2%	20%	0.201	0.002	0.000	0.002	95%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	39.135	5%	50%	0.502	0.001	0.000	0.002	96%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	335.687	2%	5%	0.054	0.006	0.000	0.002	96%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	616.136	2%	2%	0.028	0.011	0.000	0.002	96%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	96.425	15%	10%	0.180	0.002	0.000	0.002	96%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	316.064	2%	5%	0.054	0.006	0.000	0.002	96%
5.B.1. Composting	N_2O	17.100	17.100	37%	90%	0.973	0.000	0.000	0.002	96%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	32.920	2%	50%	0.500	0.001	0.000	0.002	96%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	145.786	5%	10%	0.112	0.003	0.000	0.002	97%
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	44.403	44.403	20%	31%	0.363	0.001	0.000	0.002	97%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	531.380	2%	2%	0.028	0.009	0.000	0.001	97%
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	12.456	12.456	114%	18%	1.153	0.000	0.000	0.001	97%
2.A.2. Lime Production	CO_2	169.024	169.024	8%	2%	0.082	0.003	0.000	0.001	97%
3.B.2.3 Manure Management -	N_2O	40.269	40.269	25%	20%	0.320	0.001	0.000	0.001	97%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Swaine										
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	235.643	2%	5%	0.054	0.004	0.000	0.001	97%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	61.352	2%	20%	0.201	0.001	0.000	0.001	98%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	220.705	2%	5%	0.054	0.004	0.000	0.001	98%
2.D.1 Lubricant Use	CO_2	23.251	23.251	2%	50%	0.500	0.000	0.000	0.001	98%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	52.541	2%	20%	0.201	0.001	0.000	0.001	98%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	94.194	2%	10%	0.102	0.002	0.000	0.001	98%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	175.098	2%	5%	0.054	0.003	0.000	0.001	98%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	18.091	2%	50%	0.500	0.000	0.000	0.001	98%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	22.276	25%	30%	0.391	0.000	0.000	0.001	98%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	75.346	5%	10%	0.112	0.001	0.000	0.001	98%
5.D.1 Domestic Wastewater	N_2O	26.564	26.564	8%	30%	0.310	0.000	0.000	0.001	98%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	150.166	2%	5%	0.054	0.003	0.000	0.001	98%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	66.886	5%	11%	0.120	0.001	0.000	0.001	99%
2.C.1 Iron and Steel Production	CO_2	69.692	69.692	5%	10%	0.112	0.001	0.000	0.001	99%
1.B.2.c Venting and Flaring	CH_4	70.344	70.344	10%	0%	0.100	0.001	0.000	0.001	99%
2.D.3. Solvent Use	CO_2	24.434	24.434	25%	10%	0.269	0.000	0.000	0.001	99%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	13.074	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.2.g Other - Solid Fuels	CO_2	27.263	27.263	2%	20%	0.201	0.000	0.000	0.001	99%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	17.155	2%	30%	0.301	0.000	0.000	0.000	99%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	12.485	25%	30%	0.391	0.000	0.000	0.000	99%
1.A.4.b Residential - Peat	CO_2	42.549	42.549	5%	10%	0.112	0.001	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	9.150	5%	50%	0.502	0.000	0.000	0.000	99%
4.B.2 Land converted to Cropland – Mineral soil	CO_2	6.935	6.935	64%	15%	0.662	0.000	0.000	0.000	99%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-14.143	14.143	6%	31%	0.316	0.000	0.000	0.000	99%
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	24%	107%	1.099	0.000	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	8.109	2%	50%	0.500	0.000	0.000	0.000	99%
3.H. Urea Application	CO_2	7.709	7.709	2%	50%	0.500	0.000	0.000	0.000	99%
5.C.1 Waste Incineration	N_2O	3.436	3.436	44%	100%	1.093	0.000	0.000	0.000	99%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	7.163	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	6.666	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	16.429	2%	20%	0.201	0.000	0.000	0.000	99%
2.G.3. N_2O from product uses	N_2O	3.250	3.250	2%	100%	1.000	0.000	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	6.220	5%	50%	0.502	0.000	0.000	0.000	99%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.944	15%	30%	0.335	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	5.594	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	5.286	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	25.015	2%	10%	0.102	0.000	0.000	0.000	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	44.924	2%	5%	0.054	0.001	0.000	0.000	100%
4.A.1 Forest land remaining forest land - Controlled burning	N_2O	2.516	2.516	93%		0.926	0.000	0.000	0.000	100%
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.589	6.589	9%	31%	0.322	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	CO_2	37.141	37.141	2%	5%	0.054	0.001	0.000	0.000	100%
4.E.2 Land converted to Settlements – Organic soils	CO_2	3.766	3.766	47%	18%	0.505	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	3.728	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	4.652	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	3.495	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Peat	CH_4	3.188	3.188	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	15.704	2%	10%	0.102	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	3.023	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	3.005	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	2.863	2%	50%	0.500	0.000	0.000	0.000	100%
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.911	0.911	20%	151%	1.520	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.389	4.389	5%	31%	0.314	0.000	0.000	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	CH_4	2.544	2.544	37%	36%	0.516	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	23.542	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	2.412	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	2.265	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	2.149	2%	50%	0.500	0.000	0.000	0.000	100%
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change	N_2O	0.590	0.590	64%	151%	1.639	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
of land use or management of mineral soils										
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	17.617	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	1.879	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	1.774	2%	50%	0.500	0.000	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	2.341	13%	30%	0.327	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	1.454	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	1.437	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	3.079	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	1.205	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	2.692	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	1.030	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.998	2%	50%	0.500	0.000	0.000	0.000	100%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-1.403	1.403	8%	31%	0.320	0.000	0.000	0.000	100%
4.B.1 Cropland remaining Cropland –	CO_2	-1.402	1.402	3%	31%	0.311	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Carbon stock change – dead organic matter										
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	0.868	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.789	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	3.463	10%	5%	0.112	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.761	2%	50%	0.500	0.000	0.000	0.000	100%
4.E.2 Land converted to Settlements – Mineral soils	CO_2	1.400	1.400	22%	16%	0.270	0.000	0.000	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.745	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.702	2%	50%	0.500	0.000	0.000	0.000	100%
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	0.160	0.160	42%	212%	2.157	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.575	44%	40%	0.595	0.000	0.000	0.000	100%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-1.382	1.382	8%	23%	0.244	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.108	2%	30%	0.301	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.651	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.641	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.628	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.616	5%	50%	0.502	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.782	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	0.520	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.501	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.483	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.478	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	0.455	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.450	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.356	3%	60%	0.601	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.423	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	0.327	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.318	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.296	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	0.287	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.285	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.273	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.272	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation -	N_2O	0.273	0.273	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Gaseous Fuels										
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.269	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.267	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.239	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.233	5%	50%	0.502	0.000	0.000	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.298	0.298	37%		0.370	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.218	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.186	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.181	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.171	5%	50%	0.502	0.000	0.000	0.000	100%
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-0.162	0.162	8%	52%	0.529	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.171	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.168	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	0.164	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.143	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.127	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.125	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.124	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.119	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.107	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	0.101	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.095	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.091	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	0.833	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.081	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.079	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.076	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.173	20%	5%	0.206	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.069	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.068	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.058	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.054	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.054	0.054	10%	48%	0.490	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.050	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.043	2%	50%	0.500	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.050	0.050	10%	39%	0.403	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.036	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.034	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.032	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.025	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.024	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.023	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.018	5%	50%	0.502	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
2.C.1 Iron and Steel Production	CH_4	0.069	0.069	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.015	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.014	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.011	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	0.008	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.007	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	0.055	2%	5%	0.054	0.000	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.009	32%	0%	0.322	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.005	5%	50%	0.502	0.000	0.000	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.003	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.003	20%	50%	0.539	0.000	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.001	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.011	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.001	2%	50%	0.500	0.000	0.000	0.000	100%
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	0.001	0.001	55%	19%	0.583	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
4.C.2 Land converted to Grassland – Mineral soil	CO_2	-0.003	0.003	10%	12%	0.156	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.000	2%	70%	0.700	0.000	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.003	10%	0%	0.100	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.000	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%

A.1.4. Spreadsheet for the Approach 2 analysis for 1990 – level assessment without LULUCF

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1967.300	25%	50%	0.559	0.075	0.042	0.227	23%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	2117.989	2%	20%	0.201	0.081	0.016	0.088	32%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	782.443	2%	50%	0.500	0.030	0.015	0.081	40%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	3078.955	2%	10%	0.102	0.118	0.012	0.065	46%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	1410.785	2%	20%	0.201	0.054	0.011	0.059	52%
3.G. Liming	CO_2	357.133	357.133	5%	50%	0.502	0.014	0.007	0.037	56%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	319.950	2%	50%	0.500	0.012	0.006	0.033	59%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	283.062	7%	52%	0.525	0.011	0.006	0.031	62%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	2657.607	2%	5%	0.054	0.102	0.005	0.030	65%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	605.818	2%	20%	0.201	0.023	0.005	0.025	68%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	1017.269	2%	10%	0.102	0.039	0.004	0.021	70%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid	CO_2	806.130	806.130	2%	11%	0.111	0.031	0.003	0.019	72%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Fuels										
1.A.2.g Other - Liquid Fuels	CO_2	803.741	803.741	2%	10%	0.102	0.031	0.003	0.017	73%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	700.654	2%	11%	0.109	0.027	0.003	0.016	75%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	119.570	25%	50%	0.559	0.005	0.003	0.014	76%
1.B.2.b Natural Gas	CH_4	177.238	177.238	32%	0%	0.322	0.007	0.002	0.012	77%
5.D.1 Domestic Wastewater	CH_4	185.075	185.075	6%	30%	0.306	0.007	0.002	0.012	79%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	102.282	2%	50%	0.500	0.004	0.002	0.011	80%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	1723.750	2%	2%	0.028	0.066	0.002	0.010	81%
5.D.2 Industrial Wastewater	CH_4	137.025	137.025	14%	30%	0.331	0.005	0.002	0.009	82%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	218.053	2%	20%	0.201	0.008	0.002	0.009	83%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	120.666	25%	20%	0.320	0.005	0.001	0.008	83%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	110.967	25%	20%	0.320	0.004	0.001	0.007	84%
2.A.4. Other process uses of carbonates	CO_2	69.185	69.185	8%	50%	0.506	0.003	0.001	0.007	85%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	332.334	2%	10%	0.102	0.013	0.001	0.007	85%
2.A.1. Cement Production	CO_2	345.783	345.783	8%	5%	0.094	0.013	0.001	0.007	86%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	61.201	2%	50%	0.500	0.002	0.001	0.006	87%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	279.473	2%	10%	0.102	0.011	0.001	0.006	87%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	526.803	2%	5%	0.054	0.020	0.001	0.006	88%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	276.247	2%	10%	0.102	0.011	0.001	0.006	89%
5.B.1. Composting	CH_4	23.909	23.909	37%	100%	1.066	0.001	0.001	0.005	89%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	48.030	2%	50%	0.500	0.002	0.001	0.005	90%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	43.267	2%	50%	0.500	0.002	0.001	0.004	90%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	65.378	25%	20%	0.320	0.003	0.001	0.004	90%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	103.071	2%	20%	0.201	0.004	0.001	0.004	91%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	39.135	5%	50%	0.502	0.001	0.001	0.004	91%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	335.687	2%	5%	0.054	0.013	0.001	0.004	92%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	616.136	2%	2%	0.028	0.024	0.001	0.004	92%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	96.425	15%	10%	0.180	0.004	0.001	0.004	92%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	316.064	2%	5%	0.054	0.012	0.001	0.004	93%
5.B.1. Composting	N_2O	17.100	17.100	37%	90%	0.973	0.001	0.001	0.003	93%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	32.920	2%	50%	0.500	0.001	0.001	0.003	93%
1.A.1.a Public Electricity and	CO_2	145.786	145.786	5%	10%	0.112	0.006	0.001	0.003	94%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Heat Production - Peat										
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	531.380	2%	2%	0.028	0.020	0.001	0.003	94%
2.A.2. Lime Production	CO_2	169.024	169.024	8%	2%	0.082	0.006	0.001	0.003	94%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	40.269	25%	20%	0.320	0.002	0.000	0.003	95%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	235.643	2%	5%	0.054	0.009	0.000	0.003	95%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	61.352	2%	20%	0.201	0.002	0.000	0.003	95%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	220.705	2%	5%	0.054	0.008	0.000	0.002	95%
2.D.1 Lubricant Use	CO_2	23.251	23.251	2%	50%	0.500	0.001	0.000	0.002	96%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	52.541	2%	20%	0.201	0.002	0.000	0.002	96%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	94.194	2%	10%	0.102	0.004	0.000	0.002	96%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	175.098	2%	5%	0.054	0.007	0.000	0.002	96%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	18.091	2%	50%	0.500	0.001	0.000	0.002	96%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	22.276	25%	30%	0.391	0.001	0.000	0.002	97%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	75.346	5%	10%	0.112	0.003	0.000	0.002	97%
5.D.1 Domestic Wastewater	N_2O	26.564	26.564	8%	30%	0.310	0.001	0.000	0.002	97%
1.A.2.d. Pulp, Paper and Print -	CO_2	150.166	150.166	2%	5%	0.054	0.006	0.000	0.002	97%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Gaseous Fuels										
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	66.886	5%	11%	0.120	0.003	0.000	0.002	97%
2.C.1 Iron and Steel Production	CO_2	69.692	69.692	5%	10%	0.112	0.003	0.000	0.002	97%
1.B.2.c Venting and Flaring	CH_4	70.344	70.344	10%	0%	0.100	0.003	0.000	0.001	98%
2.D.3. Solvent Use	CO_2	24.434	24.434	25%	10%	0.269	0.001	0.000	0.001	98%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	13.074	2%	50%	0.500	0.001	0.000	0.001	98%
1.A.2.g Other - Solid Fuels	CO_2	27.263	27.263	2%	20%	0.201	0.001	0.000	0.001	98%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	17.155	2%	30%	0.301	0.001	0.000	0.001	98%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	12.485	25%	30%	0.391	0.000	0.000	0.001	98%
1.A.4.b Residential - Peat	CO_2	42.549	42.549	5%	10%	0.112	0.002	0.000	0.001	98%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	9.150	5%	50%	0.502	0.000	0.000	0.001	98%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	8.109	2%	50%	0.500	0.000	0.000	0.001	98%
3.H. Urea Application	CO_2	7.709	7.709	2%	50%	0.500	0.000	0.000	0.001	99%
5.C.1 Waste Incineration	N_2O	3.436	3.436	44%	100%	1.093	0.000	0.000	0.001	99%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	7.163	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	6.666	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.2.f Non-metallic Minerals -	CO_2	16.429	16.429	2%	20%	0.201	0.001	0.000	0.001	99%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Solid Fuels										
2.G.3. N_2O from product uses	N_2O	3.250	3.250	2%	100%	1.000	0.000	0.000	0.001	99%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	6.220	5%	50%	0.502	0.000	0.000	0.001	99%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.944	15%	30%	0.335	0.000	0.000	0.001	99%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	5.594	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	5.286	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	25.015	2%	10%	0.102	0.001	0.000	0.001	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	44.924	2%	5%	0.054	0.002	0.000	0.001	99%
1.A.3.b Road Transportation - LPG	CO_2	37.141	37.141	2%	5%	0.054	0.001	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	3.728	2%	50%	0.500	0.000	0.000	0.000	99%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	4.652	25%	30%	0.391	0.000	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	3.495	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.b Residential - Peat	CH_4	3.188	3.188	5%	50%	0.502	0.000	0.000	0.000	99%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	15.704	2%	10%	0.102	0.001	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	3.023	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	3.005	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	2.863	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	23.542	2%	5%	0.054	0.001	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	2.412	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	2.265	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	2.149	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	17.617	2%	5%	0.054	0.001	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	1.879	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	1.774	2%	50%	0.500	0.000	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	2.341	13%	30%	0.327	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	1.454	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	1.437	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	3.079	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	1.205	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	2.692	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	1.030	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.998	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	0.868	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.789	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	3.463	10%	5%	0.112	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.761	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.745	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.702	2%	50%	0.500	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.575	44%	40%	0.595	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.108	2%	30%	0.301	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.651	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals -	N_2O	0.641	0.641	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Liquid Fuels										
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.628	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.616	5%	50%	0.502	0.000	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.782	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	0.520	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.501	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.483	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.478	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	0.455	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.450	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.356	3%	60%	0.601	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.423	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	0.327	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.318	5%	50%	0.502	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.296	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	0.287	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.285	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.273	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.272	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.273	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.269	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.267	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.239	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.233	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.218	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.186	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.181	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.171	5%	50%	0.502	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.171	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.168	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	0.164	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.143	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.127	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.125	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.124	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.119	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.107	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	0.101	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.095	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.091	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	0.833	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.081	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing,	CH_4	0.079	0.079	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Beverages and Tobacco - Gaseous Fuels										
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.076	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.173	20%	5%	0.206	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.069	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.068	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.058	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.054	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.050	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.043	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.036	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.034	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.032	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.025	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.3.b Road Transportation -	N_2O	0.024	0.024	10%	50%	0.510	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Lubricants										
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.023	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.018	5%	50%	0.502	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.069	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.015	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.014	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.011	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	0.008	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.007	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	ABS base year emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	0.055	2%	5%	0.054	0.000	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.009	32%	0%	0.322	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.005	5%	50%	0.502	0.000	0.000	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.003	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.003	20%	50%	0.539	0.000	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.001	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.011	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.001	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.000	2%	70%	0.700	0.000	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.003	10%	0%	0.100	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.000	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%

A.1.5 Spreadsheet for the Approach 1 analysis for 2015 – level assessment with LULUCF

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-4978.021	4978.021	0.15	15%
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4566.495	4566.495	0.14	29%
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2609.306	2609.306	0.08	36%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	-2247.360	2247.360	0.07	43%
1.A.3.b Road Transportation - Diesel Oil	CO_2	2072.062	2072.062	0.06	49%
4. G. Harvested wood products	CO_2	-1788.020	1788.020	0.05	55%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	1677.790	1677.790	0.05	60%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1480.082	1480.082	0.04	64%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	903.996	903.996	0.03	67%
3.A.1 Enteric Fermentation - Cattle	CH_4	811.783	811.783	0.02	69%
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	688.603	688.603	0.02	71%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	636.303	636.303	0.02	73%
1.A.3.b Road Transportation - Gasoline	CO_2	610.446	610.446	0.02	75%
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	547.674	547.674	0.02	77%
2.A.1. Cement Production	CO_2	466.713	466.713	0.01	78%
4.C.2 Land converted to Grassland –Mineral soil	CO_2	-464.133	464.133	0.01	79%
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-376.289	376.289	0.01	80%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	341.689	341.689	0.01	82%
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	0.01	82%
5.A.1. Managed Waste Disposal on Land	CH_4	268.779	268.779	0.01	83%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	227.588	227.588	0.01	84%
1.A.4.b Residential - Gaseous Fuels	CO_2	224.856	224.856	0.01	84%
2.F.1. Refrigeration and air conditioning	HFCs	217.872	217.872	0.01	85%
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	207.069	207.069	0.01	86%
1.A.3.c Railways - Liquid Fuels	CO_2	204.610	204.610	0.01	86%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	-185.154	185.154	0.01	87%
4.E.2 Land converted to Settlements – Organic soils	CO_2	178.520	178.520	0.01	87%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	177.538	177.538	0.01	88%
1.A.3.b Road Transportation - LPG	CO_2	168.611	168.611	0.01	88%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	165.779	165.779	0.00	89%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	149.606	149.606	0.00	89%
1.A.4.b Residential - Liquid Fuels	CO_2	143.549	143.549	0.00	90%
5.D.2 Industrial Wastewater	CH_4	135.575	135.575	0.00	90%
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	130.610	130.610	0.00	91%
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	119.259	119.259	0.00	91%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	118.691	118.691	0.00	91%
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	117.235	117.235	0.00	92%
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	-115.994	115.994	0.00	92%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	106.159	106.159	0.00	92%
4.E.2 Land converted to Settlements – Mineral soils	CO_2	101.407	101.407	0.00	93%
1.A.4.b Residential - Biomass Fuels	CH_4	99.514	99.514	0.00	93%
5.D.1 Domestic Wastewater	CH_4	99.075	99.075	0.00	93%
1.A.2.g Other - Liquid Fuels	CO_2	96.544	96.544	0.00	94%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	90.532	90.532	0.00	94%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	88.883	88.883	0.00	94%
1.B.2.b Natural Gas	CH_4	86.683	86.683	0.00	94%
1.A.2.g Other - Gaseous Fuels	CO_2	83.911	83.911	0.00	95%
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	79.079	79.079	0.00	95%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-74.180	74.180	0.00	95%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-73.073	73.073	0.00	95%
3.B.1.1 Manure Management - Cattle	CH_4	71.220	71.220	0.00	96%
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	70.245	70.245	0.00	96%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	65.993	65.993	0.00	96%
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	61.995	61.995	0.00	96%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
4.A.2 Land converted to Forest Land – grassland converted to forest land, Drained organic soil	CO_2	59.870	59.870	0.00	96%
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	54.038	54.038	0.00	96%
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-48.372	48.372	0.00	97%
1.A.4.b Residential - Solid Fuels	CO_2	47.395	47.395	0.00	97%
4.B.2 Land converted to Cropland –Mineral soil	CO_2	44.936	44.936	0.00	97%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	44.742	44.742	0.00	97%
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	44.325	44.325	0.00	97%
3.B.2.1 Manure Management - Cattle	N_2O	41.093	41.093	0.00	97%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	37.312	37.312	0.00	97%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	36.077	36.077	0.00	97%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	35.627	35.627	0.00	98%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	34.152	34.152	0.00	98%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	30.556	30.556	0.00	98%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CH_4	28.534	28.534	0.00	98%
5.B.1. Composting	CH_4	25.831	25.831	0.00	98%
1.A.3.c Railways - Liquid Fuels	N_2O	23.566	23.566	0.00	98%
4.E.1 Settlements remaining Settlements – Drained organic soils	CO_2	23.320	23.320	0.00	98%
2.D.3. Solvent Use	CO_2	22.815	22.815	0.00	98%
1.A.3.b Road Transportation - Diesel Oil	N_2O	22.387	22.387	0.00	98%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	22.180	22.180	0.00	98%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	22.068	22.068	0.00	98%
3.B.1.3 Manure Management - Swaine	CH_4	22.007	22.007	0.00	98%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	20.992	20.992	0.00	98%
3.A.2 Enteric Fermentation - Sheep	CH_4	20.460	20.460	0.00	99%
3.G. Liming	CO_2	19.938	19.938	0.00	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	19.061	19.061	0.00	99%
5.D.1 Domestic Wastewater	N_2O	18.913	18.913	0.00	99%
5.B.1. Composting	N_2O	18.474	18.474	0.00	99%
1.A.2.e Food Processing, Beverages and	CO_2	18.203	18.203	0.00	99%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Tobacco - Liquid Fuels					
1.A.2.c Chemicals - Gaseous Fuels	CO_2	18.028	18.028	0.00	99%
1.A.2.g Other - Biomass Fuels	N_2O	17.962	17.962	0.00	99%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-16.324	16.324	0.00	99%
1.B.2.c Venting and Flaring	CH_4	16.117	16.117	0.00	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	14.711	14.711	0.00	99%
2.D.1 Lubricant Use	CO_2	13.722	13.722	0.00	99%
3.A.4 Enteric Fermentation - Other livestock	CH_4	13.455	13.455	0.00	99%
3.A.3 Enteric Fermentation - Swine	CH_4	12.533	12.533	0.00	99%
1.A.2.g Other - Biomass Fuels	CH_4	11.302	11.302	0.00	99%
3.B.2.4 Manure Management - Other livestock	N_2O	11.077	11.077	0.00	99%
2.G.1. Electrical equipment	SF6	10.118	10.118	0.00	99%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	9.933	9.933	0.00	99%
1.A.5.b Mobile - Liquid Fuels	CO_2	9.568	9.568	0.00	99%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	9.546	9.546	0.00	99%
1.A.2.c Chemicals - Liquid Fuels	CO_2	9.395	9.395	0.00	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	9.270	9.270	0.00	99%
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-9.207	9.207	0.00	99%
1.A.4.b Residential - Biomass Fuels	N_2O	8.556	8.556	0.00	99%
2.A.4. Other process uses of carbonates	CO_2	7.640	7.640	0.00	99%
4.B.2 Settlements converted to cropland, mineral soils	CO_2	7.435	7.435	0.00	100%
3.B.1.4 Manure Management - Other livestock	CH_4	7.429	7.429	0.00	100%
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	6.911	6.911	0.00	100%
4.A.1 Forest land remaining forest land - wildfires	CH_4	6.246	6.246	0.00	100%
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.229	6.229	0.00	100%
3.H. Urea Application	CO_2	6.210	6.210	0.00	100%
3.B.2.3 Manure Management - Swaine	N_2O	5.898	5.898	0.00	100%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	5.437	5.437	0.00	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	5.190	5.190	0.00	100%
1.A.3.b Road Transportation - Lubricants	CO_2	5.062	5.062	0.00	100%
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.943	4.943	0.00	100%
2.D.2 Paraffin wax use	CO_2	4.912	4.912	0.00	100%
4.E.2 Settlements remaining Settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization	N_2O	4.901	4.901	0.00	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils					
2.F.4. Aerosols	HFCs	4.803	4.803	0.00	100%
4.B.2 Wetlands converted to cropland, organic soil	CO_2	4.461	4.461	0.00	100%
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	4.459	4.459	0.00	100%
2.F.2 Foam blowing agents	HFCs	4.380	4.380	0.00	100%
1.A.3.b Road Transportation - Gasoline	N_2O	4.326	4.326	0.00	100%
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	0.00	100%
1.A.4.b Residential - Solid Fuels	CH_4	3.758	3.758	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	3.698	3.698	0.00	100%
2.G.3. N_2O from product uses	N_2O	3.572	3.572	0.00	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	3.278	3.278	0.00	100%
1.A.2.g Other - Solid Fuels	CO_2	3.027	3.027	0.00	100%
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	2.973	2.973	0.00	100%
3.B.2.2 Manure Management - Sheep	N_2O	2.804	2.804	0.00	100%
1.A.3.b Road Transportation - LPG	N_2O	2.763	2.763	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	2.270	2.270	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CO_2	2.126	2.126	0.00	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	2.115	2.115	0.00	100%
1.A.3.b Road Transportation - Gasoline	CH_4	2.114	2.114	0.00	100%
5.C.1 Waste Incineration	N_2O	1.811	1.811	0.00	100%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	N_2O	1.453	1.453	0.00	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	1.351	1.351	0.00	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	1.311	1.311	0.00	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.283	1.283	0.00	100%
1.A.2.g Other - Peat	CO_2	1.157	1.157	0.00	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	1.153	1.153	0.00	100%
1.A.4.b Residential - Liquid Fuels	CH_4	1.105	1.105	0.00	100%
2.C.1 Iron and Steel Production	CO_2	1.036	1.036	0.00	100%
2.D.3.d Urea Use	CO_2	0.981	0.981	0.00	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	0.915	0.915	0.00	100%
1.A.2.f Non-metallic Minerals - Other Fossil	CH_4	0.914	0.914	0.00	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Fuels					
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.850	0.850	0.00	100%
1.A.3.b Road Transportation - LPG	CH_4	0.839	0.839	0.00	100%
4.A.1 Forest land remaining forest land - Controlled burning	N_2O	0.810	0.810	0.00	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	0.768	0.768	0.00	100%
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.732	0.732	0.00	100%
2.A.2. Lime Production	CO_2	0.721	0.721	0.00	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	0.680	0.680	0.00	100%
2.A.4.b Other Use of soda ash	CO_2	0.673	0.673	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	0.662	0.662	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	0.606	0.606	0.00	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – dead organic matter	CO_2	-0.578	0.578	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	0.561	0.561	0.00	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.521	0.521	0.00	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.515	0.515	0.00	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.486	0.486	0.00	100%
2.A.3. Glass production	CO_2	0.457	0.457	0.00	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.446	0.446	0.00	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.428	0.428	0.00	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.420	0.420	0.00	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	0.400	0.400	0.00	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	0.393	0.393	0.00	100%
1.A.3.b Road Transportation - Biomass	N_2O	0.367	0.367	0.00	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.318	0.318	0.00	100%
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.317	0.317	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.309	0.309	0.00	100%
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.291	0.291	0.00	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.287	0.287	0.00	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4	0.281	0.281	0.00	100%
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.266	0.266	0.00	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.239	0.239	0.00	100%
1.A.2.g Other - Liquid Fuels	N_2O	0.232	0.232	0.00	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
1.A.4.b Residential - Solid Fuels	N_2O	0.224	0.224	0.00	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.208	0.208	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.195	0.195	0.00	100%
5.C.1 Waste Incineration	CO_2	0.180	0.180	0.00	100%
1.A.2.g Other - Liquid Fuels	CH_4	0.173	0.173	0.00	100%
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.168	0.168	0.00	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	0.144	0.144	0.00	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.124	0.124	0.00	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.123	0.123	0.00	100%
5.D.2 Industrial Wastewater	N_2O	0.110	0.110	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	0.102	0.102	0.00	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2	0.095	0.095	0.00	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	0.081	0.081	0.00	100%
1.A.5.b Mobile - Liquid Fuels	N_2O	0.077	0.077	0.00	100%
2.D.3.b Road paving with asphalt	CO_2	0.062	0.062	0.00	100%
2.D.3.c Asphalt roofing	CO_2	0.056	0.056	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	0.053	0.053	0.00	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.050	0.050	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.048	0.048	0.00	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	0.047	0.047	0.00	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.046	0.046	0.00	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.046	0.046	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.041	0.041	0.00	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.038	0.038	0.00	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.037	0.037	0.00	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.036	0.036	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	N_2O	0.035	0.035	0.00	100%
1.A.3.c. Railway Biomass Fuels	N_2O	0.031	0.031	0.00	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.030	0.030	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	0.026	0.026	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.024	0.024	0.00	100%
1.A.3.b Road Transportation - Biomass	CH_4	0.024	0.024	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CH_4	0.022	0.022	0.00	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.021	0.021	0.00	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.020	0.020	0.00	100%
1.A.5.b Mobile - Liquid Fuels	CH_4	0.020	0.020	0.00	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.019	0.019	0.00	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.017	0.017	0.00	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.017	0.017	0.00	100%
1.A.2.g Other - Solid Fuels	N_2O	0.014	0.014	0.00	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.013	0.013	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.013	0.013	0.00	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.013	0.013	0.00	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.012	0.012	0.00	100%
1.B.2.b Natural Gas	CO_2	0.011	0.011	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.011	0.011	0.00	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.010	0.010	0.00	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.010	0.010	0.00	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.008	0.008	0.00	100%
1.A.2.g Other - Solid Fuels	CH_4	0.008	0.008	0.00	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.006	0.006	0.00	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.006	0.006	0.00	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.006	0.006	0.00	100%
1.A.2.g Other - Peat	N_2O	0.005	0.005	0.00	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	0.005	0.005	0.00	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.004	0.004	0.00	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.004	0.004	0.00	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.004	0.004	0.00	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.004	0.004	0.00	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.003	0.003	0.00	100%
2.F.3. Fire Protection	HFCs	0.003	0.003	0.00	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.003	0.003	0.00	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.003	0.003	0.00	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.002	0.002	0.00	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	0.002	0.002	0.00	100%
1.A.3.c. Railway Biomass Fuels	CH_4	0.002	0.002	0.00	100%
1.B.2.c Venting and Flaring	CO_2	0.002	0.002	0.00	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	N_2O	0.002	0.002	0.00	100%
2.C.1 Iron and Steel Production	CH_4	0.002	0.002	0.00	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4	0.002	0.002	0.00	100%
1.A.2.g Other - Peat	CH_4	0.001	0.001	0.00	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.000	0.000	0.00	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	N_2O	0.000	0.000	0.00	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	0.00	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4	0.000	0.000	0.00	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.000	0.000	0.00	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	0.00	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	0.00	100%

A.1.6 Spreadsheet for the Approach 1 analysis for 2015 – level assessment without LULUCF

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
1.A.3.b Road Transportation - Diesel Oil	CO_2	2072.062	2072.062	0.183	18%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	1677.790	1677.790	0.148	33%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1480.082	1480.082	0.131	46%
3.A.1 Enteric Fermentation - Cattle	CH_4	811.783	811.783	0.072	53%
1.A.3.b Road Transportation - Gasoline	CO_2	610.446	610.446	0.054	59%
2.A.1. Cement Production	CO_2	466.713	466.713	0.041	63%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	341.689	341.689	0.030	66%
5.A.1. Managed Waste Disposal on Land	CH_4	268.779	268.779	0.024	68%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	227.588	227.588	0.020	70%
1.A.4.b Residential - Gaseous Fuels	CO_2	224.856	224.856	0.020	72%
2.F.1. Refrigeration and air conditioning	HFCs	217.872	217.872	0.019	74%
1.A.3.c Railways - Liquid Fuels	CO_2	204.610	204.610	0.018	76%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	177.538	177.538	0.016	78%
1.A.3.b Road Transportation - LPG	CO_2	168.611	168.611	0.015	79%
1.A.4.a Commercial/Institutional -	CO_2	165.779	165.779	0.015	81%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Liquid Fuels					
1.A.4.b Residential - Liquid Fuels	CO_2	143.549	143.549	0.013	82%
5.D.2 Industrial Wastewater	CH_4	135.575	135.575	0.012	83%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	118.691	118.691	0.011	84%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	106.159	106.159	0.009	85%
1.A.4.b Residential - Biomass Fuels	CH_4	99.514	99.514	0.009	86%
5.D.1 Domestic Wastewater	CH_4	99.075	99.075	0.009	87%
1.A.2.g Other - Liquid Fuels	CO_2	96.544	96.544	0.009	88%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	90.532	90.532	0.008	89%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	88.883	88.883	0.008	89%
1.B.2.b Natural Gas	CH_4	86.683	86.683	0.008	90%
1.A.2.g Other - Gaseous Fuels	CO_2	83.911	83.911	0.007	91%
3.B.1.1 Manure Management - Cattle	CH_4	71.220	71.220	0.006	91%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	65.993	65.993	0.006	92%
1.A.4.b Residential - Solid Fuels	CO_2	47.395	47.395	0.004	92%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	44.742	44.742	0.004	93%
3.B.2.1 Manure Management - Cattle	N_2O	41.093	41.093	0.004	93%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	37.312	37.312	0.003	94%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	36.077	36.077	0.003	94%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	35.627	35.627	0.003	94%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	34.152	34.152	0.003	94%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	30.556	30.556	0.003	95%
5.B.1. Composting	CH_4	25.831	25.831	0.002	95%
1.A.3.c Railways - Liquid Fuels	N_2O	23.566	23.566	0.002	95%
2.D.3. Solvent Use	CO_2	22.815	22.815	0.002	95%
1.A.3.b Road Transportation - Diesel Oil	N_2O	22.387	22.387	0.002	96%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	22.180	22.180	0.002	96%
3.B.1.3 Manure Management - Swaine	CH_4	22.007	22.007	0.002	96%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	20.992	20.992	0.002	96%
3.A.2 Enteric Fermentation - Sheep	CH_4	20.460	20.460	0.002	96%
3.G. Liming	CO_2	19.938	19.938	0.002	97%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	19.061	19.061	0.002	97%
5.D.1 Domestic Wastewater	N_2O	18.913	18.913	0.002	97%
5.B.1. Composting	N_2O	18.474	18.474	0.002	97%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	18.203	18.203	0.002	97%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	18.028	18.028	0.002	97%
1.A.2.g Other - Biomass Fuels	N_2O	17.962	17.962	0.002	98%
1.B.2.c Venting and Flaring	CH_4	16.117	16.117	0.001	98%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	14.711	14.711	0.001	98%
2.D.1 Lubricant Use	CO_2	13.722	13.722	0.001	98%
3.A.4 Enteric Fermentation - Other livestock	CH_4	13.455	13.455	0.001	98%
3.A.3 Enteric Fermentation - Swine	CH_4	12.533	12.533	0.001	98%
1.A.2.g Other - Biomass Fuels	CH_4	11.302	11.302	0.001	98%
3.B.2.4 Manure Management - Other livestock	N_2O	11.077	11.077	0.001	98%
2.G.1. Electrical equipment	SF6	10.118	10.118	0.001	98%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	9.933	9.933	0.001	99%
1.A.5.b Mobile - Liquid Fuels	CO_2	9.568	9.568	0.001	99%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	9.546	9.546	0.001	99%
1.A.2.c Chemicals - Liquid Fuels	CO_2	9.395	9.395	0.001	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	9.270	9.270	0.001	99%
1.A.4.b Residential - Biomass Fuels	N_2O	8.556	8.556	0.001	99%
2.A.4. Other process uses of carbonates	CO_2	7.640	7.640	0.001	99%
3.B.1.4 Manure Management - Other livestock	CH_4	7.429	7.429	0.001	99%
3.H. Urea Application	CO_2	6.210	6.210	0.001	99%
3.B.2.3 Manure Management - Swaine	N_2O	5.898	5.898	0.001	99%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	5.437	5.437	0.000	99%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	5.190	5.190	0.000	99%
1.A.3.b Road Transportation - Lubricants	CO_2	5.062	5.062	0.000	99%
2.D.2 Paraffin wax use	CO_2	4.912	4.912	0.000	99%
2.F.4. Aerosols	HFCs	4.803	4.803	0.000	99%
2.F.2 Foam blowing agents	HFCs	4.380	4.380	0.000	99%
1.A.3.b Road Transportation - Gasoline	N_2O	4.326	4.326	0.000	99%
1.A.4.b Residential - Solid Fuels	CH_4	3.758	3.758	0.000	99%
1.A.4.c	CH_4	3.698	3.698	0.000	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Agriculture/Forestry/Fisheries - Biomass Fuels					
2.G.3. N_2O from product uses	N_2O	3.572	3.572	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	3.278	3.278	0.000	100%
1.A.2.g Other - Solid Fuels	CO_2	3.027	3.027	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	2.804	2.804	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	2.763	2.763	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	2.270	2.270	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CO_2	2.126	2.126	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	2.115	2.115	0.000	100%
1.A.3.b Road Transportation - Gasoline	CH_4	2.114	2.114	0.000	100%
5.C.1 Waste Incineration	N_2O	1.811	1.811	0.000	100%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	N_2O	1.453	1.453	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	1.351	1.351	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	1.311	1.311	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.283	1.283	0.000	100%
1.A.2.g Other - Peat	CO_2	1.157	1.157	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	1.153	1.153	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	1.105	1.105	0.000	100%
2.C.1 Iron and Steel Production	CO_2	1.036	1.036	0.000	100%
2.D.3.d Urea Use	CO_2	0.981	0.981	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	0.915	0.915	0.000	100%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CH_4	0.914	0.914	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.850	0.850	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.839	0.839	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	0.768	0.768	0.000	100%
2.A.2. Lime Production	CO_2	0.721	0.721	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	0.680	0.680	0.000	100%
2.A.4.b Other Use of soda ash	CO_2	0.673	0.673	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	0.662	0.662	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	0.606	0.606	0.000	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	0.561	0.561	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.521	0.521	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.515	0.515	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.486	0.486	0.000	100%
2.A.3. Glass production	CO_2	0.457	0.457	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.446	0.446	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.428	0.428	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.420	0.420	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	0.400	0.400	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	0.393	0.393	0.000	100%
1.A.3.b Road Transportation - Biomass	N_2O	0.367	0.367	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.318	0.318	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.309	0.309	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.287	0.287	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4	0.281	0.281	0.000	100%
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.266	0.266	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.239	0.239	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	0.232	0.232	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	0.224	0.224	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.208	0.208	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.195	0.195	0.000	100%
5.C.1 Waste Incineration	CO_2	0.180	0.180	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	0.173	0.173	0.000	100%
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.168	0.168	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	0.144	0.144	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.124	0.124	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.123	0.123	0.000	100%
5.D.2 Industrial Wastewater	N_2O	0.110	0.110	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	0.102	0.102	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid	CO_2	0.095	0.095	0.000	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Fuels					
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	0.081	0.081	0.000	100%
1.A.5.b Mobile - Liquid Fuels	N_2O	0.077	0.077	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.062	0.062	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.056	0.056	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	0.053	0.053	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.050	0.050	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.048	0.048	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	0.047	0.047	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.046	0.046	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.046	0.046	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.041	0.041	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.038	0.038	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.037	0.037	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.036	0.036	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	N_2O	0.035	0.035	0.000	100%
1.A.3.c. Railway Biomass Fuels	N_2O	0.031	0.031	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.030	0.030	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	0.026	0.026	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.024	0.024	0.000	100%
1.A.3.b Road Transportation - Biomass	CH_4	0.024	0.024	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CH_4	0.022	0.022	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.021	0.021	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.020	0.020	0.000	100%
1.A.5.b Mobile - Liquid Fuels	CH_4	0.020	0.020	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.019	0.019	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries -	CH_4	0.017	0.017	0.000	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Gaseous Fuels					
1.A.3.b Road Transportation - Lubricants	CH_4	0.017	0.017	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.014	0.014	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.013	0.013	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.013	0.013	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.013	0.013	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.012	0.012	0.000	100%
1.B.2.b Natural Gas	CO_2	0.011	0.011	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.011	0.011	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.010	0.010	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.010	0.010	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.008	0.008	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.008	0.008	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.006	0.006	0.000	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.006	0.006	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.006	0.006	0.000	100%
1.A.2.g Other - Peat	N_2O	0.005	0.005	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	0.005	0.005	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.004	0.004	0.000	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.004	0.004	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.004	0.004	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.004	0.004	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.003	0.003	0.000	100%
2.F.3. Fire Protection	HFCs	0.003	0.003	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.003	0.003	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.003	0.003	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.002	0.002	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	0.002	0.002	0.000	100%
1.A.3.c. Railway Biomass Fuels	CH_4	0.002	0.002	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.002	0.002	0.000	100%
1.A.2.b Non-Ferrous Metals -	N_2O	0.002	0.002	0.000	100%

IPCC category/Group	Gas	Year 2015 emissions or removals	Absolute value of 2015 emissions	Level assessment	Cumulative total of Level assessment
Gaseous Fuels					
2.C.1 Iron and Steel Production	CH_4	0.002	0.002	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4	0.002	0.002	0.000	100%
1.A.2.g Other - Peat	CH_4	0.001	0.001	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	N_2O	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	0.000	100%

A.1.7 Spreadsheet for the Approach 2 analysis for 2015 – level assessment with LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	118.735	547.674	547.674	20%	334%	3.349	0.016	0.055	0.161	16%
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4125.549	4566.495	4566.495	5%	25%	0.256	0.136	0.035	0.102	26%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	-66.910	-185.154	185.154	6%	448%	4.475	0.006	0.025	0.073	34%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	1480.082	25%	50%	0.559	0.044	0.025	0.073	41%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	567.422	636.303	636.303	44%	119%	1.269	0.019	0.024	0.071	48%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	77.978	-2247.360	2247.360	2%	31%	0.310	0.067	0.021	0.061	54%
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2761.365	2609.306	2609.306	13%	18%	0.227	0.078	0.018	0.052	59%
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	-49.115	-115.994	115.994	9%	420%	4.197	0.003	0.015	0.043	64%
4. G. Harvested wood products	CO_2	-149.836	-1788.020	1788.020	15%	0%	0.150	0.053	0.008	0.024	66%
4.C.1 Grassland remaining	CO_2	924.833	688.603	688.603	26%	19%	0.319	0.021	0.007	0.019	68%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Grassland – Drained organic soil											
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	1016.928	903.996	903.996	24%		0.242	0.027	0.007	0.019	70%
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-0.162	-376.289	376.289	8%	52%	0.529	0.011	0.006	0.017	71%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-19460.504	-4978.021	4978.021	2%	3%	0.035	0.149	0.005	0.015	73%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	56.126	149.606	149.606	44%	105%	1.137	0.004	0.005	0.015	74%
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	277.200	24%	55%	0.604	0.008	0.005	0.015	76%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	811.783	2%	20%	0.201	0.024	0.005	0.014	77%
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	125.098	119.259	119.259	115%	71%	1.349	0.004	0.005	0.014	79%
2.F.1. Refrigeration and air conditioning	HFCs	0.000	217.872	217.872	50%	50%	0.707	0.007	0.005	0.014	80%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
5.A.1. Managed Waste Disposal on Land	CH_4	0.000	268.779	268.779	7%	52%	0.525	0.008	0.004	0.012	81%
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	382.478	117.235	117.235	53%	60%	0.803	0.004	0.003	0.008	82%
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	12.456	79.079	79.079	114%	18%	1.153	0.002	0.003	0.008	83%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	1677.790	2%	5%	0.054	0.050	0.003	0.008	84%
4.E.2 Land converted to Settlements – Organic soils	CO_2	3.766	178.520	178.520	47%	18%	0.505	0.005	0.003	0.008	85%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	177.538	2%	50%	0.500	0.005	0.003	0.008	85%
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.911	54.038	54.038	20%	151%	1.520	0.002	0.002	0.007	86%
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	0.001	130.610	130.610	55%	19%	0.583	0.004	0.002	0.007	87%
4.E.2 Land converted to Settlements – Carbon stock	CO_2	44.403	207.069	207.069	20%	31%	0.363	0.006	0.002	0.007	87%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
change – dead organic matter											
4.C.2 Land converted to Grassland –Mineral soil	CO_2	-0.003	-464.133	464.133	10%	12%	0.156	0.014	0.002	0.006	88%
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	218.068	70.245	70.245	93%	6%	0.928	0.002	0.002	0.006	89%
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-6.274	-9.207	9.207	3%	701%	7.007	0.000	0.002	0.006	89%
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	69.988	61.995	61.995	61%	82%	1.017	0.002	0.002	0.006	90%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	118.691	7%	52%	0.525	0.004	0.002	0.005	90%
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-19.648	-48.372	48.372	5%	122%	1.222	0.001	0.002	0.005	91%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2072.062	2%	2%	0.028	0.062	0.002	0.005	91%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	0.000	22.068	22.068	2%	242%	2.420	0.001	0.002	0.005	92%
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	135.575	14%	30%	0.331	0.004	0.001	0.004	92%
2.A.1. Cement Production	CO_2	345.783	466.713	466.713	8%	5%	0.094	0.014	0.001	0.004	93%
1.A.4.c	CO_2	700.654	341.689	341.689	2%	11%	0.109	0.010	0.001	0.003	93%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Agriculture/Forestry/Fisheries - Liquid Fuels											
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	99.075	6%	30%	0.306	0.003	0.001	0.003	93%
4.A.2 Land converted to Forest Land – grassland converted to forest land, Drained organic soil	CO_2	0.000	59.870	59.870	44%	25%	0.502	0.002	0.001	0.003	93%
4.B.2 Land converted to Cropland –Mineral soil	CO_2	6.935	44.936	44.936	64%	15%	0.662	0.001	0.001	0.003	94%
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	143.035	44.325	44.325	53%	39%	0.659	0.001	0.001	0.003	94%
1.B.2.b Natural Gas	CH_4	177.238	86.683	86.683	32%	0%	0.322	0.003	0.001	0.002	94%
5.B.1. Composting	CH_4	23.909	25.831	25.831	37%	100%	1.066	0.001	0.001	0.002	94%
4.E.2 Land converted to Settlements – Mineral soils	CO_2	1.400	101.407	101.407	22%	16%	0.270	0.003	0.001	0.002	95%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CH_4	28.534	28.534	28.534	24%	81%	0.842	0.001	0.001	0.002	95%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-1.403	-74.180	74.180	8%	31%	0.320	0.002	0.001	0.002	95%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	71.220	25%	20%	0.320	0.002	0.001	0.002	95%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	44.742	2%	50%	0.500	0.001	0.001	0.002	95%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	35.627	25%	50%	0.559	0.001	0.001	0.002	96%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	90.532	2%	20%	0.201	0.003	0.001	0.002	96%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	36.077	2%	50%	0.500	0.001	0.001	0.002	96%
5.B.1. Composting	N_2O	17.100	18.474	18.474	37%	90%	0.973	0.001	0.001	0.002	96%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	99.514	15%	10%	0.180	0.003	0.001	0.002	96%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-1.382	-73.073	73.073	8%	23%	0.244	0.002	0.001	0.002	96%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	610.446	2%	2%	0.028	0.018	0.001	0.002	97%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	34.152	5%	50%	0.502	0.001	0.001	0.002	97%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	165.779	2%	10%	0.102	0.005	0.001	0.001	97%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	143.549	2%	10%	0.102	0.004	0.000	0.001	97%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	41.093	25%	20%	0.320	0.001	0.000	0.001	97%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	227.588	2%	5%	0.054	0.007	0.000	0.001	97%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	224.856	2%	5%	0.054	0.007	0.000	0.001	97%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	23.566	2%	50%	0.500	0.001	0.000	0.001	97%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	22.387	2%	50%	0.500	0.001	0.000	0.001	98%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	20.460	2%	50%	0.500	0.001	0.000	0.001	98%
3.G. Liming	CO_2	357.133	19.938	19.938	5%	50%	0.502	0.001	0.000	0.001	98%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	96.544	2%	10%	0.102	0.003	0.000	0.001	98%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	47.395	2%	20%	0.201	0.001	0.000	0.001	98%
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	168.611	2%	5%	0.054	0.005	0.000	0.001	98%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	17.962	5%	50%	0.502	0.001	0.000	0.001	98%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	14.711	5%	50%	0.502	0.000	0.000	0.001	98%
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.590	4.459	4.459	64%	151%	1.639	0.000	0.000	0.001	98%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	22.007	25%	20%	0.320	0.001	0.000	0.001	98%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
2.D.1 Lubricant Use	CO_2	23.251	13.722	13.722	2%	50%	0.500	0.000	0.000	0.001	98%
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	21.455	6.911	6.911	93%	36%	0.994	0.000	0.000	0.001	98%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	13.455	2%	50%	0.500	0.000	0.000	0.001	98%
4.B.2 Settlements converted to cropland, mineral soils	CO_2	0.000	7.435	7.435	64%	60%	0.881	0.000	0.000	0.001	98%
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	0.160	2.973	2.973	42%	212%	2.157	0.000	0.000	0.001	99%
2.D.3. Solvent Use	CO_2	24.434	22.815	22.815	25%	10%	0.269	0.001	0.000	0.001	99%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	30.556	2%	20%	0.201	0.001	0.000	0.001	99%
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	18.913	8%	30%	0.310	0.001	0.000	0.001	99%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	204.610	2%	2%	0.028	0.006	0.000	0.001	99%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	11.302	5%	50%	0.502	0.000	0.000	0.000	99%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-14.143	-16.324	16.324	6%	31%	0.316	0.000	0.000	0.000	99%
4.B.2 Wetlands converted to cropland, organic soil	CO_2	0.000	4.461	4.461	114%	18%	1.153	0.000	0.000	0.000	99%
2.D.2 Paraffin wax use	CO_2	0.000	4.912	4.912	2%	100%	1.000	0.000	0.000	0.000	99%
1.A.5.b Mobile - Liquid Fuels	CO_2	0.000	9.568	9.568	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.2.e Food Processing, Beverages and Tobacco -	CO_2	175.098	88.883	88.883	2%	5%	0.054	0.003	0.000	0.000	99%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Gaseous Fuels											
4.E.1 Settlements remaining Settlements – Drained organic soils	CO_2	0.000	23.320	23.320	9%	18%	0.203	0.001	0.000	0.000	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	9.270	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	83.911	2%	5%	0.054	0.003	0.000	0.000	99%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	11.077	25%	30%	0.391	0.000	0.000	0.000	99%
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	3.793	24%	107%	1.099	0.000	0.000	0.000	99%
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	7.640	8%	50%	0.506	0.000	0.000	0.000	99%
2.G.3. N_2O from product uses	N_2O	3.250	3.572	3.572	2%	100%	1.000	0.000	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	65.993	2%	5%	0.054	0.002	0.000	0.000	99%
2.F.4. Aerosols	HFCs	0.000	4.803	4.803	50%	50%	0.707	0.000	0.000	0.000	99%
4.A.1 Forest land remaining forest land - wildfires	CH_4	2.544	6.246	6.246	37%	36%	0.516	0.000	0.000	0.000	99%
3.H. Urea Application	CO_2	7.709	6.210	6.210	2%	50%	0.500	0.000	0.000	0.000	99%
2.F.2 Foam blowing agents	HFCs	0.000	4.380	4.380	50%	50%	0.707	0.000	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	0.000	106.159	106.159	2%	2%	0.028	0.003	0.000	0.000	99%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	7.429	25%	30%	0.391	0.000	0.000	0.000	99%
1.A.4.b Residential - Biomass	N_2O	8.944	8.556	8.556	15%	30%	0.335	0.000	0.000	0.000	99%

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Fuels											
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5.437	5%	50%	0.502	0.000	0.000	0.000	100%
2.G.1. Electrical equipment	SF6	0.000	10.118	10.118	2%	25%	0.251	0.000	0.000	0.000	100%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	12.533	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	4.326	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	20.992	2%	10%	0.102	0.001	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	18.203	2%	11%	0.111	0.001	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	37.312	2%	5%	0.054	0.001	0.000	0.000	100%
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.589	-6.229	6.229	9%	31%	0.322	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	9.933	2%	20%	0.201	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	1.811	1.811	44%	100%	1.093	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	19.061	2%	10%	0.102	0.001	0.000	0.000	100%
4.E.2 Settlements remaining Settlements, Direct nitrous oxide (N_2O) emissions from	N_2O		4.901	4.901	9%	38%	0.387	0.000	0.000	0.000	100%

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nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils											
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	5.898	25%	20%	0.320	0.000	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	3.758	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	3.698	5%	50%	0.502	0.000	0.000	0.000	100%
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	16.117	10%	0%	0.100	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.389	-4.943	4.943	5%	31%	0.314	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2.763	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	22.180	2%	5%	0.054	0.001	0.000	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	2.804	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	18.028	2%	5%	0.054	0.001	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	9.395	2%	10%	0.102	0.000	0.000	0.000	100%
4.A.1 Forest land remaining forest land - Controlled	N_2O	2.516	0.810	0.810	93%		0.926	0.000	0.000	0.000	100%

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burning											
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	N_2O	0.000	1.453	1.453	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	1.351	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2.114	2%	30%	0.301	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	3.027	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	1.153	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	5.062	10%	5%	0.112	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	1.105	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	9.546	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	0.915	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CH_4	0.000	0.914	0.914	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2.270	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CO_2	0.000	2.126	2.126	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	0.850	5%	50%	0.502	0.000	0.000	0.000	100%

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1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	0.839	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	1.283	2%	30%	0.301	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	0.768	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.4.b Other Use of soda ash	CO_2	0.000	0.673	0.673	8%	50%	0.506	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	0.680	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	0.662	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	0.606	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	0.561	0.561	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	5.190	2%	5%	0.054	0.000	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.457	0.457	3%	60%	0.601	0.000	0.000	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.298	0.732	0.732	37%		0.370	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	0.521	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous	CH_4	0.501	0.515	0.515	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Fuels											
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.000	0.446	0.446	5%	50%	0.502	0.000	0.000	0.000	100%
2.D.3.d Urea Use	CO_2	0.000	0.981	0.981	20%	10%	0.224	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2.115	2%	10%	0.102	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	0.428	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	0.393	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	0.486	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Biomass	N_2O	0.000	0.367	0.367	2%	50%	0.500	0.000	0.000	0.000	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – dead organic matter	CO_2	-1.402	-0.578	0.578	3%	31%	0.311	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	0.000	3.278	3.278	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	0.318	2%	50%	0.500	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.054	0.317	0.317	10%	48%	0.490	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	0.309	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.c Railways - Liquid	CH_4	0.745	0.287	0.287	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Fuels											
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4	0.000	0.281	0.281	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.000	0.266	0.266	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Peat	CO_2	0.000	1.157	1.157	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	0.239	2%	50%	0.500	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.050	0.291	0.291	10%	39%	0.403	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	0.232	2%	50%	0.500	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	1.036	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	0.224	2%	50%	0.500	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.180	0.180	44%	40%	0.595	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	0.195	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	0.173	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.000	0.168	0.168	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	0.144	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	1.311	2%	5%	0.054	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	0.124	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	0.123	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.2. Lime Production	CO_2	169.024	0.721	0.721	8%	2%	0.082	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	0.102	0.102	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	0.208	20%	5%	0.206	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	0.400	2%	10%	0.102	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	0.081	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.5.b Mobile - Liquid Fuels	N_2O	0.000	0.077	0.077	2%	50%	0.500	0.000	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	0.110	13%	30%	0.327	0.000	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	0.062	20%	50%	0.539	0.000	0.000	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	0.056	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	0.053	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	0.050	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	0.048	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	0.047	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	0.420	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	0.041	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	0.038	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2	0.000	0.095	0.095	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	0.037	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	0.036	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	N_2O	0.000	0.035	0.035	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.c. Railway Biomass Fuels	N_2O	0.000	0.031	0.031	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	0.030	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	0.026	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c	N_2O	0.423	0.024	0.024	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Agriculture/Forestry/Fisheries - Gaseous Fuels											
1.A.3.b Road Transportation - Biomass	CH_4	0.000	0.024	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CH_4	0.000	0.022	0.022	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	0.021	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.5.b Mobile - Liquid Fuels	CH_4	0.000	0.020	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	0.019	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	0.013	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	0.017	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	0.017	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	0.014	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	0.012	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	0.011	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.011	0.011	32%	0%	0.322	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.000	0.006	0.006	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	0.004	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.2.g Other - Peat	N_2O	0.000	0.005	0.005	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	0.005	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	0.004	2%	50%	0.500	0.000	0.000	0.000	100%
2.F.3. Fire Protection	HFCs	0.000	0.003	0.003	50%	50%	0.707	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	0.004	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.000	0.004	0.004	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.c. Railway Biomass Fuels	CH_4	0.000	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	N_2O	0.000	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4	0.000	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Peat	CH_4	0.000	0.001	0.001	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	N_2O	0.000	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	0.002	10%	0%	0.100	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	0.002	5%	10%	0.112	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4	0.000	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%

A.1.8 Spreadsheet for the Approach 2 analysis for 2015 – level assessment without LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	1480.082	25%	50%	0.559	0.131	0.073	0.362	36%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	811.783	2%	20%	0.201	0.072	0.014	0.071	43%
2.F.1. Refrigeration and air conditioning	HFCs	0.000	217.872	217.872	50%	50%	0.707	0.019	0.014	0.067	50%
5.A.1. Managed Waste Disposal on Land	CH_4	0.000	268.779	268.779	7%	52%	0.525	0.024	0.012	0.062	56%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	1677.790	2%	5%	0.054	0.148	0.008	0.040	60%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	177.538	2%	50%	0.500	0.016	0.008	0.039	64%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	118.691	7%	52%	0.525	0.011	0.006	0.027	67%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2072.062	2%	2%	0.028	0.183	0.005	0.026	69%
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	135.575	14%	30%	0.331	0.012	0.004	0.020	71%
2.A.1. Cement Production	CO_2	345.783	466.713	466.713	8%	5%	0.094	0.041	0.004	0.019	73%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	341.689	341.689	2%	11%	0.109	0.030	0.003	0.016	75%
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	99.075	6%	30%	0.306	0.009	0.003	0.013	76%
1.B.2.b Natural Gas	CH_4	177.238	86.683	86.683	32%	0%	0.322	0.008	0.002	0.012	77%
5.B.1. Composting	CH_4	23.909	25.831	25.831	37%	100%	1.066	0.002	0.002	0.012	79%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	71.220	25%	20%	0.320	0.006	0.002	0.010	80%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	44.742	2%	50%	0.500	0.004	0.002	0.010	81%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	35.627	25%	50%	0.559	0.003	0.002	0.009	82%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	90.532	2%	20%	0.201	0.008	0.002	0.008	82%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	36.077	2%	50%	0.500	0.003	0.002	0.008	83%
5.B.1. Composting	N_2O	17.100	18.474	18.474	37%	90%	0.973	0.002	0.002	0.008	84%
1.A.4.b Residential - Biomass	CH_4	96.425	99.514	99.514	15%	10%	0.180	0.009	0.002	0.008	85%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Fuels											
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	610.446	2%	2%	0.028	0.054	0.002	0.008	85%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	34.152	5%	50%	0.502	0.003	0.002	0.008	86%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	165.779	2%	10%	0.102	0.015	0.001	0.007	87%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	143.549	2%	10%	0.102	0.013	0.001	0.006	88%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	41.093	25%	20%	0.320	0.004	0.001	0.006	88%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	227.588	2%	5%	0.054	0.020	0.001	0.005	89%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	224.856	2%	5%	0.054	0.020	0.001	0.005	89%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	23.566	2%	50%	0.500	0.002	0.001	0.005	90%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	22.387	2%	50%	0.500	0.002	0.001	0.005	90%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	20.460	2%	50%	0.500	0.002	0.001	0.004	91%
3.G. Liming	CO_2	357.133	19.938	19.938	5%	50%	0.502	0.002	0.001	0.004	91%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	96.544	2%	10%	0.102	0.009	0.001	0.004	92%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	47.395	2%	20%	0.201	0.004	0.001	0.004	92%
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	168.611	2%	5%	0.054	0.015	0.001	0.004	92%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	17.962	5%	50%	0.502	0.002	0.001	0.004	93%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	14.711	5%	50%	0.502	0.001	0.001	0.003	93%
3.B.1.3 Manure Management -	CH_4	65.378	22.007	22.007	25%	20%	0.320	0.002	0.001	0.003	93%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Swaine											
2.D.1 Lubricant Use	CO_2	23.251	13.722	13.722	2%	50%	0.500	0.001	0.001	0.003	94%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	13.455	2%	50%	0.500	0.001	0.001	0.003	94%
2.D.3. Solvent Use	CO_2	24.434	22.815	22.815	25%	10%	0.269	0.002	0.001	0.003	94%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	30.556	2%	20%	0.201	0.003	0.001	0.003	95%
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	18.913	8%	30%	0.310	0.002	0.001	0.003	95%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	204.610	2%	2%	0.028	0.018	0.001	0.003	95%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	11.302	5%	50%	0.502	0.001	0.001	0.002	95%
2.D.2 Paraffin wax use	CO_2	0.000	4.912	4.912	2%	100%	1.000	0.000	0.000	0.002	96%
1.A.5.b Mobile - Liquid Fuels	CO_2	0.000	9.568	9.568	2%	50%	0.500	0.001	0.000	0.002	96%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	88.883	88.883	2%	5%	0.054	0.008	0.000	0.002	96%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	9.270	5%	50%	0.502	0.001	0.000	0.002	96%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	83.911	2%	5%	0.054	0.007	0.000	0.002	96%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	11.077	25%	30%	0.391	0.001	0.000	0.002	97%
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	7.640	8%	50%	0.506	0.001	0.000	0.002	97%
2.G.3. N_2O from product uses	N_2O	3.250	3.572	3.572	2%	100%	1.000	0.000	0.000	0.002	97%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	65.993	2%	5%	0.054	0.006	0.000	0.002	97%
2.F.4. Aerosols	HFCs	0.000	4.803	4.803	50%	50%	0.707	0.000	0.000	0.001	97%
3.H. Urea Application	CO_2	7.709	6.210	6.210	2%	50%	0.500	0.001	0.000	0.001	97%

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2.F.2 Foam blowing agents	HFCs	0.000	4.380	4.380	50%	50%	0.707	0.000	0.000	0.001	97%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	0.000	106.159	106.159	2%	2%	0.028	0.009	0.000	0.001	98%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	7.429	25%	30%	0.391	0.001	0.000	0.001	98%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	8.556	15%	30%	0.335	0.001	0.000	0.001	98%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5.437	5%	50%	0.502	0.000	0.000	0.001	98%
2.G.1. Electrical equipment	SF6	0.000	10.118	10.118	2%	25%	0.251	0.001	0.000	0.001	98%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	12.533	2%	20%	0.201	0.001	0.000	0.001	98%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	4.326	2%	50%	0.500	0.000	0.000	0.001	98%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	20.992	2%	10%	0.102	0.002	0.000	0.001	98%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	18.203	2%	11%	0.111	0.002	0.000	0.001	98%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	37.312	2%	5%	0.054	0.003	0.000	0.001	99%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	9.933	2%	20%	0.201	0.001	0.000	0.001	99%
5.C.1 Waste Incineration	N_2O	3.436	1.811	1.811	44%	100%	1.093	0.000	0.000	0.001	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	19.061	2%	10%	0.102	0.002	0.000	0.001	99%
3.B.2.3 Manure Management -	N_2O	40.269	5.898	5.898	25%	20%	0.320	0.001	0.000	0.001	99%

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Swaine											
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	3.758	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	3.698	5%	50%	0.502	0.000	0.000	0.001	99%
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	16.117	10%	0%	0.100	0.001	0.000	0.001	99%
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2.763	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	22.180	2%	5%	0.054	0.002	0.000	0.001	99%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	2.804	25%	30%	0.391	0.000	0.000	0.000	99%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	18.028	2%	5%	0.054	0.002	0.000	0.000	99%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	9.395	2%	10%	0.102	0.001	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	N_2O	0.000	1.453	1.453	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	1.351	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2.114	2%	30%	0.301	0.000	0.000	0.000	99%
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	3.027	2%	20%	0.201	0.000	0.000	0.000	99%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	1.153	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	5.062	10%	5%	0.112	0.000	0.000	0.000	99%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	1.105	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion -	CO_2	0.833	9.546	9.546	2%	5%	0.054	0.001	0.000	0.000	100%

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Diesel Oil											
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	0.915	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CH_4	0.000	0.914	0.914	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2.270	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CO_2	0.000	2.126	2.126	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	0.850	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	0.839	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	1.283	2%	30%	0.301	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	0.768	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.4.b Other Use of soda ash	CO_2	0.000	0.673	0.673	8%	50%	0.506	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	0.680	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	0.662	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	0.606	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.c	CH_4	5.286	0.561	0.561	2%	50%	0.500	0.000	0.000	0.000	100%

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Agriculture/Forestry/Fisheries - Liquid Fuels											
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	5.190	2%	5%	0.054	0.000	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.457	0.457	3%	60%	0.601	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	0.521	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	0.515	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.000	0.446	0.446	5%	50%	0.502	0.000	0.000	0.000	100%
2.D.3.d Urea Use	CO_2	0.000	0.981	0.981	20%	10%	0.224	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2.115	2%	10%	0.102	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	0.428	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	0.393	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	0.486	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Biomass	N_2O	0.000	0.367	0.367	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	0.000	3.278	3.278	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	0.318	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	0.309	5%	50%	0.502	0.000	0.000	0.000	100%

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1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	0.287	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4	0.000	0.281	0.281	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.000	0.266	0.266	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Peat	CO_2	0.000	1.157	1.157	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	0.239	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	0.232	2%	50%	0.500	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	1.036	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	0.224	2%	50%	0.500	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.180	0.180	44%	40%	0.595	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	0.195	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	0.173	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.000	0.168	0.168	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	0.144	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	1.311	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	0.124	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	0.123	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.2. Lime Production	CO_2	169.024	0.721	0.721	8%	2%	0.082	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries -	CH_4	1.774	0.102	0.102	2%	50%	0.500	0.000	0.000	0.000	100%

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Gaseous Fuels											
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	0.208	20%	5%	0.206	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	0.400	2%	10%	0.102	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	0.081	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.5.b Mobile - Liquid Fuels	N_2O	0.000	0.077	0.077	2%	50%	0.500	0.000	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	0.110	13%	30%	0.327	0.000	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	0.062	20%	50%	0.539	0.000	0.000	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	0.056	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	0.053	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	0.050	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	0.048	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	0.047	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	0.420	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.2.e Food Processing,	CH_4	0.079	0.041	0.041	2%	50%	0.500	0.000	0.000	0.000	100%

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Beverages and Tobacco - Gaseous Fuels											
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	0.038	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2	0.000	0.095	0.095	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	0.037	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	0.036	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	N_2O	0.000	0.035	0.035	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.c. Railway Biomass Fuels	N_2O	0.000	0.031	0.031	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	0.030	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	0.026	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.024	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Biomass	CH_4	0.000	0.024	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CH_4	0.000	0.022	0.022	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	0.021	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid	N_2O	0.024	0.020	0.020	2%	50%	0.500	0.000	0.000	0.000	100%

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Fuels and Other Energy Industries - Gaseous Fuels											
1.A.5.b Mobile - Liquid Fuels	CH_4	0.000	0.020	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	0.019	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	0.013	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	0.017	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	0.017	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	0.014	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	0.012	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	0.011	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous	CH_4	0.011	0.008	0.008	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Fuels											
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.011	0.011	32%	0%	0.322	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.000	0.006	0.006	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	0.004	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.2.g Other - Peat	N_2O	0.000	0.005	0.005	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	0.005	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	0.004	2%	50%	0.500	0.000	0.000	0.000	100%
2.F.3. Fire Protection	HFCs	0.000	0.003	0.003	50%	50%	0.707	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	0.004	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.000	0.004	0.004	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print -	CH_4	0.068	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	ABS Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Level Assessment	Level Assessment with Uncertainty	Contribution to Level Assessment	Cumulative Total
Gaseous Fuels											
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.c. Railway Biomass Fuels	CH_4	0.000	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	N_2O	0.000	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4	0.000	0.002	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Peat	CH_4	0.000	0.001	0.001	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	N_2O	0.000	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	0.002	10%	0%	0.100	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	0.002	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4	0.000	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%

A 1.9 Spreadsheet for the Approach 1 analysis for 2015 – trend assessment with LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-19460.504	-4978.021	2%	3%	0.532	0.289	29%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	77.978	-2247.360	2%	31%	0.133	0.072	36%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2%	10%	0.130	0.070	43%
4. G. Harvested wood products	CO_2	-149.836	-1788.020	15%	0%	0.097	0.053	48%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2%	2%	0.093	0.051	54%
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4125.549	4566.495	5%	25%	0.089	0.049	58%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	2%	20%	0.058	0.031	62%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	2%	20%	0.042	0.023	64%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	2%	2%	0.037	0.020	66%
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2761.365	2609.306	13%	18%	0.034	0.019	68%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	2%	10%	0.033	0.018	70%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	2%	11%	0.033	0.018	71%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	2%	50%	0.030	0.016	73%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	2%	10%	0.028	0.015	74%
4.C.2 Land converted to Grassland –Mineral soil	CO_2	-0.003	-464.133	10%	12%	0.027	0.015	76%
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	118.735	547.674	20%	334%	0.027	0.014	77%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	2%	20%	0.023	0.012	79%
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-0.162	-376.289	8%	52%	0.022	0.012	80%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	2%	5%	0.017	0.009	81%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	2%	5%	0.015	0.008	82%
3.G. Liming	CO_2	357.133	19.938	5%	50%	0.014	0.008	82%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	567.422	636.303	44%	119%	0.013	0.007	83%
2.A.1. Cement Production	CO_2	345.783	466.713	8%	5%	0.012	0.007	84%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	2%	10%	0.011	0.006	84%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	2%	2%	0.011	0.006	85%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	2%	10%	0.010	0.006	85%
4.E.2 Land converted to Settlements – Organic soils	CO_2	3.766	178.520	47%	18%	0.010	0.006	86%
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	44.403	207.069	20%	31%	0.010	0.005	87%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	341.689	2%	11%	0.010	0.005	87%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	2%	5%	0.010	0.005	88%
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	382.478	117.235	53%	60%	0.009	0.005	88%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	1016.928	903.996	24%		0.009	0.005	89%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	2%	5%	0.009	0.005	89%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	2%	20%	0.009	0.005	90%
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	2%	5%	0.008	0.004	90%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	-66.910	-185.154	6%	448%	0.008	0.004	90%
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	0.001	130.610	55%	19%	0.008	0.004	91%
2.A.2. Lime Production	CO_2	169.024	0.721	8%	2%	0.007	0.004	91%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	56.126	149.606	44%	105%	0.006	0.003	92%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	0.000	5%	10%	0.006	0.003	92%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	2%	5%	0.006	0.003	92%
4.E.2 Land converted to Settlements – Mineral soils	CO_2	1.400	101.407	22%	16%	0.006	0.003	93%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	2%	10%	0.006	0.003	93%
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	218.068	70.245	93%	6%	0.005	0.003	93%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	7%	52%	0.005	0.003	93%
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	-49.115	-115.994	9%	420%	0.005	0.003	94%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	2%	20%	0.005	0.002	94%
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	24%	55%	0.004	0.002	94%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	2%	50%	0.004	0.002	94%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-1.403	-74.180	8%	31%	0.004	0.002	95%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2%	20%	0.004	0.002	95%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-1.382	-73.073	8%	23%	0.004	0.002	95%
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	12.456	79.079	114%	18%	0.004	0.002	95%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	0.000	2%	10%	0.004	0.002	95%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	2%	5%	0.004	0.002	96%
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	143.035	44.325	53%	39%	0.003	0.002	96%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	2%	50%	0.003	0.002	96%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	0.000	5%	10%	0.003	0.002	96%
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.911	54.038	20%	151%	0.003	0.002	96%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	25%	50%	0.003	0.002	97%
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	5%	10%	0.003	0.002	97%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	0.000	5%	11%	0.003	0.002	97%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	25%	20%	0.003	0.001	97%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	0.000	2%	20%	0.003	0.001	97%
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	8%	50%	0.002	0.001	97%
1.B.2.b Natural Gas	CH_4	177.238	86.683	32%	0%	0.002	0.001	97%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	25%	50%	0.002	0.001	98%
4.B.2 Land converted to Cropland –Mineral soil	CO_2	6.935	44.936	64%	15%	0.002	0.001	98%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	88.883	2%	5%	0.002	0.001	98%
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	6%	30%	0.002	0.001	98%
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	14%	30%	0.002	0.001	98%
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	10%	0%	0.002	0.001	98%
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-19.648	-48.372	5%	122%	0.002	0.001	98%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	2%	50%	0.002	0.001	98%
1.A.4.b Residential - Peat	CO_2	42.549	0.000	5%	10%	0.002	0.001	98%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	15%	10%	0.002	0.001	98%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	125.098	119.259	115%	71%	0.002	0.001	99%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	2%	20%	0.001	0.001	99%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	25%	20%	0.001	0.001	99%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	25%	20%	0.001	0.001	99%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	2%	50%	0.001	0.001	99%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	2%	50%	0.001	0.001	99%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	2%	5%	0.001	0.001	99%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	5%	50%	0.001	0.001	99%
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	2%	20%	0.001	0.001	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	5%	50%	0.001	0.000	99%
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	924.833	688.603	26%	19%	0.001	0.000	99%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	0.000	2%	5%	0.001	0.000	99%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	5%	50%	0.001	0.000	99%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	2%	10%	0.001	0.000	99%
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	69.988	61.995	61%	82%	0.001	0.000	99%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2%	30%	0.001	0.000	99%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	25%	20%	0.001	0.000	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	5%	50%	0.001	0.000	99%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	2%	5%	0.001	0.000	99%
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	21.455	6.911	93%	36%	0.001	0.000	99%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
5.B.1. Composting	CH_4	23.909	25.831	37%	100%	0.000	0.000	100%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CH_4	28.534	28.534	24%	81%	0.000	0.000	100%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-14.143	-16.324	6%	31%	0.000	0.000	100%
5.B.1. Composting	N_2O	17.100	18.474	37%	90%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	2%	50%	0.000	0.000	100%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	25%	30%	0.000	0.000	100%
2.D.3. Solvent Use	CO_2	24.434	22.815	25%	10%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	2%	50%	0.000	0.000	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-6.274	-9.207	3%	701%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	2%	5%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	2%	50%	0.000	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	CH_4	2.544	6.246	37%	36%	0.000	0.000	100%
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.590	4.459	64%	151%	0.000	0.000	100%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	0.561	2%	50%	0.000	0.000	100%
2.D.1 Lubricant Use	CO_2	23.251	13.722	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	5%	50%	0.000	0.000	100%
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	0.160	2.973	42%	212%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	10%	5%	0.000	0.000	100%
1.A.4.b Residential - Peat	CH_4	3.188	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	0.000	2%	20%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	15%	30%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	0.000	2%	20%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	2%	50%	0.000	0.000	100%
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.389	-4.943	5%	31%	0.000	0.000	100%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	25%	30%	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	13%	30%	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	2%	50%	0.000	0.000	100%
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.589	-6.229	9%	31%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	5%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	2%	5%	0.000	0.000	100%
2.G.3. N_2O from product uses	N_2O	3.250	3.572	2%	100%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	0.102	2%	50%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	2%	50%	0.000	0.000	100%
4.A.1 Forest land remaining forest land - Controlled burning	N_2O	2.516	0.810	93%		0.000	0.000	100%
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	24%	107%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	5%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	2%	5%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	2%	10%	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.000	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	2%	50%	0.000	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	1.811	44%	100%	0.000	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	25%	30%	0.000	0.000	100%
3.H. Urea Application	CO_2	7.709	6.210	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	2%	50%	0.000	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.298	0.732	37%		0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.000	2%	50%	0.000	0.000	100%
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	8%	30%	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	2%	30%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	2%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.000	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.000	5%	50%	0.000	0.000	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – dead organic matter	CO_2	-1.402	-0.578	3%	31%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	2%	5%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.024	2%	50%	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.054	0.317	10%	48%	0.000	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	2%	50%	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.050	0.291	10%	39%	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.180	44%	40%	0.000	0.000	100%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.000	5%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.000	5%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.000	2%	50%	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.457	3%	60%	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco -	CH_4	0.267	0.006	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
Solid Fuels								
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.000	5%	50%	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.000	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	2%	50%	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	5%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	2%	50%	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	25%	30%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	20%	5%	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	2%	50%	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	5%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.000	2%	50%	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	20%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	20%	50%	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	5%	10%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	2%	50%	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.000	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	2%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.000	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	10%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.000	5%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	2%	70%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	2%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.000	5%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.000	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	2%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.000	2%	50%	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.011	32%	0%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	2%	70%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	10%	50%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	20%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	2%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	10%	0%	0.000	0.000	100%

A 1.10 Spreadsheet for the Approach 1 analysis for 2015 – trend assessment without LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2%	2%	0.069	0.197	20%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2%	10%	0.051	0.145	34%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	25%	50%	0.024	0.069	41%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	2%	20%	0.022	0.063	48%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	2%	5%	0.020	0.058	53%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	2%	11%	0.013	0.036	57%
2.A.1. Cement Production	CO_2	345.783	466.713	8%	5%	0.012	0.035	60%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	2%	50%	0.011	0.032	64%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	2%	10%	0.010	0.030	67%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	2%	10%	0.010	0.027	69%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	2%	20%	0.008	0.023	72%
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	2%	5%	0.006	0.017	73%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	2%	5%	0.006	0.016	75%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	2%	2%	0.005	0.015	76%
3.G. Liming	CO_2	357.133	19.938	5%	50%	0.005	0.015	78%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	2%	5%	0.005	0.014	79%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	2%	10%	0.004	0.012	80%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	2%	20%	0.004	0.011	82%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	2%	10%	0.004	0.011	83%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	2%	20%	0.003	0.009	84%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	2%	20%	0.003	0.009	85%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	2%	5%	0.003	0.009	85%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	2%	5%	0.003	0.009	86%
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	14%	30%	0.003	0.008	87%
2.A.2. Lime Production	CO_2	169.024	0.721	8%	2%	0.003	0.008	88%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	2%	5%	0.003	0.008	89%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	0.000	5%	10%	0.002	0.007	89%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	2%	5%	0.002	0.007	90%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	15%	10%	0.002	0.006	91%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	2%	50%	0.002	0.005	91%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2%	20%	0.002	0.005	92%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	0.000	2%	10%	0.002	0.004	92%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	2%	50%	0.001	0.004	92%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	341.689	2%	11%	0.001	0.004	93%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	0.000	5%	10%	0.001	0.004	93%
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	5%	10%	0.001	0.003	94%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	0.000	5%	11%	0.001	0.003	94%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	0.000	2%	20%	0.001	0.003	94%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	2%	2%	0.001	0.003	94%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	25%	20%	0.001	0.003	95%
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	8%	50%	0.001	0.002	95%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	2%	50%	0.001	0.002	95%
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	6%	30%	0.001	0.002	95%
1.A.4.b Residential - Peat	CO_2	42.549	0.000	5%	10%	0.001	0.002	96%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	2%	5%	0.001	0.002	96%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	5%	50%	0.001	0.002	96%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	2%	50%	0.001	0.002	96%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	5%	50%	0.001	0.002	96%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	2%	50%	0.001	0.002	97%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	25%	50%	0.001	0.002	97%
5.B.1. Composting	CH_4	23.909	25.831	37%	100%	0.001	0.002	97%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	5%	50%	0.001	0.002	97%
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	10%	0%	0.001	0.002	97%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	88.883	2%	5%	0.001	0.001	97%
2.D.3. Solvent Use	CO_2	24.434	22.815	25%	10%	0.000	0.001	97%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	25%	20%	0.000	0.001	98%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	5%	50%	0.000	0.001	98%
5.B.1. Composting	N_2O	17.100	18.474	37%	90%	0.000	0.001	98%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	25%	20%	0.000	0.001	98%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	2%	20%	0.000	0.001	98%
1.B.2.b Natural Gas	CH_4	177.238	86.683	32%	0%	0.000	0.001	98%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	2%	5%	0.000	0.001	98%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	5%	50%	0.000	0.001	98%
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	2%	20%	0.000	0.001	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	2%	10%	0.000	0.001	99%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	2%	5%	0.000	0.001	99%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	0.000	2%	5%	0.000	0.001	99%
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	8%	30%	0.000	0.001	99%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	2%	10%	0.000	0.001	99%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	25%	20%	0.000	0.001	99%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	2%	50%	0.000	0.001	99%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	2%	50%	0.000	0.001	99%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2%	30%	0.000	0.001	99%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	15%	30%	0.000	0.001	99%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	7%	52%	0.000	0.000	99%
2.D.1 Lubricant Use	CO_2	23.251	13.722	2%	50%	0.000	0.000	99%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	10%	5%	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	2%	50%	0.000	0.000	99%
1.A.1.a Public Electricity and Heat	N_2O	7.163	0.005	2%	50%	0.000	0.000	99%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
Production - Liquid Fuels								
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	2%	50%	0.000	0.000	99%
3.H. Urea Application	CO_2	7.709	6.210	2%	50%	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2%	50%	0.000	0.000	100%
2.G.3. N_2O from product uses	N_2O	3.250	3.572	2%	100%	0.000	0.000	100%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	25%	30%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	0.561	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	2%	50%	0.000	0.000	100%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	25%	30%	0.000	0.000	100%
1.A.4.b Residential - Peat	CH_4	3.188	0.000	5%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	0.000	2%	20%	0.000	0.000	100%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	2%	5%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid	CO_2	2.692	0.000	2%	20%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
Fuels								
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	2%	50%	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	13%	30%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	5%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	2%	50%	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	2%	30%	0.000	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	25%	30%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	2%	50%	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	0.102	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.000	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	2%	5%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	2%	50%	0.000	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	1.811	44%	100%	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.457	3%	60%	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.000	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	2%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.000	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.000	5%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	5%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.024	2%	50%	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	25%	30%	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	2%	10%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.000	5%	50%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	20%	5%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.000	5%	50%	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	5%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.000	2%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	2%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.000	5%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.000	2%	50%	0.000	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.000	5%	50%	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	2%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.000	5%	50%	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	2%	50%	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.180	44%	40%	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	2%	50%	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	20%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	20%	50%	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.000	2%	50%	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	2%	50%	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	2%	50%	0.000	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	2%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	2%	50%	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	2%	50%	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	5%	10%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	2%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	10%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	5%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	2%	50%	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	2%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.000	2%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid	N_2O	0.036	0.000	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
Fuels								
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.000	5%	50%	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.000	2%	50%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	2%	70%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	2%	50%	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.000	5%	50%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	2%	50%	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.011	32%	0%	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	2%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	2%	50%	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.000	5%	50%	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	10%	50%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.000	2%	50%	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	2%	50%	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Trend assessment	Contribution to trend	Cumulative total of contribution to trend
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	2%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	2%	70%	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.000	2%	50%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	20%	50%	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	10%	0%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.000	0.000	100%

A.1.11 Spreadsheet for the Approach 2 analysis for 2015 – trend assessment with LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2	118.735	547.674	20%	334%	3.349	0.027	0.089	0.195	19%
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	77.978	-2247.360	2%	31%	0.310	0.133	0.041	0.090	28%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	-66.910	-185.154	6%	448%	4.475	0.008	0.035	0.077	36%
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4125.549	4566.495	5%	25%	0.256	0.089	0.023	0.050	41%
4.E.1 Settlements remaining Settlements –	CO_2	-49.115	-115.994	9%	420%	4.197	0.005	0.019	0.042	45%

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Carbon stock change – living biomass										
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-19460.504	-4978.021	2%	3%	0.035	0.532	0.019	0.041	49%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	567.422	636.303	44%	119%	1.269	0.013	0.016	0.035	53%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	2%	50%	0.500	0.030	0.015	0.033	56%
4. G. Harvested wood products	CO_2	-149.836	-1788.020	15%	0%	0.150	0.097	0.015	0.032	59%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2%	10%	0.102	0.130	0.013	0.029	62%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	2%	20%	0.201	0.058	0.012	0.025	65%
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-0.162	-376.289	8%	52%	0.529	0.022	0.011	0.025	67%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	2%	20%	0.201	0.042	0.009	0.019	69%
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2761.365	2609.306	13%	18%	0.227	0.034	0.008	0.017	71%
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	382.478	117.235	53%	60%	0.803	0.009	0.008	0.016	73%
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	56.126	149.606	44%	105%	1.137	0.006	0.007	0.016	74%
3.G. Liming	CO_2	357.133	19.938	5%	50%	0.502	0.014	0.007	0.015	76%
4.E.2 Land converted to Settlements – Organic soils	CO_2	3.766	178.520	47%	18%	0.505	0.010	0.005	0.011	77%
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	218.068	70.245	93%	6%	0.928	0.005	0.005	0.010	78%

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4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.911	54.038	20%	151%	1.520	0.003	0.005	0.010	79%
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	12.456	79.079	114%	18%	1.153	0.004	0.005	0.010	80%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	2%	20%	0.201	0.023	0.005	0.010	81%
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	0.001	130.610	55%	19%	0.583	0.008	0.004	0.010	82%
4.C.2 Land converted to Grassland –Mineral soil	CO_2	-0.003	-464.133	10%	12%	0.156	0.027	0.004	0.009	83%
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	44.403	207.069	20%	31%	0.363	0.010	0.004	0.008	84%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	2%	11%	0.111	0.033	0.004	0.008	84%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	2%	10%	0.102	0.033	0.003	0.007	85%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	2%	10%	0.102	0.028	0.003	0.006	86%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	7%	52%	0.525	0.005	0.003	0.006	86%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2%	2%	0.028	0.093	0.003	0.006	87%
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	24%	55%	0.604	0.004	0.003	0.006	87%
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-19.648	-48.372	5%	122%	1.222	0.002	0.002	0.005	88%
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	143.035	44.325	53%	39%	0.659	0.003	0.002	0.005	88%
4.D.1. Wetlands, Peat extraction from lands,	CO_2	1016.928	903.996	24%		0.242	0.009	0.002	0.005	89%

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organic soils										
4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	125.098	119.259	115%	71%	1.349	0.002	0.002	0.005	89%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	2%	50%	0.500	0.004	0.002	0.005	90%
4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-6.274	-9.207	3%	701%	7.007	0.000	0.002	0.004	90%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	2%	20%	0.201	0.009	0.002	0.004	91%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	25%	50%	0.559	0.003	0.002	0.004	91%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	2%	50%	0.500	0.003	0.002	0.004	91%
4.E.2 Land converted to Settlements – Mineral soils	CO_2	1.400	101.407	22%	16%	0.270	0.006	0.002	0.003	92%
4.B.2 Land converted to Cropland –Mineral soil	CO_2	6.935	44.936	64%	15%	0.662	0.002	0.002	0.003	92%
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	25%	50%	0.559	0.002	0.001	0.003	92%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-1.403	-74.180	8%	31%	0.320	0.004	0.001	0.003	93%
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	8%	50%	0.506	0.002	0.001	0.003	93%
2.A.1. Cement Production	CO_2	345.783	466.713	8%	5%	0.094	0.012	0.001	0.003	93%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	2%	10%	0.102	0.011	0.001	0.003	93%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	341.689	2%	11%	0.109	0.010	0.001	0.002	94%

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1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	2%	10%	0.102	0.010	0.001	0.002	94%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	2%	2%	0.028	0.037	0.001	0.002	94%
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-1.382	-73.073	8%	23%	0.244	0.004	0.001	0.002	94%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	2%	5%	0.054	0.017	0.001	0.002	95%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	2%	20%	0.201	0.005	0.001	0.002	95%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	2%	50%	0.500	0.002	0.001	0.002	95%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	25%	20%	0.320	0.003	0.001	0.002	95%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2%	20%	0.201	0.004	0.001	0.002	95%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	2%	5%	0.054	0.015	0.001	0.002	96%
1.B.2.b Natural Gas	CH_4	177.238	86.683	32%	0%	0.322	0.002	0.001	0.002	96%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	0.000	5%	10%	0.112	0.006	0.001	0.002	96%
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	14%	30%	0.331	0.002	0.001	0.001	96%
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	6%	30%	0.306	0.002	0.001	0.001	96%
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	69.988	61.995	61%	82%	1.017	0.001	0.001	0.001	96%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	2%	50%	0.500	0.001	0.001	0.001	96%
2.A.2. Lime Production	CO_2	169.024	0.721	8%	2%	0.082	0.007	0.001	0.001	97%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	2%	10%	0.102	0.006	0.001	0.001	97%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	2%	50%	0.500	0.001	0.001	0.001	97%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	0.000	2%	20%	0.201	0.003	0.001	0.001	97%
5.B.1. Composting	CH_4	23.909	25.831	37%	100%	1.066	0.000	0.001	0.001	97%

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1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	2%	5%	0.054	0.010	0.001	0.001	97%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	5%	50%	0.502	0.001	0.001	0.001	97%
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	21.455	6.911	93%	36%	0.994	0.001	0.001	0.001	97%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	25%	20%	0.320	0.001	0.000	0.001	97%
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	2%	5%	0.054	0.009	0.000	0.001	98%
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	2%	5%	0.054	0.008	0.000	0.001	98%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	25%	20%	0.320	0.001	0.000	0.001	98%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	5%	50%	0.502	0.001	0.000	0.001	98%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	0.000	2%	10%	0.102	0.004	0.000	0.001	98%
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.590	4.459	64%	151%	1.639	0.000	0.000	0.001	98%
4.D.1. Wetlands, Peat extraction from lands, organic soils	CH_4	28.534	28.534	24%	81%	0.842	0.000	0.000	0.001	98%
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	0.160	2.973	42%	212%	2.157	0.000	0.000	0.001	98%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	0.000	5%	10%	0.112	0.003	0.000	0.001	98%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	0.000	5%	11%	0.120	0.003	0.000	0.001	98%
5.B.1. Composting	N_2O	17.100	18.474	37%	90%	0.973	0.000	0.000	0.001	98%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	2%	5%	0.054	0.006	0.000	0.001	98%
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	5%	10%	0.112	0.003	0.000	0.001	99%

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1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	5%	50%	0.502	0.001	0.000	0.001	99%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	15%	10%	0.180	0.002	0.000	0.001	99%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	2%	20%	0.201	0.001	0.000	0.001	99%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	2%	2%	0.028	0.011	0.000	0.001	99%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	5%	50%	0.502	0.001	0.000	0.001	99%
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	924.833	688.603	26%	19%	0.319	0.001	0.000	0.001	99%
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	10%	0%	0.100	0.002	0.000	0.000	99%
1.A.4.b Residential - Peat	CO_2	42.549	0.000	5%	10%	0.112	0.002	0.000	0.000	99%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	2%	5%	0.054	0.004	0.000	0.000	99%
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	2%	20%	0.201	0.001	0.000	0.000	99%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	25%	20%	0.320	0.001	0.000	0.000	99%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2%	30%	0.301	0.001	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	2%	50%	0.500	0.000	0.000	0.000	99%
4.A.1 Forest land remaining forest land - wildfires	CH_4	2.544	6.246	37%	36%	0.516	0.000	0.000	0.000	99%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.2.e Food Processing, Beverages and	CO_2	175.098	88.883	2%	5%	0.054	0.002	0.000	0.000	99%

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Tobacco - Gaseous Fuels										
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	25%	30%	0.391	0.000	0.000	0.000	99%
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-14.143	-16.324	6%	31%	0.316	0.000	0.000	0.000	99%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	0.561	2%	50%	0.500	0.000	0.000	0.000	100%
2.D.1 Lubricant Use	CO_2	23.251	13.722	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	5%	50%	0.502	0.000	0.000	0.000	100%
2.D.3. Solvent Use	CO_2	24.434	22.815	25%	10%	0.269	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2%	50%	0.500	0.000	0.000	0.000	100%
2.G.3. N_2O from product uses	N_2O	3.250	3.572	2%	100%	1.000	0.000	0.000	0.000	100%
1.A.4.b Residential - Peat	CH_4	3.188	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	2%	10%	0.102	0.001	0.000	0.000	100%
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	24%	107%	1.099	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	2%	5%	0.054	0.001	0.000	0.000	100%
4.A.1 Forest land remaining forest land - Controlled burning	N_2O	2.516	0.810	93%		0.926	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	2%	50%	0.500	0.000	0.000	0.000	100%

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1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	2%	50%	0.500	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	1.811	44%	100%	1.093	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	0.000	2%	5%	0.054	0.001	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	15%	30%	0.335	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	0.102	2%	50%	0.500	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.389	-4.943	5%	31%	0.314	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	2%	50%	0.500	0.000	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	13%	30%	0.327	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	2%	5%	0.054	0.001	0.000	0.000	100%
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.589	-6.229	9%	31%	0.322	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	0.000	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	0.000	2%	20%	0.201	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	2%	50%	0.500	0.000	0.000	0.000	100%
3.H. Urea Application	CO_2	7.709	6.210	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	10%	5%	0.112	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	2%	50%	0.500	0.000	0.000	0.000	100%
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.298	0.732	37%		0.370	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	8%	30%	0.310	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.180	44%	40%	0.595	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	2%	30%	0.301	0.000	0.000	0.000	100%
4.B.1 Cropland remaining Cropland – Carbon stock change – dead organic matter	CO_2	-1.402	-0.578	3%	31%	0.311	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.054	0.317	10%	48%	0.490	0.000	0.000	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.457	3%	60%	0.601	0.000	0.000	0.000	100%
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	2%	50%	0.500	0.000	0.000	0.000	100%
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.050	0.291	10%	39%	0.403	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	2%	10%	0.102	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.000	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	25%	30%	0.391	0.000	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	20%	50%	0.539	0.000	0.000	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	2%	5%	0.054	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	20%	5%	0.206	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	2%	50%	0.500	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.000	5%	50%	0.502	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	2%	70%	0.700	0.000	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.011	32%	0%	0.322	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	10%	0%	0.100	0.000	0.000	0.000	100%

A.1.12 Spreadsheet for the Approach 2 analysis for 2015 – trend assessment without LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	25%	50%	0.559	0.024	0.013	0.235	23%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	2%	50%	0.500	0.011	0.006	0.098	33%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2%	10%	0.102	0.051	0.005	0.090	42%
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	2%	20%	0.201	0.022	0.004	0.078	50%
3.G. Liming	CO_2	357.133	19.938	5%	50%	0.502	0.005	0.003	0.045	55%
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2%	2%	0.028	0.069	0.002	0.034	58%
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	2%	20%	0.201	0.008	0.002	0.029	61%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	2%	11%	0.111	0.013	0.001	0.024	63%
2.A.1. Cement Production	CO_2	345.783	466.713	8%	5%	0.094	0.012	0.001	0.020	65%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	2%	5%	0.054	0.020	0.001	0.019	67%
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	2%	10%	0.102	0.010	0.001	0.019	69%
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	2%	10%	0.102	0.010	0.001	0.017	71%
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	14%	30%	0.331	0.003	0.001	0.017	73%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	2%	50%	0.500	0.002	0.001	0.015	74%
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	2%	20%	0.201	0.004	0.001	0.014	75%
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	2%	50%	0.500	0.001	0.001	0.013	77%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	2%	20%	0.201	0.003	0.001	0.011	78%
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	2%	20%	0.201	0.003	0.001	0.011	79%
5.B.1. Composting	CH_4	23.909	25.831	37%	100%	1.066	0.001	0.001	0.011	80%
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	2%	10%	0.102	0.004	0.000	0.008	81%
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	8%	50%	0.506	0.001	0.000	0.008	82%
5.B.1. Composting	N_2O	17.100	18.474	37%	90%	0.973	0.000	0.000	0.007	82%
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	15%	10%	0.180	0.002	0.000	0.007	83%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	2%	10%	0.102	0.004	0.000	0.007	84%
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	2%	50%	0.500	0.001	0.000	0.007	84%
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	25%	50%	0.559	0.001	0.000	0.006	85%
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	5%	50%	0.502	0.001	0.000	0.006	85%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	2%	50%	0.500	0.001	0.000	0.006	86%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	5%	50%	0.502	0.001	0.000	0.006	87%
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	2%	50%	0.500	0.001	0.000	0.006	87%
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2%	20%	0.201	0.002	0.000	0.006	88%
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	2%	5%	0.054	0.006	0.000	0.005	88%
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	2%	5%	0.054	0.006	0.000	0.005	89%
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	25%	20%	0.320	0.001	0.000	0.005	89%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	5%	50%	0.502	0.001	0.000	0.005	90%
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	0.000	5%	10%	0.112	0.002	0.000	0.005	90%
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	2%	5%	0.054	0.005	0.000	0.005	91%
2.A.2. Lime Production	CO_2	169.024	0.721	8%	2%	0.082	0.003	0.000	0.004	91%
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	6%	30%	0.306	0.001	0.000	0.004	92%
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	5%	50%	0.502	0.000	0.000	0.004	92%
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	0.000	2%	20%	0.201	0.001	0.000	0.004	92%
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	5%	50%	0.502	0.000	0.000	0.003	93%
1.A.4.a	CO_2	335.687	227.588	2%	5%	0.054	0.003	0.000	0.003	93%

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Commercial/Institutional - Gaseous Fuels										
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	2%	5%	0.054	0.003	0.000	0.003	93%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	341.689	2%	11%	0.109	0.001	0.000	0.003	93%
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	0.000	2%	10%	0.102	0.002	0.000	0.003	94%
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	2%	2%	0.028	0.005	0.000	0.003	94%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	2%	5%	0.054	0.003	0.000	0.003	94%
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	25%	20%	0.320	0.000	0.000	0.002	94%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	0.000	5%	10%	0.112	0.001	0.000	0.002	95%
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	25%	20%	0.320	0.000	0.000	0.002	95%
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	0.000	5%	11%	0.120	0.001	0.000	0.002	95%
2.D.3. Solvent Use	CO_2	24.434	22.815	25%	10%	0.269	0.000	0.000	0.002	95%
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	5%	10%	0.112	0.001	0.000	0.002	96%
1.B.2.b Natural Gas	CH_4	177.238	86.683	32%	0%	0.322	0.000	0.000	0.002	96%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	2%	5%	0.054	0.002	0.000	0.002	96%
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	2%	50%	0.500	0.000	0.000	0.002	96%

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3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	2%	50%	0.500	0.000	0.000	0.002	96%
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	8%	30%	0.310	0.000	0.000	0.002	97%
2.G.3. N_2O from product uses	N_2O	3.250	3.572	2%	100%	1.000	0.000	0.000	0.001	97%
1.A.4.b Residential - Peat	CO_2	42.549	0.000	5%	10%	0.112	0.001	0.000	0.001	97%
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	2%	20%	0.201	0.000	0.000	0.001	97%
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	25%	20%	0.320	0.000	0.000	0.001	97%
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	7%	52%	0.525	0.000	0.000	0.001	97%
2.D.1 Lubricant Use	CO_2	23.251	13.722	2%	50%	0.500	0.000	0.000	0.001	97%
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	2%	20%	0.201	0.000	0.000	0.001	98%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	2%	50%	0.500	0.000	0.000	0.001	98%
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2%	30%	0.301	0.000	0.000	0.001	98%
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	15%	30%	0.335	0.000	0.000	0.001	98%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	2%	50%	0.500	0.000	0.000	0.001	98%
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	2%	50%	0.500	0.000	0.000	0.001	98%
3.H. Urea Application	CO_2	7.709	6.210	2%	50%	0.500	0.000	0.000	0.001	98%
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	10%	0%	0.100	0.001	0.000	0.001	98%
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5%	50%	0.502	0.000	0.000	0.001	98%

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1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	2%	50%	0.500	0.000	0.000	0.001	98%
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	2%	5%	0.054	0.001	0.000	0.001	99%
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	0.561	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	2%	10%	0.102	0.000	0.000	0.001	99%
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	25%	30%	0.391	0.000	0.000	0.001	99%
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	2%	50%	0.500	0.000	0.000	0.001	99%
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	2%	2%	0.028	0.001	0.000	0.000	99%
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	88.883	2%	5%	0.054	0.001	0.000	0.000	99%
1.A.4.b Residential - Peat	CH_4	3.188	0.000	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.c	CO_2	3.023	0.000	5%	50%	0.502	0.000	0.000	0.000	99%

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Agriculture/Forestry/Fisheries - Peat										
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	2%	10%	0.102	0.000	0.000	0.000	99%
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	2%	50%	0.500	0.000	0.000	0.000	99%
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	25%	30%	0.391	0.000	0.000	0.000	99%
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	2%	5%	0.054	0.000	0.000	0.000	99%
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	5%	50%	0.502	0.000	0.000	0.000	99%
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	2%	5%	0.054	0.000	0.000	0.000	99%
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	0.000	2%	5%	0.054	0.000	0.000	0.000	99%
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	2%	50%	0.500	0.000	0.000	0.000	99%
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	10%	5%	0.112	0.000	0.000	0.000	99%
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	2%	50%	0.500	0.000	0.000	0.000	99%

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1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	2%	50%	0.500	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	N_2O	3.436	1.811	44%	100%	1.093	0.000	0.000	0.000	100%
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CH_4	1.774	0.102	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	25%	30%	0.391	0.000	0.000	0.000	100%
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	13%	30%	0.327	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	0.000	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	2%	30%	0.301	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	0.000	2%	20%	0.201	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	2%	50%	0.500	0.000	0.000	0.000	100%
2.A.3. Glass production	CO_2	0.356	0.457	3%	60%	0.601	0.000	0.000	0.000	100%

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1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	2%	50%	0.500	0.000	0.000	0.000	100%

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1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.024	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	2%	5%	0.054	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	25%	30%	0.391	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Liquid	CH_4	0.273	0.004	2%	50%	0.500	0.000	0.000	0.000	100%

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Fuels										
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
5.C.1 Waste Incineration	CO_2	0.575	0.180	44%	40%	0.595	0.000	0.000	0.000	100%
1.A.4.b Residential - Peat	N_2O	0.186	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	2%	50%	0.500	0.000	0.000	0.000	100%
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	2%	50%	0.500	0.000	0.000	0.000	100%
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	20%	5%	0.206	0.000	0.000	0.000	100%
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation -	CO_2	0.011	0.420	2%	5%	0.054	0.000	0.000	0.000	100%

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Aviation Gasoline										
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	2%	10%	0.102	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	2%	70%	0.700	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.e Food Processing, Beverages and Tobacco -	N_2O	0.095	0.048	2%	50%	0.500	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
Gaseous Fuels										
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	5%	10%	0.112	0.000	0.000	0.000	100%
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	10%	50%	0.510	0.000	0.000	0.000	100%
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.000	5%	50%	0.502	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	2%	70%	0.700	0.000	0.000	0.000	100%
1.B.2.b Natural Gas	CO_2	0.009	0.011	32%	0%	0.322	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.000	2%	50%	0.500	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	20%	50%	0.539	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	100%

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined Uncertainty	Trend assessment	Trend assessment with Uncertainty	% Contribution to Trend	Cumulative total of contribution to trend
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	10%	0%	0.100	0.000	0.000	0.000	100%
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	100%

ANNEX 2: ASSESSMENT OF UNCERTAINTY

A.2.1 Approach 1 uncertainty analysis for 2015 including LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%	
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2%	10%	0.102	0.000	0.129	0.000	0.013	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	2%	20%	0.201	0.000	0.009	0.001	0.002	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	2%	5%	0.054	0.000	0.015	0.097	0.001	0.003	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	0.000	5%	10%	0.112	0.000	0.006	0.000	0.001	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CO_2	3.079	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Biomass	CH_4	0.327	9.270	5%	50%	0.502	0.000	0.001	0.001	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels													2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	5%	50%	0.502	0.000	0.001	0.001	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	2%	10%	0.102	0.000	0.000	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels and Other Energy Industries - Solid Fuels													Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	44.924	37.312	2%	5%	0.054	0.000	0.000	0.002	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	0.000	5%	10%	0.112	0.000	0.003	0.000	0.000	0.000	0.000	AD -AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	CH_4	0.000	0.281	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.000	0.446	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	0.000	2%	10%	0.102	0.000	0.004	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Solid Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	2%	5%	0.054	0.000	0.009	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	0.000	2%	20%	0.201	0.000	0.003	0.000	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Solid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													combustion, Table 2.12
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Biomass Fuels	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Solid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Biomass Fuels	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel -	N_2O	0.998	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Other fossil fuels													Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CO_2	0.000	0.000	2%	10%	0.102	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2	0.000	0.095	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	0.000	3.278	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4	0.000	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Biomass Fuels	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2.12
1.A.2.b Non-Ferrous Metals - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Liquid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Solid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals	N_2O	0.000	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP;

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
- Gaseous Fuels													EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Biomass Fuels	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	2%	10%	0.102	0.000	0.011	0.001	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	2%	5%	0.054	0.000	0.000	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.c Chemicals - Peat	CO_2	0.000	0.000	5%	11%	0.120	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													combustion, Table 2.12
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.000	0.168	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.000	0.266	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	2%	10%	0.102	0.000	0.001	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	2%	5%	0.054	0.000	0.006	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and	CH_4	0.015	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Print - Liquid Fuels													Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.000	0.004	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and	N_2O	0.081	0.003	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Print - Gaseous Fuels													Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.000	0.006	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	2%	11%	0.111	0.000	0.033	0.001	0.004	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2%	20%	0.201	0.000	0.004	0.000	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	88.883	2%	5%	0.054	0.000	0.002	0.005	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CO_2	0.000	2.126	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.e Food Processing, Beverages and Tobacco - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CH_4	0.000	0.022	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	N_2O	1.879	0.026	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco -	N_2O	0.478	0.011	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Solid Fuels													2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	N_2O	0.000	0.035	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	2%	10%	0.102	0.000	0.010	0.001	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	2%	20%	0.201	0.000	0.005	0.005	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	2%	5%	0.054	0.000	0.010	0.004	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	0.000	106.159	2%	2%	0.028	0.000	0.006	0.006	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Liquid Fuels	CH_4	0.269	0.021	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2.12
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CH_4	0.000	0.914	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	N_2O	0.000	1.453	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	2%	10%	0.102	0.000	0.028	0.006	0.003	0.000	0.000	AD -CSP; EF-2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 2, pg. 2.38; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	2%	20%	0.201	0.000	0.001	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	2%	5%	0.054	0.000	0.017	0.005	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Peat	CO_2	0.000	1.157	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Other Fossil Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	5%	50%	0.502	0.000	0.001	0.001	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Peat	CH_4	0.000	0.001	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	5%	50%	0.502	0.000	0.001	0.001	0.001	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Peat	N_2O	0.000	0.005	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	2%	70%	0.700	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	2%	70%	0.700	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	2%	2%	0.028	0.000	0.037	0.035	0.001	0.001	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2%	2%	0.028	0.000	0.093	0.119	0.002	0.003	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	2%	5%	0.054	0.000	0.008	0.010	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	10%	5%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation	CO_2	17.617	0.000	2%	5%	0.054	0.000	0.001	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
- Gaseous Fuels													IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2%	30%	0.301	0.000	0.001	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	2%	30%	0.301	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	10%	50%	0.510	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Biomass	CH_4	0.000	0.024	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	2%	50%	0.500	0.000	0.001	0.001	0.001	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Volume 2, pp.3.29
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	10%	50%	0.510	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Biomass	N_2O	0.000	0.367	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	2%	2%	0.028	0.000	0.011	0.012	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c. Railway Biomass Fuels	CH_4	0.000	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	2%	50%	0.500	0.000	0.001	0.001	0.001	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c. Railway Biomass Fuels	N_2O	0.000	0.031	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Volume 2, pp.3.43&3.46
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	20%	5%	0.206	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	2%	5%	0.054	0.000	0.001	0.001	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	2%	10%	0.102	0.000	0.033	0.010	0.003	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	2%	20%	0.201	0.000	0.058	0.002	0.012	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	2%	5%	0.054	0.000	0.001	0.013	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	0.000	5%	11%	0.120	0.000	0.003	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Other Fossil Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	5%	50%	0.502	0.000	0.000	0.002	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													3.6.1.7
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a	N_2O	0.296	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC

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Commercial/Institutional - Peat													Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	2%	10%	0.102	0.000	0.006	0.008	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.b Residential - Solid	CO_2	605.818	47.395	2%	20%	0.201	0.000	0.023	0.003	0.005	0.000	0.000	AD -CSP; EF-2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels													Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	2%	5%	0.054	0.000	0.004	0.013	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Peat	CO_2	42.549	0.000	5%	10%	0.112	0.000	0.002	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Other Fossil Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													3.6.1.7
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	2%	50%	0.500	0.000	0.002	0.000	0.001	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	15%	10%	0.180	0.000	0.002	0.006	0.000	0.001	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Peat	CH_4	3.188	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	15%	30%	0.335	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Peat	N_2O	0.186	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg.

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	700.654	341.689	2%	11%	0.109	0.000	0.010	0.020	0.001	0.001	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	102.282	0.662	2%	50%	0.500	0.000	0.004	0.000	0.002	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	782.443	44.742	2%	50%	0.500	0.000	0.030	0.003	0.015	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CO_2	3.023	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/Fisheries - Other Fossil Fuels	CO_2	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CH_4	5.286	0.561	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CH_4	8.109	0.053	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c	CH_4	1.774	0.102	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Agriculture/Forestry/Fisheries - Gaseous Fuels													Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	CH_4	9.150	3.698	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Peat	CH_4	0.233	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.c Agriculture/Forestry/Fisheries - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	43.267	36.077	2%	50%	0.500	0.000	0.000	0.002	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	N_2O	0.483	0.003	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	N_2O	0.423	0.024	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Biomass Fuels	N_2O	1.454	0.606	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/Fisheries - Peat	N_2O	0.014	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Agriculture/Forestry/Fisheries - Other Fossil Fuels													Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.5.b Mobile - Liquid Fuels	CO_2	0.000	9.568	2%	50%	0.500	0.000	0.001	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.5.b Mobile - Liquid Fuels	CH_4	0.000	0.020	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.5.b Mobile - Liquid Fuels	N_2O	0.000	0.077	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.B.2.b Natural Gas	CO_2	0.009	0.011	32%	0%	0.322	0.000	0.000	0.000	0.000	0.000	0.000	AD - Latvijas Gāze
1.B.2.b Natural Gas	CH_4	177.238	86.683	32%	0%	0.322	0.000	0.002	0.005	0.000	0.002	0.000	AD - Latvijas Gāze
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	10%	0%	0.100	0.000	0.000	0.000	0.000	0.000	0.000	AD - Latvijas Gāze
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	10%	0%	0.100	0.000	0.002	0.001	0.000	0.000	0.000	AD - Latvijas Gāze

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
2.A.1. Cement Production	CO_2	345.783	466.713	8%	5%	0.094	0.000	0.012	0.027	0.001	0.003	0.000	AD - Cement Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 2, page 2.7 Table 2.3
2.A.2. Lime Production	CO_2	169.024	0.721	8%	2%	0.082	0.000	0.007	0.000	0.000	0.000	0.000	AD - Lime Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 2, page 2.25 Table 2.5
2.A.3. Glass production	CO_2	0.356	0.457	3%	60%	0.601	0.000	0.000	0.000	0.000	0.000	0.000	AD - Glass Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 2, page 2.31
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	8%	50%	0.506	0.000	0.002	0.000	0.001	0.000	0.000	AD - Bricks Production plant`s GHG report under EU ETS; EF - Expert judgment
2.A.4.b Other Use of soda ash	CO_2	0.000	0.673	8%	50%	0.506	0.000	0.000	0.000	0.000	0.000	0.000	AD - Glass Production plant`s GHG report under EU

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													ETS; EF - Expert judgment
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	5%	10%	0.112	0.000	0.003	0.000	0.000	0.000	0.000	AD - Steel Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 4, Table 4.4
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - Steel Production plant`s GHG report under EU ETS; EF - Expert judgment
2.D.1 Lubricant Use	CO_2	23.251	13.722	2%	50%	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD - CSB; EF - 2006 IPCC Guidelines, Volume 3, Chapter 5, page 5.10
2.D.2 Paraffin wax use	CO_2	0.000	4.912	2%	100%	1.000	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSB; EF - 2006 IPCC Guidelines, Volume 3, Chapter 5, page 5.13
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.D.3. Solvent Use	CO_2	24.434	22.815	25%	10%	0.269	0.000	0.000	0.001	0.000	0.000	0.000	AD, EF - 2006 IPCC Guidelines, Volume 3, Chapter 5, pp.5.17

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
2.D.3.d Urea Use	CO_2	0.000	0.981	20%	10%	0.224	0.000	0.000	0.000	0.000	0.000	0.000	Volume 2: Energy pp 3.12
2.F.1. Refrigeration and air conditioning	HFCs	0.000	217.872	50%	50%	0.707	0.000	0.013	0.013	0.006	0.009	0.000	AD, EF - Expert judgment
2.F.2 Foam blowing agents	HFCs	0.000	4.380	50%	50%	0.707	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.F.3. Fire Protection	HFCs	0.000	0.003	50%	50%	0.707	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.F.4. Aerosols	HFCs	0.000	4.803	50%	50%	0.707	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.G.1. Electrical equipment	SF6	0.000	10.118	2%	25%	0.251	0.000	0.001	0.001	0.000	0.000	0.000	AD, EF - 2006 IPCC Guidelines, Colume 3, Chapter 8, page 8.21, Table 8.5
2.G.3. N_2O from product uses	N_2O	3.250	3.572	2%	100%	1.000	0.000	0.000	0.000	0.000	0.000	0.000	AD - State Agency of Medicines of Latvia, EF - Belgium National Inventory Report, 2014
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	**2%**	**20%**	0.201	0.000	0.042	0.047	0.008	0.001	0.000	AD - Central Statistical Bureau EF -IPCC
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	**2%**	**50%**	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD - Central Statistical Bureau EF -IPCC
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	**2%**	**20%**	0.201	0.000	0.001	0.001	0.000	0.000	0.000	AD - Central Statistical Bureau EF -IPCC

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3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	**2%**	**50%**	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD - Central Statistical Bureau EF -IPCC
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	**25%**	**20%**	0.320	0.000	0.001	0.004	0.000	0.001	0.000	AD, EF -IPCC
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	**25%**	**20%**	0.320	0.000	0.003	0.002	0.001	0.001	0.000	AD, EF -IPCC
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	**25%**	**20%**	0.320	0.000	0.001	0.001	0.000	0.000	0.000	AD, EF -IPCC
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	**25%**	**20%**	0.320	0.000	0.001	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	**25%**	**30%**	0.391	0.000	0.000	0.001	0.000	0.000	0.000	AD, EF -IPCC
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	**25%**	**50%**	0.559	0.000	0.003	0.002	0.001	0.001	0.000	AD - IPCC, EF - Expert judgment
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	**25%**	**50%**	0.559	0.004	0.002	0.085	0.001	0.030	0.001	AD - IPCC, EF - Expert judgment
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	**2%**	**50%**	0.500	0.000	0.003	0.010	0.002	0.000	0.000	
3.G. Liming	CO_2	357.133	19.938	**5%**	**50%**	0.502	0.000	0.014	0.001	0.007	0.000	0.000	AD - Expert

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													judgment, EF - IPCC
3.H. Urea Application	CO_2	7.709	6.210	**2%**	**50%**	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD - Central Statistical Bureau, EF - IPCC
4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2	-19460.504	-4978.021	1.61%	3.09%	0.035	0.000	0.539	0.287	0.017	0.007	0.000	AD - NFI, EF - NFI; J. Liepiņš et al. 2015, 2016; expert judgement
4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2	77.978	-2247.360	1.61%	31.00%	0.310	0.003	0.133	0.129	0.041	0.003	0.002	AD - NFI, EF - NFI; expert judgement
4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2	4125.549	4566.495	5.28%	25.00%	0.256	0.008	0.089	0.263	0.022	0.020	0.001	AD - NFI, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2	-0.162	-376.289	8.02%	52.30%	0.529	0.000	0.022	0.022	0.011	0.002	0.000	AD - NFI, EF - NFI; J. Liepiņš et al. 2015, 2016; expert judgement
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2	-1.403	-74.180	8.02%	31.00%	0.320	0.000	0.004	0.004	0.001	0.000	0.000	AD - NFI, EF - NFI; expert judgement

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, litter	CO_2	-1.382	-73.073	8.02%	23.00%	0.244	0.000	0.004	0.004	0.001	0.000	0.000	AD - NFI, EF - NFI; forest soil monitoring project BioSoil
4.A.2 Land converted to Forest Land – grassland converted to forest land, Drained organic soil	CO_2	0.000	59.870	43.53%	25.00%	0.502	0.000	0.003	0.003	0.001	0.002	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.A.1 Forest land remaining forest land - Controlled burning	CO_2	218.068	70.245	92.60%	6.00%	0.928	0.000	0.005	0.004	0.000	0.005	0.000	AD - 2006 IPCC Guidelines, Table 2.6; expert judgement, EF - 2006 IPCC Guidelines, Table 2.5
4.A.1 Forest land remaining forest land - Controlled burning	CH_4	21.455	6.911	92.60%	36.00%	0.994	0.000	0.001	0.000	0.000	0.001	0.000	AD - 2006 IPCC Guidelines, Table 2.6; expert judgement, EF - 2006 IPCC Guidelines, Table 2.5
4.A.1 Forest land remaining forest land - Controlled burning	N_2O	2.516	0.810	92.60%		0.926	0.000	0.000	0.000	0.000	0.000	0.000	AD - 2006 IPCC Guidelines, Table 2.6; expert judgement, EF - NO
4.A.1 Forest land remaining forest land - wildfires	CH_4	2.544	6.246	37.00%	36.00%	0.516	0.000	0.000	0.000	0.000	0.000	0.000	AD - 2006 IPCC Guidelines, Table 2.6; expert judgement, EF

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													- 2006 IPCC Guidelines, Table 2.5
4.A.1 Forest land remaining forest land - wildfires	N_2O	0.298	0.732	37.00%		0.370	0.000	0.000	0.000	0.000	0.000	0.000	AD - 2006 IPCC Guidelines, Table 2.6; expert judgement, EF - NO
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	0.000	22.068	1.50%	242.00%	2.420	0.000	0.001	0.001	0.003	0.000	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 3.1
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	56.126	149.606	43.80%	104.90%	1.137	0.000	0.006	0.009	0.007	0.005	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.3 and Table 2.4
4.A.1. Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O	567.422	636.303	43.80%	119.11%	1.269	0.004	0.013	0.037	0.015	0.023	0.001	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.5

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4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2	-6.274	-9.207	2.60%	700.70%	7.007	0.000	0.000	0.001	0.002	0.000	0.000	AD - NFI, EF - NFI
4.B.1 Cropland remaining Cropland – Carbon stock change – dead organic matter	CO_2	-1.402	-0.578	2.60%	31.00%	0.311	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - NFI; expert judgement
4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2	2761.365	2609.306	13.30%	18.40%	0.227	0.002	0.034	0.150	0.006	0.028	0.001	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2	382.478	117.235	53.37%	60.00%	0.803	0.000	0.009	0.007	0.006	0.005	0.000	AD - NFI, EF - NFI; J. Liepiņš et al. 2015, 2016; forest soil monitoring project BioSoil
4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2	143.035	44.325	53.37%	38.60%	0.659	0.000	0.003	0.003	0.001	0.002	0.000	AD - NFI, EF - NFI; expert judgement
4.B.2 Land converted to Cropland –Mineral soil	CO_2	6.935	44.936	64.45%	15.00%	0.662	0.000	0.002	0.003	0.000	0.002	0.000	AD - NFI, EF - Forest soil monitoring project BioSoil; 2006 IPCC Guidelines,

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													Table 5.5
4.B.2 Land converted to Cropland – Drained organic soil	CO_2	12.456	79.079	113.85%	18.40%	1.153	0.000	0.004	0.005	0.001	0.007	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.B.2 Grassland converted to cropland, organic soils	CO_2	0.000	0.000	113.85%	18.36%	1.153	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.B.2 Grassland converted to cropland, mineral soils	CO_2	0.000	0.000	64.45%	12.00%	0.656	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table 5.5
4.B.2 Wetlands converted to cropland, organic soil	CO_2	0.000	4.461	113.85%	18.36%	1.153	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.B.2 Settlements converted to cropland, mineral soils	CO_2	0.000	7.435	64.45%	60.00%	0.881	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table 5.5

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4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	125.098	119.259	114.70%	71.00%	1.349	0.000	0.002	0.007	0.001	0.011	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.4
4.B.2 Land converted to cropland, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.590	4.459	64.45%	150.70%	1.639	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table 11.1 and Equation 11.8
4.C.1 Grassland remaining Grassland – Carbon stock change – living biomass	CO_2	-19.648	-48.372	4.98%	122.10%	1.222	0.000	0.002	0.003	0.002	0.000	0.000	AD - NFI, EF - NFI
4.C.1 Grassland remaining Grassland – Carbon stock change – dead organic matter	CO_2	-4.389	-4.943	4.98%	31.00%	0.314	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - NFI; expert judgement
4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2	924.833	688.603	25.74%	18.90%	0.319	0.000	0.001	0.040	0.000	0.014	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National

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													Greenhouse Gas Inventories: Wetlands, Table 2.1
4.C.2 Land converted to Grassland –Mineral soil	CO_2	-0.003	-464.133	9.96%	12.00%	0.156	0.000	0.027	0.027	0.003	0.004	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table 5.5
4.C.2 Land converted to Grassland – Drained organic soil	CO_2	0.001	130.610	55.10%	18.90%	0.583	0.000	0.008	0.008	0.001	0.006	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.C. Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	69.988	61.995	60.80%	81.50%	1.017	0.000	0.001	0.004	0.001	0.003	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.3 and Table 2.4
4.C.1 Grassland remaining Grassland, wildfires	CH_4	0.050	0.291	10.00%	39.00%	0.403	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table2.5
4.C.1 Grassland remaining Grassland, wildfires	N_2O	0.054	0.317	10.00%	48.00%	0.490	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table2.5
4.C.2. Lands converted to	N_2O	0.000	0.000			0.000	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - NO

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grasslands, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils													
4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2	-66.910	-185.154	5.90%	447.50%	4.475	0.004	0.008	0.011	0.035	0.001	0.001	AD - NFI, EF - NFI
4.D.1 Wetlands remaining Wetlands – Carbon stock change – dead organic matter	CO_2	-14.143	-16.324	5.90%	31.00%	0.316	0.000	0.000	0.001	0.000	0.000	0.000	AD - NFI, EF - NFI,expert judgement
4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2	277.200	277.200	24.23%	55.35%	0.604	0.000	0.004	0.016	0.002	0.005	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.D.1. Wetlands, Peat extraction from lands, organic soils	CO_2	1016.928	903.996	24.23%		0.242	0.000	0.009	0.052	0.000	0.018	0.000	AD - NFI, EF - NO
4.D.1. Wetlands, Peat	CH_4	28.534	28.534	24.23%	80.60%	0.842	0.000	0.000	0.002	0.000	0.001	0.000	AD - NFI, EF - 2013 Supplement to the

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extraction from lands, organic soils													2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.3 and Table 2.4
4.D.1. Wetlands, Peat extraction from lands, organic soils	N_2O	3.793	3.793	24.23%	107.17%	1.099	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.5
4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2	-49.115	-115.994	8.67%	419.60%	4.197	0.001	0.005	0.007	0.019	0.001	0.000	AD - NFI, EF - NFI
4.E.1 Settlements remaining Settlements – Carbon stock change – dead organic matter	CO_2	-6.589	-6.229	8.67%	31.00%	0.322	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - NFI; expert judgement
4.E.1 Settlements remaining Settlements – Drained organic soils	CO_2	0.000	23.320	8.67%	18.34%	0.203	0.000	0.001	0.001	0.000	0.000	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.E.2 Land converted to	CO_2	118.735	547.674	19.60%	334.30%	3.349	0.021	0.027	0.032	0.089	0.009	0.008	AD - NFI, EF - NFI

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Settlements – Carbon stock change – living biomass													
4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2	44.403	207.069	19.60%	30.60%	0.363	0.000	0.010	0.012	0.003	0.003	0.000	AD - NFI, EF - NFI; expert judgement; forest soil monitoring project BioSoil
4.E.2 Land converted to Settlements – Mineral soils	CO_2	1.400	101.407	21.98%	15.60%	0.270	0.000	0.006	0.006	0.001	0.002	0.000	AD - NFI, EF - Forest soil monitoring project BioSoil
4.E.2 Land converted to Settlements – Organic soils	CO_2	3.766	178.520	47.04%	18.34%	0.505	0.000	0.010	0.010	0.002	0.007	0.000	AD - NFI, EF - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.1
4.E.2 Lands converted to settlements, Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	0.911	54.038	19.60%	150.70%	1.520	0.000	0.003	0.003	0.005	0.001	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table 11.1 and Equation 11.8
4.E.2 Settlements remaining Settlements, Direct nitrous	N_2O		4.901	8.67%	37.69%	0.387	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2013 Supplement to the

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils													2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Table 2.5
4. G. Harvested wood products	CO_2	-149.836	-1788.020	15.00%	0.00%	0.150	0.000	0.097	0.103	0.000	0.022	0.000	AD, EF - NO
4 (IV) Indirect nitrous oxide (N_2O) emissions from managed soils	N_2O	0.160	2.973	41.60%	211.60%	2.157	0.000	0.000	0.000	0.000	0.000	0.000	AD - NFI, EF - 2006 IPCC Guidelines, Table 11.3 and Equation 11.8
5.A.1. Managed Waste Disposal on Land	CH_4	0.000	268.779	7%	52%	0.525	0.000	0.015	0.015	0.008	0.002	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	7%	52%	0.525	0.000	0.005	0.007	0.003	0.001	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.B.1. Composting	CH_4	23.909	25.831	37%	100%	1.066	0.000	0.000	0.001	0.000	0.001	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
5.B.1. Composting	N_2O	17.100	18.474	37%	90%	0.973	0.000	0.000	0.001	0.000	0.001	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.C.1 Waste Incineration	CO_2	0.575	0.180	44%	40%	0.595	0.000	0.000	0.000	0.000	0.000	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.C.1 Waste Incineration	N_2O	3.436	1.811	44%	100%	1.093	0.000	0.000	0.000	0.000	0.000	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	6%	30%	0.306	0.000	0.002	0.006	0.001	0.000	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.17
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	8%	30%	0.310	0.000	0.000	0.001	0.000	0.000	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.27
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	14%	30%	0.331	0.000	0.002	0.008	0.001	0.002	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.23
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	13%	30%	0.327	0.000	0.000	0.000	0.000	0.000	0.000	AD - calculated, EF - 2006 IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Guidelines, Volume 5, Chapter 6, pp. 6.27
Total		17354.3389	12679.8108				0.0518					0.0177	
Total Uncertainties						Uncertainty in total inventory %:	**23%**				Trend uncertainty %:	**13%**	

A.2.2 Approach 1 uncertainty analysis for 2015 excluding LULUCF

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%	
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	3078.955	2.115	2%	10%	0.102	0.000	0.051	0.000	0.005	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	218.053	9.933	2%	20%	0.201	0.000	0.003	0.000	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	2657.607	1677.790	2%	5%	0.054	0.000	0.020	0.064	0.001	0.002	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	145.786	0.000	5%	10%	0.112	0.000	0.002	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.a Public Electricity and Heat Production - Other	CO_2	3.079	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
fossil fuels													
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CH_4	3.005	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CH_4	0.058	0.003	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CH_4	1.205	0.768	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	0.327	9.270	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Peat	CH_4	0.034	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	CH_4	0.032	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	N_2O	7.163	0.005	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Solid Fuels	N_2O	1.030	0.047	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	N_2O	1.437	0.915	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	0.520	14.711	5%	50%	0.502	0.000	0.001	0.001	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Peat	N_2O	0.616	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.a Public Electricity and Heat Production - Other fossil fuels	N_2O	0.050	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	25.015	19.061	2%	10%	0.102	0.000	0.000	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid Fuels and Other Energy	CO_2	44.924	37.312	2%	5%	0.054	0.000	0.001	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Industries - Gaseous Fuels													
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	75.346	0.000	5%	10%	0.112	0.000	0.001	0.000	0.000	0.000	0.000	AD -AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CH_4	0.023	0.019	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH_4	0.020	0.017	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass	CH_4	0.000	0.281	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels													2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CH_4	0.018	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	N_2O	0.054	0.046	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	N_2O	0.024	0.020	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Biomass Fuels	N_2O	0.000	0.446	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	N_2O	0.318	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	94.194	0.000	2%	10%	0.102	0.000	0.002	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Solid Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	235.643	22.180	2%	5%	0.054	0.000	0.003	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.a Iron and Steel - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	61.352	0.000	2%	20%	0.201	0.000	0.001	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.a Iron and Steel - Liquid Fuels	CH_4	0.091	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Solid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Gaseous Fuels	CH_4	0.107	0.010	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Biomass Fuels	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Other fossil fuels	CH_4	0.628	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Liquid Fuels	N_2O	0.218	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Solid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Gaseous Fuels	N_2O	0.127	0.012	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Biomass Fuels	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.a Iron and Steel - Other fossil fuels	N_2O	0.998	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CO_2	0.000	0.000	2%	10%	0.102	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.b Non-Ferrous Metals - Solid Fuels	CO_2	0.000	0.095	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CO_2	0.000	3.278	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.b Non-Ferrous Metals - Liquid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Solid Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	CH_4	0.000	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.b Non-Ferrous Metals - Biomass Fuels	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Liquid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Solid Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Gaseous Fuels	N_2O	0.000	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Table 2.12
1.A.2.b Non-Ferrous Metals - Biomass Fuels	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.b Non-Ferrous Metals - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Liquid Fuels	CO_2	279.473	9.395	2%	10%	0.102	0.000	0.004	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.c Chemicals - Gaseous Fuels	CO_2	23.542	18.028	2%	5%	0.054	0.000	0.000	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.c Chemicals - Peat	CO_2	0.000	0.000	5%	11%	0.120	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.c Chemicals - Liquid Fuels	CH_4	0.273	0.004	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Gaseous Fuels	CH_4	0.011	0.008	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Biomass Fuels	CH_4	0.000	0.168	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Table 2.12
1.A.2.c Chemicals - Liquid Fuels	N_2O	0.651	0.006	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Gaseous Fuels	N_2O	0.013	0.010	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Biomass Fuels	N_2O	0.000	0.266	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.c Chemicals - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CO_2	15.704	0.400	2%	10%	0.102	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CO_2	2.692	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	150.166	5.190	2%	5%	0.054	0.000	0.002	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	CH_4	0.015	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Solid Fuels	CH_4	0.007	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertain ty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contributio n to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CH_4	0.068	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	CH_4	0.000	0.004	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Liquid Fuels	N_2O	0.036	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Solid Fuels	N_2O	0.013	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Table 2.12
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	N_2O	0.081	0.003	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Biomass Fuels	N_2O	0.000	0.006	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.d. Pulp, Paper and Print - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	806.130	18.203	2%	11%	0.111	0.000	0.013	0.001	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	103.071	2.270	2%	20%	0.201	0.000	0.002	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	175.098	88.883	2%	5%	0.054	0.000	0.001	0.003	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CO_2	0.000	2.126	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CH_4	0.789	0.013	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CH_4	0.267	0.006	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CH_4	0.079	0.041	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	CH_4	0.171	0.195	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	CH_4	0.000	0.022	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Liquid	N_2O	1.879	0.026	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels													Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	N_2O	0.478	0.011	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	N_2O	0.095	0.048	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Biomass Fuels	N_2O	0.272	0.309	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.e Food Processing, Beverages and Tobacco - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.e Food Processing, Beverages and Tobacco - Other Fossil Fuels	N_2O	0.000	0.035	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	276.247	20.992	2%	10%	0.102	0.000	0.004	0.001	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	16.429	90.532	2%	20%	0.201	0.000	0.003	0.003	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	316.064	65.993	2%	5%	0.054	0.000	0.003	0.003	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Peat	CO_2	0.000	0.000	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	0.000	106.159	2%	2%	0.028	0.000	0.004	0.004	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.f Non-metallic Minerals - Liquid	CH_4	0.269	0.021	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels													Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Solid Fuels	CH_4	0.043	0.239	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CH_4	0.143	0.030	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Biomass Fuels	CH_4	0.005	0.850	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Peat	CH_4	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CH_4	0.000	0.914	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Liquid Fuels	N_2O	0.641	0.050	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Solid Fuels	N_2O	0.076	0.428	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Gaseous Fuels	N_2O	0.171	0.036	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Biomass Fuels	N_2O	0.008	1.351	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Peat	N_2O	0.000	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	N_2O	0.000	1.453	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Liquid Fuels	CO_2	803.741	96.544	2%	10%	0.102	0.000	0.010	0.004	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.2.g Other - Solid Fuels	CO_2	27.263	3.027	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Gaseous Fuels	CO_2	526.803	83.911	2%	5%	0.054	0.000	0.006	0.003	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Peat	CO_2	0.000	1.157	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Other Fossil Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.2.g Other - Liquid Fuels	CH_4	2.265	0.173	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.2.g Other - Solid Fuels	CH_4	0.069	0.008	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Gaseous Fuels	CH_4	0.239	0.038	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Biomass Fuels	CH_4	0.287	11.302	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Peat	CH_4	0.000	0.001	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Liquid Fuels	N_2O	2.149	0.232	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.2.g Other - Solid Fuels	N_2O	0.124	0.014	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Stationary combustion, Table 2.12
1.A.2.g Other - Gaseous Fuels	N_2O	0.285	0.046	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Biomass Fuels	N_2O	0.455	17.962	5%	50%	0.502	0.000	0.001	0.001	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Peat	N_2O	0.000	0.005	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.2.g Other - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.3.a Domestic Aviation - Aviation Gasoline	CO_2	0.011	0.420	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Jet kerosene	CO_2	0.055	1.311	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Aviation Gasoline	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Jet kerosene	CH_4	0.000	0.000	2%	60%	0.600	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Aviation Gasoline	N_2O	0.000	0.004	2%	70%	0.700	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.a Domestic Aviation - Jet kerosene	N_2O	0.000	0.013	2%	70%	0.700	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.69
1.A.3.b Road Transportation - Gasoline	CO_2	1723.750	610.446	2%	2%	0.028	0.000	0.005	0.023	0.000	0.001	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Diesel Oil	CO_2	616.136	2072.062	2%	2%	0.028	0.000	0.069	0.079	0.001	0.002	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - LPG	CO_2	37.141	168.611	2%	5%	0.054	0.000	0.006	0.006	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.3.b Road Transportation - Lubricants	CO_2	3.463	5.062	10%	5%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gaseous Fuels	CO_2	17.617	0.000	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gasoline	CH_4	17.155	2.114	2%	30%	0.301	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Diesel Oil	CH_4	1.108	1.283	2%	30%	0.301	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - LPG	CH_4	0.125	0.839	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Lubricants	CH_4	0.025	0.017	10%	50%	0.510	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gaseous Fuels	CH_4	0.702	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Biomass	CH_4	0.000	0.024	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gasoline	N_2O	13.074	4.326	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29

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1.A.3.b Road Transportation - Diesel Oil	N_2O	5.594	22.387	2%	50%	0.500	0.000	0.001	0.001	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - LPG	N_2O	0.164	2.763	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Lubricants	N_2O	0.024	0.037	10%	50%	0.510	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Gaseous Fuels	N_2O	0.273	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.b Road Transportation - Biomass	N_2O	0.000	0.367	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.29
1.A.3.c Railways - Liquid Fuels	CO_2	531.380	204.610	2%	2%	0.028	0.000	0.001	0.008	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c Railways - Liquid Fuels	CH_4	0.745	0.287	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c. Railway Biomass Fuels	CH_4	0.000	0.002	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c Railways - Liquid Fuels	N_2O	61.201	23.566	2%	50%	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46
1.A.3.c. Railway Biomass Fuels	N_2O	0.000	0.031	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.43&3.46

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.3.d Domestic Naviagtion - Gasoline	CO_2	0.173	0.208	20%	5%	0.206	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Diesel Oil	CO_2	0.833	9.546	2%	5%	0.054	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Gasoline	CH_4	0.003	0.004	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Diesel Oil	CH_4	0.001	0.013	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Gasoline	N_2O	0.000	0.000	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.3.d Domestic Naviagtion - Diesel Oil	N_2O	0.101	1.153	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD – CSB; EF - 2006 IPCC Guidelines, Volume 2, pp.3.54
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	1017.269	165.779	2%	10%	0.102	0.000	0.010	0.006	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	1410.785	30.556	2%	20%	0.201	0.000	0.022	0.001	0.004	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	335.687	227.588	2%	5%	0.054	0.000	0.003	0.009	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Peat	CO_2	66.886	0.000	5%	11%	0.120	0.000	0.001	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Other Fossil Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.a Commercial/Institutional - Liquid Fuels	CH_4	3.495	0.680	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.a Commercial/Institutional - Solid Fuels	CH_4	3.728	0.081	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.a Commercial/Institutional - Gaseous Fuels	CH_4	0.761	0.521	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Biomass Fuels	CH_4	39.135	34.152	5%	50%	0.502	0.000	0.001	0.001	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Peat	CH_4	0.168	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	2.412	0.393	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.a Commercial/Institutional - Solid Fuels	N_2O	6.666	0.144	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Gaseous Fuels	N_2O	0.181	0.124	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Biomass Fuels	N_2O	6.220	5.437	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.a Commercial/Institutional - Peat	N_2O	0.296	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Table 2.12
1.A.4.a Commercial/Institutional - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Liquid Fuels	CO_2	332.334	143.549	2%	10%	0.102	0.000	0.000	0.005	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.b Residential - Solid Fuels	CO_2	605.818	47.395	2%	20%	0.201	0.000	0.008	0.002	0.002	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Gaseous Fuels	CO_2	220.705	224.856	2%	5%	0.054	0.000	0.005	0.009	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Peat	CO_2	42.549	0.000	5%	10%	0.112	0.000	0.001	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.b Residential - Other Fossil Fuels	CO_2	0.000	0.000	2%	20%	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.b Residential - Liquid Fuels	CH_4	0.868	1.105	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.b Residential - Solid Fuels	CH_4	48.030	3.758	2%	50%	0.500	0.000	0.001	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Gaseous Fuels	CH_4	0.501	0.515	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Biomass Fuels	CH_4	96.425	99.514	15%	10%	0.180	0.000	0.002	0.004	0.000	0.001	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.b Residential - Peat	CH_4	3.188	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Liquid Fuels	N_2O	0.450	0.318	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.b Residential - Solid Fuels	N_2O	2.863	0.224	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Gaseous Fuels	N_2O	0.119	0.123	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

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													Table 2.12
1.A.4.b Residential - Biomass Fuels	N_2O	8.944	8.556	15%	30%	0.335	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Peat	N_2O	0.186	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.b Residential - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Liquid Fuels	CO_2	700.654	341.689	2%	11%	0.109	0.000	0.001	0.013	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.c Agriculture/Forestry/ Fisheries - Solid Fuels	CO_2	102.282	0.662	2%	50%	0.500	0.000	0.002	0.000	0.001	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/ Fisheries - Gaseous Fuels	CO_2	782.443	44.742	2%	50%	0.500	0.000	0.011	0.002	0.006	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/ Fisheries - Peat	CO_2	3.023	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/ Fisheries - Other Fossil Fuels	CO_2	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.38
1.A.4.c Agriculture/Forestry/ Fisheries - Liquid Fuels	CH_4	5.286	0.561	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Solid Fuels	CH_4	8.109	0.053	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.A.4.c Agriculture/Forestry/ Fisheries - Gaseous Fuels	CH_4	1.774	0.102	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Biomass Fuels	CH_4	9.150	3.698	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Peat	CH_4	0.233	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Other Fossil Fuels	CH_4	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Liquid	N_2O	43.267	36.077	2%	50%	0.500	0.000	0.001	0.001	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
Fuels													Table 2.12; 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.4.c Agriculture/Forestry/ Fisheries - Solid Fuels	N_2O	0.483	0.003	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Gaseous Fuels	N_2O	0.423	0.024	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Biomass Fuels	N_2O	1.454	0.606	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Peat	N_2O	0.014	0.000	5%	50%	0.502	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSP; 2006 IPCC Guidelines, Volume 2, Chapter 1, pg. 1.19; 2006 IPCC Guidelines, Volume 2, Chapter 2, pg. 2.41 EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion,

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
													Table 2.12
1.A.4.c Agriculture/Forestry/ Fisheries - Other Fossil Fuels	N_2O	0.000	0.000	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 2 Stationary combustion, Table 2.12
1.A.5.b Mobile - Liquid Fuels	CO_2	0.000	9.568	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF-2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.5.b Mobile - Liquid Fuels	CH_4	0.000	0.020	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.A.5.b Mobile - Liquid Fuels	N_2O	0.000	0.077	2%	50%	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD -CSP; EF- 2006 IPCC Guidelines, Volume 2, Chapter 3 Mobile combustion, Section 3.6.1.7
1.B.2.b Natural Gas	CO_2	0.009	0.011	32%	0%	0.322	0.000	0.000	0.000	0.000	0.000	0.000	AD - Latvijas Gāze
1.B.2.b Natural Gas	CH_4	177.238	86.683	32%	0%	0.322	0.000	0.000	0.003	0.000	0.002	0.000	AD - Latvijas Gāze
1.B.2.c Venting and Flaring	CO_2	0.003	0.002	10%	0%	0.100	0.000	0.000	0.000	0.000	0.000	0.000	AD - Latvijas Gāze

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
1.B.2.c Venting and Flaring	CH_4	70.344	16.117	10%	0%	0.100	0.000	0.001	0.001	0.000	0.000	0.000	AD - Latvijas Gāze
2.A.1. Cement Production	CO_2	345.783	466.713	8%	5%	0.094	0.000	0.012	0.018	0.001	0.002	0.000	AD - Cement Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 2, page 2.7 Table 2.3
2.A.2. Lime Production	CO_2	169.024	0.721	8%	2%	0.082	0.000	0.003	0.000	0.000	0.000	0.000	AD - Lime Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 2, page 2.25 Table 2.5
2.A.3. Glass production	CO_2	0.356	0.457	3%	60%	0.601	0.000	0.000	0.000	0.000	0.000	0.000	AD - Glass Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3, Chapter 2, page 2.31
2.A.4. Other process uses of carbonates	CO_2	69.185	7.640	8%	50%	0.506	0.000	0.001	0.000	0.000	0.000	0.000	AD - Bricks Production plant`s GHG report under EU ETS; EF - Expert judgment
2.A.4.b Other Use of soda ash	CO_2	0.000	0.673	8%	50%								AD - Glass Production plant`s GHG report under EU ETS; EF - Expert judgment
2.C.1 Iron and Steel Production	CO_2	69.692	1.036	5%	10%	0.112	0.000	0.001	0.000	0.000	0.000	0.000	AD - Steel Production plant`s GHG report under EU ETS; EF - 2006 IPCC Guidelines, Volume 3,

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													Chapter 4, Table 4.4
2.C.1 Iron and Steel Production	CH_4	0.069	0.002	5%	10%	0.112	0.000	0.000	0.000	0.000	0.000	0.000	AD - Steel Production plant`s GHG report under EU ETS; EF - Expert judgment
2.D.1 Lubricant Use	CO_2	23.251	13.722	2%	50%	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD - CSB; EF - 2006 IPCC Guidelines, Volume 3, Chapter 5, page 5.10
2.D.2 Paraffin wax use	CO_2	0.000	4.912	2%	100%	1.000	0.000	0.000	0.000	0.000	0.000	0.000	AD - CSB; EF - 2006 IPCC Guidelines, Volume 3, Chapter 5, page 5.13
2.D.3.b Road paving with asphalt	CO_2	0.001	0.062	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.D.3.c Asphalt roofing	CO_2	0.003	0.056	20%	50%	0.539	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.D.3. Solvent Use	CO_2	24.434	22.815	25%	10%	0.269	0.000	0.000	0.001	0.000	0.000	0.000	AD, EF - 2006 IPCC Guidelines, Volume 3, Chapter 5, pp.5.17
2.D.3.d Urea Use	CO_2	0.000	0.981	20%	10%	0.224	0.000	0.000	0.000	0.000	0.000	0.000	Volume 2: Energy pp 3.12
2.F.1. Refrigeration and air conditioning	HFCs	0.000	217.872	50%	50%	0.707	0.000	0.008	0.008	0.004	0.006	0.000	AD, EF - Expert judgment
2.F.2 Foam blowing agents	HFCs	0.000	4.380	50%	50%	0.707	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.F.3. Fire Protection	HFCs	0.000	0.003	50%	50%	0.707	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
2.F.4. Aerosols	HFCs	0.000	4.803	50%	50%	0.707	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - Expert judgment
2.G.1. Electrical equipment	SF6	0.000	10.118	2%	25%	0.251	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF - 2006 IPCC Guidelines, Colume 3, Chapter 8, page 8.21, Table 8.5
2.G.3. N_2O from product uses	N_2O	3.250	3.572	2%	100%	1.000	0.000	0.000	0.000	0.000	0.000	0.000	AD - State Agency of Medicines of Latvia, EF - Belgium National Inventory Report, 2014
3.A.1 Enteric Fermentation - Cattle	CH_4	2117.989	811.783	**2%**	**20%**	0.201	0.000	0.004	0.031	0.001	0.001	0.000	AD - Central Statistical Bureau EF -IPCC
3.A.2 Enteric Fermentation - Sheep	CH_4	32.920	20.460	**2%**	**50%**	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD - Central Statistical Bureau EF -IPCC
3.A.3 Enteric Fermentation - Swine	CH_4	52.541	12.533	**2%**	**20%**	0.201	0.000	0.000	0.000	0.000	0.000	0.000	AD - Central Statistical Bureau EF -IPCC
3.A.4 Enteric Fermentation - Other livestock	CH_4	18.091	13.455	**2%**	**50%**	0.500	0.000	0.000	0.001	0.000	0.000	0.000	AD - Central Statistical Bureau EF -IPCC
3.B.1.1 Manure Management - Cattle	CH_4	110.967	71.220	**25%**	**20%**	0.320	0.000	0.001	0.003	0.000	0.001	0.000	AD, EF -IPCC
3.B.2.1 Manure Management - Cattle	N_2O	120.666	41.093	**25%**	**20%**	0.320	0.000	0.000	0.002	0.000	0.001	0.000	AD, EF -IPCC
3.B.1.2 Manure Management - Sheep	CH_4	0.782	0.486	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
3.B.2.2 Manure Management - Sheep	N_2O	4.652	2.804	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.1.3 Manure Management - Swaine	CH_4	65.378	22.007	**25%**	**20%**	0.320	0.000	0.000	0.001	0.000	0.000	0.000	AD, EF -IPCC
3.B.2.3 Manure Management - Swaine	N_2O	40.269	5.898	**25%**	**20%**	0.320	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.1.4 Manure Management - Other livestock	CH_4	12.485	7.429	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.2.4 Manure Management - Other livestock	N_2O	22.276	11.077	**25%**	**30%**	0.391	0.000	0.000	0.000	0.000	0.000	0.000	AD, EF -IPCC
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	119.570	35.627	**25%**	**50%**	0.559	0.000	0.001	0.001	0.000	0.000	0.000	AD - IPCC, EF - Expert judgment
3.D.1. Direct N_2O emissions from managed soils	N_2O	1967.300	1480.082	**25%**	**50%**	0.559	0.005	0.024	0.057	0.012	0.020	0.001	AD - IPCC, EF - Expert judgment
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	319.950	177.538	**2%**	**50%**	0.500	0.000	0.001	0.007	0.001	0.000	0.000	
3.G. Liming	CO_2	357.133	19.938	**5%**	**50%**	0.502	0.000	0.005	0.001	0.003	0.000	0.000	AD - Expert judgment, EF - IPCC
3.H. Urea Application	CO_2	7.709	6.210	**2%**	**50%**	0.500	0.000	0.000	0.000	0.000	0.000	0.000	AD - Central Statistical Bureau, EF - IPCC

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
5.A.1. Managed Waste Disposal on Land	CH_4	0.000	268.779	7%	52%	0.525	0.000	0.010	0.010	0.005	0.001	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.A.2. Unmanaged Waste Disposal Sites	CH_4	283.062	118.691	7%	52%	0.525	0.000	0.000	0.005	0.000	0.000	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.B.1. Composting	CH_4	23.909	25.831	37%	100%	1.066	0.000	0.001	0.001	0.001	0.001	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.B.1. Composting	N_2O	17.100	18.474	37%	90%	0.973	0.000	0.000	0.001	0.000	0.000	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.C.1 Waste Incineration	CO_2	0.575	0.180	44%	40%	0.595	0.000	0.000	0.000	0.000	0.000	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.C.1 Waste Incineration	N_2O	3.436	1.811	44%	100%	1.093	0.000	0.000	0.000	0.000	0.000	0.000	AD uncertainty calculated using trend line and measured data; EF - 2006 IPCC Guidelines
5.D.1 Domestic Wastewater	CH_4	185.075	99.075	6%	30%	0.306	0.000	0.001	0.004	0.000	0.000	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.17
5.D.1 Domestic Wastewater	N_2O	26.564	18.913	8%	30%	0.310	0.000	0.000	0.001	0.000	0.000	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.27

IPCC category/Group	Gas	Base year emissions or removals	Year 2015 emissions or removals	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by category in year x	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Comments
5.D.2 Industrial Wastewater	CH_4	137.025	135.575	14%	30%	0.331	0.000	0.003	0.005	0.001	0.001	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.23
5.D.2 Industrial Wastewater	N_2O	2.341	0.110	13%	30%	0.327	0.000	0.000	0.000	0.000	0.000	0.000	AD - calculated, EF - 2006 IPCC Guidelines, Volume 5, Chapter 6, pp. 6.27
Total		26141.43	11302.67				0.0062					0.0007	
Total Uncertainties						Uncertainty in total inventory %:	**8%**				Trend uncertainty %:	**3%**	

ANNEX 3: OTHER DETAILED METHODOLOGICAL DESCRIPTIONS FOR INDIVIDUAL SOURCE OR SINK CATEGORIES, INCLUDING FOR KP-LULUCF ACTIVITIES

A.3.1 Energy (excluding Transport sector)

Fuel	NCV	Sulphur content (%)																				
		1990-95	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Diesel	42.49	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
RFO	40.60	2.00	2.00	2.12	2.10	2.00	2.08	1.98	1.96	2.02	1.38	1.23	0.99	1.21	0.91	0.79	0.91	0.97	0.94	0.80	0.84	0.79
Gasoline	43.97	0.015	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jet fuel	43.21	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Other liquid fuels	41.86	0.65	0.61	0.59	0.58	0.57	0.56	0.55	0.53	0.52	0.51	0.50	0.48	0.47	0.46	0.45	0.44	0.42	0.41	0.40	0.39	0.40
LPG	45.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shale oil	39.35	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Coal	23.91	1.80	1.80	1.47	1.37	1.06	0.90	0.87	0.78	0.66	0.67	0.72	0.66	0.52	0.45	0.46	0.39	0.41	0.50	0.44	0.48	0.57
Coke	26.79	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Oil shale	9.20	1.60	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	10.05	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
RFO (marine)	40.60	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.00	1.00	1.00	1.00	1.00	1.00
Wood	6.70	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Natural gas	Changes annually	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029	0.00029
		EF (kt/PJ)																				
Diesel		0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.094	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
RFO		0.966	0.966	1.024	1.013	0.968	1.003	0.957	0.948	0.976	0.665	0.596	0.479	0.583	0.441	0.382	0.442	0.467	0.456	0.389	0.405	0.384
Gasoline		0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0023	0.0023	0.0023	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Jet fuel		0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Other liquid fuels		0.311	0.290	0.284	0.278	0.273	0.267	0.261	0.255	0.249	0.243	0.237	0.231	0.226	0.220	0.214	0.208	0.202	0.196	0.190	0.184	0.190
LPG		0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013
Shale oil		0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407	0.407
Coal		1.138	1.138	0.928	0.865	0.673	0.567	0.551	0.493	0.451	0.459	0.498	0.454	0.357	0.308	0.319	0.266	0.280	0.342	0.328	0.359	0.431
Coke		0.410	0.410	0.410	0.410	0.410	0.410	0.410	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403	0.403
Oil shale		3.130	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat		0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508
RFO (marine)		0.966	0.966	0.966	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.483	0.483	0.483	0.483	0.483	0.483
Wood		0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
Natural gas		0.00017	0.00018	0.00018	0.00018	0.00018	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00017	0.00016

Notes:
Gasoline, diesel oil – EU legislation
RFO – EU legislation, average value from database Nr.2-Air
Other liquids – average value from database Nr.2-Air
Coal – average value from database Nr.2-Air
Shale oil – Luik, H. "Coal, oil shale, natural bitumen, heavy oil and peat" Vol. II Chemicals and Other products from Shale Oil
Oil shale – Gavrilova, O., Randla, T., Vallner, L., Strandberg, M., Vilu, R. 2005. "Life Cycle Analysis of the Estonian Oil Shale Industry"
Peat, peat briquettes – Latvian Peat Producers Association

Wood – Zandersons, J, Žūriņš, A., Rižikovs, J., Dobele, G., Latvian Institute of Wood chemistry "Feasibility of processing and utilisation of used up railway sleepers"
Natural gas – allowed content of mercaptan (3 mg/m3)

Fuel consumption in Energy sector (stationary combustion), TJ

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	2013	2014	2015
1.A.1. Energy Industries																										
Total	**94338**	**88210**	**73651**	**57391**	**53160**	**50514**	**51326**	**52637**	**54187**	**48325**	**42657**	**44355**	**43268**	**43796**	**41000**	**40407**	**41916**	**39400**	**38929**	**37897**	**45595**	**42380**	**40380**	**46021**	**43786**	**46657**
Liquid Fuels	40437	33253	28441	27170	30859	20519	27333	17437	20662	17491	7900	5235	5033	3576	3055	2365	1511	1389	905	1194	918	848	662	466	319	283
Solid Fuels	2305	1736	1935	2106	1366	1395	740	541	455	398	371	398	285	209	210	183	105	341	446	472	419	419	513	424	175	105
Peat Total	2089	2343	2814	3007	2841	3430	2974	3083	2157	1275	2351	1230	1005	663	70	60	30	29	20	10	11	9	NO	40	NO	NO
Gaseous Fuels	49029	50288	39788	24246	16770	24107	18644	28165	26802	25464	28803	33510	32497	34074	32371	33306	35181	32613	32650	31236	38687	35607	31872	33926	29870	31395
Biomass	436	590	673	862	1324	1063	1634	3412	4111	3697	3232	3940	4406	5245	5206	4464	5089	5028	4908	4956	5531	5494	7333	11165	13422	14874
Other Fossil Fuels	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	42	29	88	29	NO	NO	NO	29	29	3	NO	NO	NO	NO
1.A.1.a. Public Electricity and Heat Production																										
Total	**92473**	**86689**	**71901**	**55946**	**51496**	**48590**	**48499**	**51233**	**50453**	**44329**	**39919**	**42931**	**41998**	**42183**	**39348**	**39061**	**40483**	**38378**	**37639**	**36780**	**44274**	**40852**	**39004**	**44541**	**42276**	**45345**
Liquid Fuels	40098	33002	28190	26919	30426	20266	26110	17107	18116	14486	6350	5065	4821	3406	2843	2153	1299	1219	693	1031	705	593	492	211	33	28
Solid Fuels	2305	1736	1935	2106	1366	1395	740	541	427	370	371	398	285	209	210	183	105	341	446	472	419	419	513	424	175	105
Peat Total	1378	1703	1945	2437	2246	2703	2403	2600	1764	1046	1970	1125	995	653	60	40	20	20	20	10	11	9	NO	40	NO	NO
Gaseous Fuels	48214	49658	39158	23622	16134	23163	17612	27599	26069	24831	27996	32633	31691	33199	31499	32434	34242	32043	31845	30739	37812	34664	30895	32997	29040	30712
Biomass	436	590	673	862	1324	1063	1634	3386	4077	3596	3232	3668	4164	4687	4648	4222	4817	4755	4635	4499	5298	5164	7104	10869	13028	14500
Other Fossil Fuels	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	42	29	88	29	NO	NO	NO	29	29	3	NO	NO	NO	NO
Diesel oil	5524	5226	3824	935	382	85	42	297	85	85	127	42	42	42	42	42	42	43	43	16	15	25	127	94	22	14
RFO	32561	26147	23183	24563	30044	20016	25984	16768	17905	14007	5279	4425	4425	3207	2801	2111	1218	1137	650	1015	690	568	365	113	10	13
LPG	46	46	46	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	1	1
Other liquid fuels	1967	1583	1137	1421	NO	126	84	42	126	NO	NO	126	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	39	NO	NO	NO	394	944	472	354	157	NO	NO	39	39	NO	NO	NO	NO	NO	NO	NO	NO
Coal	2305	1736	1935	2106	1366	1395	740	541	427	370	371	398	285	209	210	183	105	341	446	472	419	419	513	424	175	105
Peat briquettes	31	15	15	15	15	77	62	77	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO
Peat	1347	1688	1930	2422	2231	2626	2341	2523	1749	1046	1970	1125	995	653	60	40	20	20	20	10	10	9	NO	40	NO	NO
Natural gas	48214	49658	39158	23622	16134	23163	17612	27599	26069	24831	27996	32633	31691	33199	31499	32434	34242	32043	31845	30739	37812	34664	30895	32997	29040	30712
Wood	436	590	673	831	1300	1045	1595	3363	4060	3558	3191	3617	4097	4644	4570	4132	4741	4675	4556	4390	5120	4635	5793	9198	11184	12286
Sludge gas	NO	NO	NO	31	24	18	39	23	17	38	41	51	67	43	78	90	76	80	79	100	114	100	105	97	91	99
Landfill gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9	18	22	22	14	16	28
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	37	355	1145	1560	1737	2086
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8	52	39	NO	NO	NO
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO	NO
Waste oils	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	42	29	88	29	NO	NO	NO	29	29	3	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	2013	2014	2015
1.A.1.c. Manufacture of Solid Fuels and Other Energy Industries																										
Total	**1865**	**1521**	**1750**	**1445**	**1664**	**1924**	**2826**	**1405**	**3734**	**3996**	**2738**	**1424**	**1270**	**1613**	**1652**	**1346**	**1433**	**1022**	**1290**	**1117**	**1321**	**1528**	**1376**	**1480**	**1510**	**1312**
Liquid Fuels	339	251	251	251	433	253	1223	330	2546	3005	1550	170	212	170	212	212	212	170	212	163	213	255	170	255	286	255
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	28	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	711	640	869	570	595	727	571	483	393	229	381	105	10	10	10	20	10	9	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	815	630	630	624	636	944	1032	566	733	633	807	877	806	875	872	872	939	570	805	497	875	943	977	929	830	683
Biomass	NO	NO	NO	NO	NO	NO	NO	26	34	101	NO	272	242	558	558	242	272	273	273	457	233	330	229	296	394	374
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	212	170	170	170	170	212	127	127	127	212	127	170	212	170	212	212	212	170	212	163	213	255	170	255	286	255
RFO	81	81	81	81	81	41	1096	203	487	731	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	46	NO	NO	NO	182	NO	NO	NO	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	216	346	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	NO	NO	NO	NO	NO	NO	NO	NO	1716	1716	1423	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	NO	NO	NO	NO	NO	NO	NO	NO	28	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	711	640	869	570	595	727	571	483	393	229	381	105	10	10	10	20	10	9	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	815	630	630	624	636	944	1032	566	733	633	807	877	806	875	872	872	939	570	805	497	875	943	977	929	830	683
Wood	NO	NO	NO	NO	NO	NO	NO	26	34	101	NO	272	242	558	558	242	272	273	273	457	233	330	229	296	394	374

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	2013	2014	2015
1.A.2 Manufacturing Industries and Construction																										
Total	58640	45567	38083	32982	29888	29837	29430	28709	26228	24129	20526	20910	21411	21329	22992	24014	25616	24380	23176	22377	26693	25255	27930	26004	26913	26320
Liquid Fuels	29747	20311	17430	17082	16545	16745	16344	16010	12910	11400	7575	4681	3966	4417	4277	2866	4075	3847	3076	2946	3500	2298	2649	2576	2254	2014
Solid Fuels	1545	882	968	1639	1444	650	592	450	393	421	252	252	253	262	236	971	1394	1967	1997	1363	1861	2229	2149	1406	1336	1014
Peat Total	NO	20	10	NO	15	15	15	25	25	15	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	14	2	2	24	24	11
Gaseous Fuels	25894	23752	19059	12482	9783	10014	9815	9484	9712	9080	9873	11583	12838	12729	13157	13680	13395	12881	11836	9261	10537	7578	7952	6259	5258	5262
Biomass	617	603	616	1779	2101	2414	2664	2740	3188	3186	2733	3926	3487	3391	4795	5584	6462	5415	5895	8674	10319	12399	14301	14624	16762	16771
Other Fossil Fuels	837	NO	NO	NO	NO	NO	NO	NO	NO	26	94	469	866	530	517	914	290	270	372	133	462	749	877	1115	1279	1248
Gasoline	880	220	220	220	132	44	132	88	88	44	44	44	69	44	88	88	88	88	88	44	44	44	44	44	43	48
Diesel oil	5564	5606	4034	3779	1611	1485	1315	1740	1655	1527	1484	1357	1231	1187	1357	1400	1527	1997	1657	1530	1359	1785	1997	1996	1722	1547
RFO	22532	14007	12871	12504	14127	14413	14129	12993	9947	8446	3411	1625	1178	813	487	529	529	451	366	366	335	162	203	81	31	13
LPG	46	46	46	46	46	91	137	137	46	92	46	46	46	46	92	92	137	137	91	91	91	228	366	413	423	406
Jet fuel	NO	NO	NO	NO	NO	NO	43	86	43	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	2013	2014	2015
Other kerosene	432	432	259	86	43	86	86	129	43	43	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	293	NO	NO	447	586	586	502	837	1088	1130	1130	1215	1047	1214	1047	210	1089	963	795	711	1005	NO	NO	42	35	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	198	956	1088	429	627	132	NO	165	627	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	39	NO	NO	NO	118	1417	394	197	157	118	118	78	79	79	39	39	79	39	NO	NO	NO
Coal	1280	882	968	1534	1365	597	539	397	367	368	226	226	226	235	209	917	1362	1967	1997	1363	1861	2229	2067	1379	1336	1014
Coke	237	NO	NO	105	79	53	53	53	26	53	26	26	27	27	27	54	32	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	82	27	NO	NO
Oil shale	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	15	15	15	15	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	NO	NO	4	4	1
Peat	NO	20	10	NO	NO	NO	NO	10	10	NO	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	10	2	2	20	20	10
Natural gas	25894	23752	19059	12482	9783	10014	9815	9484	9712	9080	9873	11583	12838	12729	13157	13680	13395	12881	11836	9261	10537	7578	7952	6259	5258	5262
Wood	617	603	616	1779	2101	2414	2664	2740	3188	3176	2696	3856	3393	3309	4706	5535	6425	5387	5797	8633	9801	11187	12921	13530	15368	15528
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	2	1	8	8	1	4	2	4	3
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	18	125	57	124	80
Municipal wastes (biomass fraction)	NO	NO	NO	NO	NO	NO	NO	NO	NO	10	37	70	94	82	89	49	34	26	98	33	510	1193	1250	1035	1266	1130
Waste oils	837	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	293	628	322	293	789	205	205	234	88	58	85	58	29	29	29
Industrial wastes (used tires)	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	94	176	238	208	224	125	85	65	58	15	84	331	242	379	335	273
Municipal wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80	30	320	332	577	707	915	946
1.A.2.a. Iron and Steel																										
Total	6331	4649	4157	3651	4019	3065	3282	5079	5083	4991	5076	5142	4861	4932	5016	4804	5059	5081	4738	4187	4870	1207	1633	583	13	406
Liquid Fuels	1219	1016	732	731	912	705	785	1162	1088	1130	1172	1042	963	963	963	126	963	963	917	792	1006	NO	NO	NO	NO	NO
Solid Fuels	NO	NO	NO	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	27	27	5	NO	NO	NO	26	27	184	32	NO	NO
Peat Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	4275	3633	3425	2892	3107	2360	2497	3917	3995	3861	3904	4058	3898	3969	4026	4125	4091	4118	3821	3395	3838	1180	1449	551	13	406
Biomass	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	2013	2014	2015
Other Fossil Fuels	837	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	526	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel oil	42	42	42	NO	42	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	42	NO	NO	NO	NO	1	NO	NO	NO	NO	NO
RFO	1177	974	690	284	284	203	325	325	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	122	81	NO	NO	NO	NO	NO	NO
Other liquid fuels	NO	NO	NO	447	586	502	460	837	1088	1130	1130	963	963	963	963	84	963	963	795	711	1005	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	79	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	NO	NO	NO	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	27	102	5	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	27	27	5	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	82	27	NO	NO
Natural gas	4275	3633	3425	2892	3107	2360	2497	3917	3995	3861	3904	4058	3898	3969	4026	4125	4091	4118	3821	3395	3838	1180	1449	551	13	406
Waste oils	837	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	526	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b. Non-Ferrous Metals																										
Total	NO	NO	NO	NO	NO	NO	NO	NO	53	100	168	232	269	302	269	203	204	201	134	101	135	172	173	138	72	61
Liquid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	3	NO	NO	NO
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	1	NO	NO	1
Peat Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO	NO	53	100	168	190	269	302	269	203	204	201	134	101	135	168	168	138	72	60
Biomass	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	3	NO	NO	NO
Coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	1	NO	NO	1
Natural gas	NO	NO	NO	NO	NO	NO	NO	NO	53	100	168	190	269	302	269	203	204	201	134	101	135	168	168	138	72	60
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO
1.A.2.c. Chemicals																										
Total	4070	2642	2098	3638	3977	5645	4160	3529	643	580	486	479	469	449	452	471	539	455	854	773	888	724	807	804	880	770
Liquid Fuels	3643	2059	1684	2963	3249	4547	3451	3207	325	164	122	164	162	122	NO	NO	NO	NO	124	126	94	131	154	137	159	148
Solid Fuels	NO	NO	NO	28	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO
Peat Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	11	NO
Gaseous Fuels	427	584	414	643	693	1090	696	302	298	362	317	269	278	308	405	442	480	381	513	518	606	404	371	385	316	330
Biomass	NO	NO	NO	4	7	7	13	20	20	54	47	46	29	19	47	29	59	74	188	130	188	188	282	262	394	292
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO	NO	NO	NO	NO	NO	NO
Diesel oil	127	127	85	NO	42	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	43	85	85	85	17	NO	15	9

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
RFO	3127	1543	1340	2963	3207	4547	3451	3207	325	122	122	122	162	122	NO	NO	NO	NO	81	41	9	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	46	137	137	144	139
Other kerosene	389	389	259	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	NO	NO	NO	28	28	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	10	NO
Natural gas	427	584	414	643	693	1090	696	302	298	362	317	269	278	308	405	442	480	381	513	518	606	404	371	385	316	330
Wood	NO	NO	NO	4	7	7	13	20	20	54	47	46	29	19	47	29	56	72	187	127	187	169	210	208	278	221
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	2	1	3	1	1	NO	NO	1	1
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	18	72	54	115	70
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO	NO	NO	NO	NO	NO	NO
1.A.2.d. Pulp, Paper and Print																										
Total	2956	2827	2562	953	330	326	194	181	142	168	124	176	182	214	213	255	281	217	208	264	260	223	176	200	106	106
Liquid Fuels	203	162	122	122	41	81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	14	6	NO	6	6
Solid Fuels	28	28	28	113	56	56	56	57	28	28	NO	28	28	26	26	26	26	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	2724	2637	2412	653	45	101	118	104	94	100	101	135	134	168	167	202	235	201	201	101	101	101	68	103	97	95
Biomass	NO	NO	NO	65	188	87	20	20	20	40	23	13	20	20	20	27	20	16	7	163	156	108	102	97	3	5
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	3	14	6	NO	2	2
RFO	203	162	122	122	41	81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	NO	NO	4	4
Coal	28	28	28	113	56	56	56	57	28	28	NO	28	28	26	26	26	26	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	2724	2637	2412	653	45	101	118	104	94	100	101	135	134	168	167	202	235	201	201	101	101	101	68	103	97	95
Wood	NO	NO	NO	65	188	87	20	20	20	40	23	13	20	20	20	27	20	16	7	163	156	108	102	97	3	5
1.A.2.e. Food Processing, Beverages and Tobacco																										
Total	15020	11250	10442	11139	8145	8394	9317	8809	8443	7299	6167	5366	5452	4763	5219	5315	5131	4254	3351	3086	2908	2694	2911	2789	2636	2216
Liquid Fuels	10547	7700	7046	6807	4419	4693	5429	5205	5238	4133	2970	1651	1442	1034	873	912	916	673	420	586	566	376	500	475	378	267
Solid Fuels	1069	598	655	594	565	309	309	252	168	224	140	140	141	158	105	132	106	79	79	52	52	16	27	25	24	24
Peat Total	NO	NO	NO	NO	15	NO	NO	15	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	NO	NO	NO	NO	NO
Gaseous	3177	2722	2511	3500	2829	3065	3250	3013	2694	2578	2607	2775	2985	2764	3238	3149	3249	2684	2370	1930	1919	1886	1819	1808	1729	1627

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Fuels																										
Biomass	228	231	230	238	316	327	330	325	328	349	450	800	842	719	916	1034	772	701	394	488	339	360	536	452	476	269
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	88	88	88	88	117	88	30	29	56	29	29	29	29
Diesel oil	3229	3229	3102	3229	765	552	510	807	722	552	552	467	340	340	340	297	255	213	212	212	170	85	121	170	152	111
RFO	7105	4425	3898	3532	3654	4060	4791	4223	4384	3492	1745	975	893	609	406	406	447	329	122	244	285	121	203	81	31	8
LPG	46	46	46	46	NO	NO	NO	46	46	46	NO	46	46	46	46	46	91	91	46	91	72	91	137	182	160	148
Jet fuel	NO	NO	NO	NO	NO	NO	43	86	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other kerosene	NO	NO	NO	NO	NO	NO	43	43	43	43	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	167	NO	NO	NO	NO	42	42	NO	NO	NO	NO	84	84	NO	42	84	84	NO	NO	NO	NO	NO	NO	42	35	NO
Shale oil	NO	NO	NO	NO	NO	39	NO	NO	NO	NO	630	79	79	39	39	79	39	40	40	39	39	79	39	NO	NO	NO
Coal	911	598	655	541	512	256	256	199	142	171	114	114	114	131	105	105	79	79	79	52	52	16	27	25	24	24
Coke	158	NO	NO	53	53	53	53	53	26	53	26	26	27	27	NO	27	27	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	15	NO	NO	15	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	NO	NO	NO	NO	NO
Natural gas	3177	2722	2511	3500	2829	3065	3250	3013	2694	2578	2607	2775	2985	2764	3238	3149	3249	2684	2370	1930	1919	1886	1819	1808	1729	1627
Wood	228	231	230	238	316	327	330	325	328	349	450	800	842	719	916	1034	772	701	394	483	333	360	535	449	467	230
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5	6	NO	1	NO	NO	NO
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	9	10
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	88	88	88	88	117	88	30	29	56	29	29	29	29
1.A.2.f. Non-metallic minerals																										
Total	9496	5911	5584	2962	3998	4052	3941	3145	3045	3071	2512	2797	3673	3903	3648	4271	4296	4484	4307	2694	4555	5271	5573	5062	5400	4801
Liquid Fuels	3585	1307	1301	1260	3057	2562	2519	2396	1912	2274	1521	482	358	1367	1209	764	920	379	207	293	864	298	291	297	275	281
Solid Fuels	170	85	114	199	171	114	57	85	28	28	28	28	28	26	26	682	1127	1809	1888	1285	1757	2136	1910	1299	1254	957
Peat Total	NO	NO	NO	NO	NO	NO	NO	10	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	5734	4513	4163	1476	750	1282	1345	634	1066	698	808	1821	2352	1884	1845	2381	1878	1979	1782	942	1010	977	1280	1344	1353	1208
Biomass	7	6	6	27	20	94	20	20	29	44	61	82	111	184	139	144	169	165	175	100	520	1196	1273	1035	1269	1135
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	94	385	824	442	429	300	202	153	255	74	404	664	819	1086	1250	1219
Diesel oil	127	127	42	42	169	84	42	42	85	85	42	42	42	42	42	255	212	127	127	128	237	298	291	297	275	280
RFO	3289	1137	1259	1218	2842	2436	2477	2354	1827	2071	731	162	NO	NO	NO	41	NO	81	41	NO	NO	NO	NO	NO	NO	NO
LPG	NO	NO	NO	NO	46	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
Other	43	43	NO	NO	NO	NO	NO	NO	NO	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	2013	2014	2015
kerosene																										
Other liquid fuels	126	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	42	NO	251	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	198	956	1088	429	627	132	NO	165	627	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	118	748	236	118	118	79	39	39	39	39	NO	NO	NO	NO	NO	NO	NO
Coal	142	85	114	199	171	114	57	85	28	28	28	28	28	26	26	682	1127	1809	1888	1285	1757	2136	1910	1299	1254	957
Oil shale	28	NO	NO	NO	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	10	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	5734	4513	4163	1476	750	1282	1345	634	1066	698	808	1821	2352	1884	1845	2381	1878	1979	1782	942	1010	977	1280	1344	1353	1208
Wood	7	6	6	27	20	94	20	20	29	34	24	12	17	102	50	95	135	139	77	67	10	3	23	NO	NO	3
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	2
Municipal wastes (biomass fraction)	NO	NO	NO	NO	NO	NO	NO	NO	NO	10	37	70	94	82	89	49	34	26	98	33	510	1193	1250	1035	1266	1130
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	209	586	234	205	175	117	88	117	29	NO	NO	NO	NO	NO	NO
Industrial wastes (used tires)	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	94	176	238	208	224	125	85	65	58	15	84	331	242	379	335	273
Municipal wastes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80	30	320	332	577	707	915	946
1.A.2.g. Other																										
Total	20768	18288	13240	10639	9420	8356	8536	7965	8819	7920	5993	6718	6504	6766	8175	8695	10106	9688	9583	11272	13077	14964	16657	16429	17805	17960
Liquid Fuels	10551	8067	6546	5199	4867	4156	4160	4039	4347	3699	1790	1300	1041	931	1233	1064	1276	1832	1408	1149	967	1477	1695	1667	1436	1312
Solid Fuels	278	171	171	677	623	170	169	56	169	141	84	56	56	52	52	104	130	79	30	26	26	47	27	50	58	32
Peat Total	NO	20	10	NO	NO	15	15	NO	NO	NO	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	11	2	2	4	13	11
Gaseous Fuels	9557	9664	6134	3318	2360	2115	1910	1515	1512	1380	1968	2335	2922	3334	3208	3177	3258	3318	3014	2275	2928	2862	2797	1930	1678	1536
Biomass	382	366	380	1445	1570	1899	2281	2355	2791	2699	2152	2985	2485	2449	3673	4350	5442	4459	5132	7793	9116	10547	12107	12778	14620	15069
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	29	29	29	29	NO	NO	NO
Gasoline	880	220	220	220	132	44	132	88	88	44	44	44	69	44	88	88	88	88	88	44	44	44	44	44	43	48
Diesel oil	2039	2081	763	508	593	849	763	891	848	848	848	806	849	805	975	806	1060	1657	1275	1105	863	1301	1559	1529	1278	1145
RFO	7632	5766	5563	4385	4099	3086	3085	2883	3411	2761	813	366	123	82	82	82	82	41	NO	NO	41	41	NO	NO	NO	5
LPG	NO	NO	NO	NO	NO	91	137	91	NO	46	46	NO	NO	NO	46	46	46	46	45	NO	19	91	92	94	115	114
Other	NO	NO	NO	86	43	86	43	86	NO	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	2013	2014	2015
kerosene																										
Other liquid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	84	NO	NO	42	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	199	171	171	625	597	170	169	56	169	141	84	56	56	52	52	104	130	79	30	26	26	47	27	50	58	32
Coke	79	NO	NO	52	26	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat briquettes	NO	NO	NO	NO	NO	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	4	3	1
Peat	NO	20	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	10	NO	NO	NO	NO	NO	10	2	2	NO	10	10
Natural gas	9557	9664	6134	3318	2360	2115	1910	1515	1512	1380	1968	2335	2922	3334	3208	3177	3258	3318	3014	2275	2928	2862	2797	1930	1678	1536
Wood	382	366	380	1445	1570	1899	2281	2355	2791	2699	2152	2985	2485	2449	3673	4350	5442	4459	5132	7793	9115	10547	12051	12776	14620	15069
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	2	2	NO	NO
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	54	NO	NO	NO
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	NO	NO	NO	NO	NO	NO	29	29	29	29	NO	NO	NO

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	2013	2014	2015
1.A.4 Other Sectors																										
Total	102092	108961	83730	77831	64625	60182	61263	56261	52470	52089	49117	54029	53828	57273	59428	59055	58857	59344	55403	58823	52940	51629	53939	50148	49268	44601
Liquid Fuels	27829	32499	24223	21319	14008	8817	8761	7849	6947	7439	6888	7363	6919	7887	7936	7807	8456	7888	7114	7778	8334	8351	8351	8476	8753	8887
Solid Fuels	22398	19894	15853	13347	9363	5180	5521	4639	3330	2817	2162	2988	2390	2203	2150	2045	1940	1940	1783	1574	2098	1861	983	1075	962	831
Peat Total	1128	880	1030	617	515	391	506	357	266	66	41	15	NO	10	NO	20	40	61	31	16	21	32	32	NO	11	NO
Gaseous Fuels	24289	24628	11751	9338	7002	7150	6732	5434	5670	5865	6218	7061	8098	8795	9651	9632	9983	11027	10959	10241	11819	10343	10477	9809	9670	9101
Biomass	26448	31060	30873	33210	33737	38643	39743	37983	36257	35902	33808	36561	36295	38321	39574	39523	38380	38399	35487	39215	30659	31042	34097	30788	29872	25782
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO
Gasoline	1672	176	176	176	352	88	176	176	88	132	264	220	195	220	220	308	352	352	308	308	308	440	395	440	354	289
Diesel oil	16189	22860	16189	14574	6840	5267	5098	4248	3611	4419	4589	5099	4886	5651	5863	5566	6288	6288	5566	6365	6942	6902	6896	6981	7234	7588
RFO	6415	6292	5318	3897	4507	1664	1990	1706	1340	1218	772	772	569	528	447	527	406	40	80	41	44	5	NO	NO	NO	1
LPG	2961	2869	2368	2413	2050	1366	1367	1503	1822	1412	1184	1230	1185	1321	1321	1367	1367	1184	1139	1047	1023	1002	1055	1055	1165	1009
Jet fuel	NO	NO	NO	NO	NO	86	43	173	43	130	NO	NO	NO	NO	43	NO	43	24	21	17	17	2	4	NO	NO	NO
Other kerosene	215	302	172	259	259	346	86	43	43	86	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	377	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	42	84	167	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	79	NO	NO	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	22398	19894	15853	13347	9363	5180	5521	4639	3330	2817	2162	2988	2390	2203	2150	2045	1940	1940	1783	1574	2098	1861	983	1075	962	831
Peat briquettes	836	588	728	527	294	309	355	247	186	46	31	15	NO	NO	NO	NO	NO	1	1	6	1	3	4	NO	1	NO
Peat	292	292	302	90	221	82	150	110	80	20	10	NO	NO	10	NO	20	40	60	30	10	20	29	28	NO	10	NO

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Natural gas	24289	24628	11751	9338	7002	7150	6732	5434	5670	5865	6218	7061	8098	8795	9651	9632	9983	11027	10959	10241	11819	10343	10477	9809	9670	9101
Wood	26448	31060	30873	33210	33737	38643	39743	37983	36257	35902	33808	36561	36249	38159	39302	39211	38080	38067	35123	38811	30222	30442	33226	29652	28585	24043
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	30	60	30	45	60	60	60	60	59	90	90	60
Landfill gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	162	242	251	259	271	290	314	314	327	325	357	353	596
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	91	358	523	673	887
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	11	16	14	29	59	43	38	58	99	106
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5	79	90	108	71	90
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO
1.A.4.a. Commercial/Institutional																										
Total	40346	40142	34150	27786	17464	16517	16581	14795	12297	13125	11356	12366	13179	13856	15142	14292	14964	15997	13248	12578	13329	11772	12743	12526	12038	11959
Liquid Fuels	13453	16642	11910	10556	5308	2890	2758	2459	2017	2346	1715	1928	1818	2207	2167	1860	2289	1902	1596	1586	1619	1397	1859	1939	2129	2243
Solid Fuels	14913	11413	10872	7854	4297	2903	3272	2732	2419	2049	1565	1536	1423	1338	1285	1049	1075	1075	918	735	1023	891	354	519	407	323
Peat Total	672	517	620	288	326	114	250	163	71	15	31	15	NO	10	NO	20	40	61	31	16	1	32	32	NO	11	NO
Gaseous Fuels	6090	6408	5466	3579	1903	2328	2271	1805	2175	2536	3054	3347	4103	4278	4680	4598	4851	5676	5679	5415	5623	5055	4952	4477	4401	4166
Biomass	5218	5162	5282	5508	5630	8282	8029	7636	5615	6179	4991	5497	5709	5965	6894	6737	6651	7253	4995	4826	5054	4398	5546	5591	5090	5227
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO
Gasoline	44	44	44	44	220	NO	88	88	44	88	88	77	46	44	44	44	44	44	44	44	44	88	44	88	44	44
Diesel oil	8116	11515	7436	7478	1529	1189	1147	552	340	935	1020	1190	1317	1530	1657	1275	1700	1657	1360	1393	1418	1251	1713	1755	1924	2054
RFO	4953	4953	4344	2679	3248	1177	1300	1421	1137	974	528	528	325	284	244	365	365	40	80	41	41	2	NO	NO	NO	1
LPG	46	NO	NO	182	137	91	137	182	410	91	NO	91	46	182	137	137	137	137	91	91	99	54	98	96	161	144
Jet fuel	NO	NO	NO	NO	NO	86	43	173	43	130	NO	NO	NO	NO	43	NO	43	24	21	17	17	2	4	NO	NO	NO
Other kerosene	43	130	86	173	173	346	43	43	43	86	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	251	NO	NO	NO	NO	NO	NO	NO	NO	42	NO	42	84	167	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	79	NO	NO	NO	NO	39	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	14913	11413	10872	7854	4297	2903	3272	2732	2419	2049	1565	1536	1423	1338	1285	1049	1075	1075	918	735	1023	891	354	519	407	323
Peat briquettes	511	356	449	248	155	62	139	93	31	15	31	15	NO	NO	NO	NO	NO	1	1	6	1	3	4	NO	1	NO
Peat	161	161	171	40	171	52	110	70	40	NO	NO	NO	NO	10	NO	20	40	60	30	10	NO	29	28	NO	10	NO
Natural gas	6090	6408	5466	3579	1903	2328	2271	1805	2175	2536	3054	3347	4103	4278	4680	4598	4851	5676	5679	5415	5623	5055	4952	4477	4401	4166
Wood	5218	5162	5282	5508	5630	8282	8029	7636	5615	6179	4991	5497	5663	5803	6652	6485	6381	6966	4691	4482	4680	3997	5163	5087	4603	4512
Landfill gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	162	242	251	259	271	290	314	314	327	325	357	353	596
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	49	69	74
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	11	16	14	29	57	43	24	44	53	30
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	31	34	54	12	15
Waste oils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	42	126	58	117	29	58	29	29	NO	8	NO	NO	NO	NO	NO
1.A.4.b. Residential																										
Total	35751	42489	39047	40790	38562	37659	38588	36043	35336	34027	32851	36298	35666	37702	38261	38948	37955	37271	37067	40809	33561	33797	35117	31228	30846	25862
Liquid Fuels	4908	5671	5003	4010	2848	1402	1272	1363	1454	1406	1443	1441	1441	1398	1443	1577	1621	1438	1393	2025	2237	2229	2236	2237	2283	2055

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Solid Fuels	6404	7542	4440	5037	4411	1821	1964	1708	797	683	512	1338	854	787	787	944	813	813	813	813	1049	944	577	530	531	501
Peat Total	425	332	379	258	144	252	241	179	195	51	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	NO	NO	NO	NO	NO
Gaseous Fuels	4004	4275	4905	5089	4359	4181	3762	3063	2896	2829	2659	3001	3293	3667	3958	4193	4326	4587	4693	4304	5219	4480	4481	4266	4252	4116
Biomass	20010	24669	24320	26396	26800	30003	31349	29730	29994	29058	28227	30518	30078	31850	32073	32234	31195	30433	30168	33667	25036	26144	27823	24195	23780	19190
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	132	132	132	132	132	220	264	264	264	264	264	264	263	264	264	220
Diesel oil	1912	2762	2592	1827	892	127	42	42	42	85	127	170	170	127	127	127	127	127	127	850	1062	1062	1062	1062	1062	1062
RFO	41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	2869	2823	2368	2140	1913	1275	1230	1321	1412	1321	1184	1139	1139	1139	1184	1230	1230	1047	1002	911	911	903	911	911	957	773
Other kerosene	86	86	43	43	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	6404	7542	4440	5037	4411	1821	1964	1708	797	683	512	1338	854	787	787	944	813	813	813	813	1049	944	577	530	531	501
Peat briquettes	294	201	248	248	124	232	201	139	155	31	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	131	131	131	10	20	20	40	40	40	20	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	20	NO	NO	NO	NO	NO
Natural gas	4004	4275	4905	5089	4359	4181	3762	3063	2896	2829	2659	3001	3293	3667	3958	4193	4326	4587	4693	4304	5219	4480	4481	4266	4252	4116
Wood	20010	24669	24320	26396	26800	30003	31349	29730	29994	29058	28227	30518	30078	31850	32043	32174	31165	30388	30108	33607	24974	26084	27764	24105	23690	19130
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	30	60	30	45	60	60	60	60	59	90	90	60
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	NO	NO	NO	NO	NO
1.A.4.c. Agriculture/Forestry/Fisheries																										
Total	25995	26331	10533	9255	8599	6005	6094	5424	4837	4937	4910	5365	4983	5716	6025	5815	5938	6077	5088	5436	6050	6059	6079	6394	6383	6781
Liquid Fuels	9468	10186	7310	6752	5852	4526	4731	4027	3476	3687	3730	3994	3660	4282	4326	4370	4546	4548	4125	4167	4478	4725	4255	4300	4341	4589
Solid Fuels	1081	939	541	456	655	456	285	199	114	85	85	113	113	78	78	52	52	52	52	26	26	26	52	26	24	7
Peat Total	31	31	31	71	45	25	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	14195	13945	1380	670	739	641	699	566	599	500	505	712	702	850	1014	841	806	764	587	521	977	808	1044	1066	1017	819
Biomass	1220	1229	1271	1306	1307	358	365	617	648	665	590	546	508	506	607	552	534	713	324	722	569	500	727	1002	1001	1366
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	1628	132	132	132	132	88	88	88	44	44	44	11	17	44	44	44	44	44	NO	NO	NO	88	88	88	46	25
Diesel oil	6161	8583	6161	5269	4419	3951	3909	3654	3229	3399	3442	3739	3399	3994	4079	4164	4461	4504	4079	4122	4462	4589	4121	4164	4248	4472
RFO	1421	1339	974	1217	1258	487	691	285	203	244	244	244	244	244	203	162	41	NO	NO	NO	3	3	NO	NO	NO	NO
LPG	46	46	NO	91	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	45	13	45	46	48	47	92
Other kerosene	86	86	43	43	43	NO	43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	126	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	1081	939	541	456	655	456	285	199	114	85	85	113	113	78	78	52	52	52	52	26	26	26	52	26	24	7
Peat briquettes	31	31	31	31	15	15	15	15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	40	30	10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	14195	13945	1380	670	739	641	699	566	599	500	505	712	702	850	1014	841	806	764	587	521	977	808	1044	1066	1017	819
Wood	1220	1229	1271	1306	1307	358	365	617	648	665	590	546	508	506	607	552	534	713	324	722	568	361	299	460	292	401
Other biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	91	358	474	604	814

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Straws	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	14	14	46	76
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	48	56	54	59	75

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	2013	2014	2015
1.A.5 Other (Not elsewhere specified)																										
Total	NO	NO	NO	NO	NO	NO	3	1	3	2	2	2	94	84	131	104	103	39	47	73	107	98	100	88	128	130
Liquid Fuels	NO	NO	NO	NO	NO	NO	3	1	3	2	2	2	94	84	131	104	103	39	47	73	107	98	100	88	128	130
Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biomass	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other Fossil Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	NO	NO	NO	NO	NO	NO	3	1	3	2	2	2	2	2	3	2	6	1	5	1	0	NO	NO	NO	NO	NO
Diesel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	75	65	111	77	73	14	21	49	87	80	79	63	105	112
Jet fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	17	17	17	24	24	24	21	23	20	18	21	24	23	18

Energy losses, statistical differences, transfers and secondary production of products in Energy sector, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Statistical differences																										
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1102	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	NO	NO	NO	NO	NO	NO	NO	NO	NO	6380	2508	2464	2948	747	528	264	440	NO	NO	132	835	883	510	309	352	264
Other kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	346	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel	NO	NO	NO	255	2082	2719	425	1360	1232	2209	5141	1785	3569	3909	3782	4589	5949	5355	4334	7649	9634	5781	1360	2228	383	3824
RFO	NO	1177	162	41	NO	NO	NO	NO	NO	650	974	NO	1421	325	284	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other liquid fuels	167	122	122	81	84	42	126	167	126	42	42	42	NO	84	42	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	101	438	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	275	NO	NO
Transfer																										
Shale oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	669	1102	826	79	NO	NO	NO	NO	NO	NO
Jet fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2636	4623	43	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	130	86	43	129	216	NO	NO	NO	NO	NO	NO	NO
Diesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	340	127	127	212	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	2013	2014	2015
RFO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8120	11815	853	1218	893	122	NO	NO	NO	NO	NO	NO
Other liquid fuels	167	122	122	81	84	42	126	167	126	42	42	42	NO	84	42	42	42	42	42	42	NO	NO	NO	NO	NO	NO
Losses																										
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46	46	46	46	46	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	127	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gasoline	44	44	44	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal	114	114	114	57	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	26	NO	NO	NO	NO	1	NO	NO
Peat	70	20	10	30	NO	NO	NO	NO	10	10	60	NO	NO	241	10	NO	NO	NO	40	10	60	NO	NO	20	NO	NO
Natural gas	136	1625	1481	1434	1004	977	999	1032	1032	999	673	472	572	740	536	167	268	335	336	639	269	505	505	275	588	338
Wood	80	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	36	18	45	NO	NO	NO	7	7	NO	NO	NO
Secondary Production																										
Other liquid fuels	NO	NO	NO	NO	NO	NO	1088	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other fossil fuels	42	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	419	292	88	292	205	234	263	88	66	29	29	29	29	29

A.3.2. Energy 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 (%)
MCO_2 – 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**
Wood, W^d = 55%	20.11	6.70*	109.98	0.98	**107.78**
Peat, W^d = 40%	29.07	10.05	105.98	0.98**	**103.87**
Residual fuel oil	85.72	40.60	77.36	0.99	**76.59**
Gasoline (used in offroads***)	93.13	44 (1990-2001) 43.97 (2003-2014)	88.75 87.36	0.99	**68.53** **68.58**
Diesel oil, liquid oven fuel	86.68	42.49	74.75	0.99	**74.00**
Natural gas	Changes annually; see Chapter 3.2.4.2			0.995	**Changes annually**
LPG	77.99	45.54	62.75	0.995	**62.44**
Shale oil	82.82	39.35	77.12	0.99	**76.35**
Other kerosene	85.17	43.20 (1990-2000) 43.21 (2004) 43.2 (2005-2014)	72.24 72.22	0.99	**71.52** **71.50**
Jet fuel	85.18	43.2 (1990-2002) 43.21 (2003-2014)	72.25 72.23	0.99	**71.53** **71.51**

* for wood – Q_z^d is TJ/1000m³

** natural gas – Q_z^d is MJ/m³

**** 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^nCO_2) 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^nCO_2, kg/t (1000 m^3)
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
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.

4. Explanation and suggestions

1. In IPCC methodology 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.

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 ~ 0, 95 Q_a

for gaseous fuels Q_z^d ~ 0,9 Q

Amendment

Using data about fuel carbon content and net calorific value from 2004 research, and oxidation factor from 2006 IPCC Guidelines Volume 2, Chapter 1, pg. 1.20 emission factor recalculation were made for 2016 resubmission.

Table with new emission factors is provided below and values in there are used to calculate CO_2 emissions from fuel combustion. Table 3 replaces A.3.2 Table 1.

Table 3 Carbon content in organic fuels working masses, net calorific values and 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
Wood, W^d = 55%	20.11	6.70*	109.98	1	**109.98**
Peat, W^d = 40%	29.07	10.05	105.99	1	**105.99**
Residual fuel oil	85.72	40.60	77.36	1	**77.36**
Gasoline (used in offroads***)	83.13	44 (1990-2001) 43.97 (2003-2015)	69.23 69.27	1	**69.23** **69.27**
Diesel oil, liquid oven fuel	86.68	42.49	74.75	1	**74.75**
Natural gas**	Changes annually; see Chapter 3.2.4.2			1	**Changes annually**
LPG	77.99	45.54	62.75	1	**62.75**
Shale oil	82.82	39.35	77.12	1	**77.12**
Other kerosene	85.17	43.20 (1990-2000) 43.21 (2004) 43.2 (2005-2015)	72.24 72.22 72.24	1	**72.24** **72.22** **72.24**
Jet fuel	85.18	43.2 (1990-2002) 43.21 (2003-2015)	72.25 72.23	1	**72.25** **72.23**

* for wood – Q_z^d is TJ/1000m^3
** 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

A.3.3. Energy: CO_2 reference approach and comparison with sectoral approach

Table 1 Reference Approach estimations (TABLE 1.A(b))

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (kt)	Carbon stored[C excluded] (kt C)	Net carbon emissions ((kt) C)	Fraction of carbon oxidized	Actual CO_2 emissions ((kt) 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		10470.00	1988.00	NO	-176.00	8658.00	1.00	NCV	8658.00	18.91	163.69	NO	163.69	1.00	600.19
		Jet kerosene	TJ		4512.00	NO	4494.00	NO	18.00	1.00	NCV	18.00	19.71	0.35	NO	0.35	1.00	1.30
		Other kerosene	TJ		NO	NO	NO	NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Shale oil	TJ		39.00	39.00		NO	0.00	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Gas/diesel oil	TJ		76292.00	31485.00	5226.00	3106.00	36475.00	1.00	NCV	36475.00	20.40	744.09	NO	744.09	1.00	2728.34
		Residual fuel oil	TJ		5469.00	609.00	5440.00	-607.00	27.00	1.00	NCV	27.00	21.11	0.57	NO	0.57	1.00	2.09
		Liquefied petroleum gases (LPG)	TJ		9567.00	5510.00		-46.00	4103.00	1.00	NCV	4103.00	17.13	70.27	NO	70.27	1.00	257.64
		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		3433.00	NO		84.00	3349.00	1.00	NCV	3349.00	22.00	73.68	73.68	0.00	1.00	0.00
		Lubricants	TJ		1675.00	879.00	NO	42.00	754.00	1.00	NCV	754.00	20.00	15.08	1.00	14.08	1.00	51.64
		Petroleum coke	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Refinery feedstocks	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other oil	TJ		544.00	209.00		-42.00	377.00	1.00	NCV	377.00	20.00	7.54	NO	7.54	1.00	27.65
Other liquid fossil												NO		NO	NO	NO		NO
Liquid fossil totals												53761.00		1075.27	74.67	1000.60		3668.86
Solid fossil	Primary fuels	Anthracite	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Coking coal	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Other	TJ	NO	1711.00	48.00	NO	-287.00	1950.00	1.00	NCV	1950.00	25.80	50.31	NO	50.31	1.00	184.47

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (kt)	Carbon stored[C excluded] (kt C)	Net carbon emissions ((kt) C)	Fraction of carbon oxidized	Actual CO_2 emissions ((kt) CO_2)
		bituminous coal																
		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 and tar sand	TJ	NO	NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
	Secondary fuels	BKB and patent fuel	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Coke oven/gas coke	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
		Coal tar	TJ		NO	NO		NO	NO	NO	NCV	NO	NO	NO	NO	NO	NO	NO
Other solid fossil												NO		NO	NO	NO		NO
Solid fossil totals												1950.00		50.31	NO	50.31		184.47
Gaseous fossil		Natural gas (dry)	TJ	NO	45435.00	NO		-661.00	46096.00	1.00	NCV	46096.00	14.91	687.26	NO	687.26	1.00	2519.96
Other gaseous fossil												NO		NO	NO	NO		NO
Gaseous fossil totals												46096.00		687.26	NO	687.26		2519.96
Waste (non-biomass fraction)			TJ	NO	IE	IE	NO	IE	NO,IE	IE	NCV	NO,IE	IE	NO,IE	IE	NO,IE	IE	NO,IE
Other fossil fuels												1223.54		29.01	NO	29.01		106.37
		Waste oils	TJ	29.00	NO	NO		NO	29.00	1.00	NCV	29.00	20.01	0.58	NO	0.58	1.00	2.13
		Municipal waste	TJ	NO	970.67	16.27		8.24	946.16	1.00	NCV	946.16	24.25	22.94	NO	22.94	1.00	84.12
		Industrial waste	TJ	NO	234.33	NO		-14.05	248.39	1.00	NCV	248.39	22.09	5.49	NO	5.49	1.00	20.12
Peat[(5,6)]			TJ	3.00	2.00	2.00	NO	-8.00	11.00	1.00	NCV	11.00	28.15	0.31	NO	0.31	1.00	1.14
Total												103041.54		1842.16	74.67	1767.49		6480.79
Biomass total												58896.95		1670.11	NO	1670.11		6123.73

FUEL TYPES		Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (kt)	Carbon stored[C excluded] (kt C)	Net carbon emissions ((kt) C)	Fraction of carbon oxidized	Actual CO_2 emissions ((kt) CO_2)
	Solid biomass	TJ	84121.00	4213.00	34025.00		1883.00	52426.00	1.00	NCV	52426.00	30.01	1573.49	NO	1573.49	1.00	5769.45
	Liquid biomass	TJ	2852.00	938.00	2063.00		160.00	1567.00	1.00	NCV	1567.00	19.30	30.24	NO	30.24	1.00	110.89
	Gas biomass	TJ	3777.04	NO	NO		NO	3777.04	1.00	NCV	3777.04	13.95	52.70	NO	52.70	1.00	193.24
	Other non-fossil fuels (biogenic waste)	TJ	NO	1148.02	17.88		3.23	1126.91	1.00	NCV	1126.91	12.14	13.68	NO	13.68	1.00	50.15

Table 2 Comparison of CO_2 emissions from fuel combustion (1.A(c))

FUEL TYPES	REFERENCE APPROACH			SECTORAL APPROACH		DIFFERENCE	
	Apparent energy consumption (PJ)	Apparent energy consumption (excluding non-energy use, reductants and feedstocks) (PJ)	CO_2 emissions (kt)	Energy consumption (PJ)	CO_2 emissions (kt)	Energy consumption (%)	CO_2 emissions (%)
Liquid fuels (excluding international bunkers)	53.76	49.08	3668.86	53.57	3899.57	-8.37	-5.92
Solid fuels (excluding international bunkers)	1.95	1.95	184.47	1.95	184.47	0.00	0.00
Gaseous fuels	46.10	46.10	2519.96	45.76	2499.75	0.74	0.81
Other fossil fuels	1.22	1.22	106.37	1.25	108.28	-1.97	-1.77
Peat	0.01	0.01	1.14	0.01	1.16	0.00	-1.90
Total	103.04	98.36	6480.79	102.54	6693.23	-4.07	-3.17

A.3.4 Reporting consistency with energy data

FUEL TYPES			Apparent consumption reported in GHG inventory (TJ) (3)	Apparent consumption using data reported pursuant to Regulation (EC) No 1099/2008 (TJ) (3)	Absolute difference (1) (TJ) (3)	Relative difference (2) % (3)	Explanations for differences
Liquid fossil	Primary fuels	Crude oil	NO	NO	0.0	0.0%	
		Orimulsion	NO	NO	0.0	0.0%	
		Natural gas liquids	NO	NO	0.0	0.0%	
	Secondary fuels	Gasoline	8658.0	8618.1	39.9	0.5%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs. Data in Annual Questionnaires are given with precision up to 1 kt.
		Jet kerosene	18.0	0.0	18.0	100.0%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs. Data in Annual Questionnaires are given with precision up to 1 kt.
		Other kerosene	NO	NO	0.0	0.0%	
		Shale oil	NO	NO	0.0	0.0%	
		Gas/diesel oil	36475.0	40238.0	-3763.0	-10.3%	In Reference approach it is impossible to input such data as statistical differences. In Latvia's case statistical differences are assumed as diesel that is imported illegally. These amounts are taken into account in Energy balance, hence the Sectoral approach.
		Residual fuel oil	27.0	0.0	27.0	100.0%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs. Data in Annual Questionnaires are given with precision up to 1 kt.
		Liquefied petroleum gases (LPG)	4103.0	4098.6	4.4	0.1%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs. Data in Annual Questionnaires are given with precision up to 1 kt.
		Ethane	NO	NO	0.0	0.0%	
		Naptha	NO	NO	0.0	0.0%	
		Bitumen	3349.0	3348.8	0.2	0.0%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotones which need to be transformed into TJ using NCVs. Data in Annual Questionnaires are given with precision up to 1 kt.

FUEL TYPES			Apparent consumption reported in GHG inventory (TJ) (3)	Apparent consumption using data reported pursuant to Regulation (EC) No 1099/2008 (TJ) (3)	Absolute difference (1) (TJ) (3)	Relative difference (2) % (3)	Explanations for differences
		Lubricants	754.0	753.5	0.5	0.0%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs. Data in Annual Questionnaires are given with precision up to 1 kt.
		Petroleum coke	NO	NO	0.0	0.0%	
		Refinery feedstocks	NO	NO	0.0	0.0%	
		Other oil	377.0	29.2	347.8	92.2%	Waste oils in Annual Questionnaires are included in other liquid fuels while in GHG inventory waste oils are separated and reported under other fossil fuels together with industrial and municipal waste, according to 2006 IPCC Guidelines. Therefore there is a remarkable difference between IEA and GHG inventory data. However, after EU internal review where Reference Approach was compared with Sectoral Approach, it was assumed that in other oil products are included also paraffin waxes and white spirits. To ensure the consistency between RA/SA comparison during EU review, Latvia also included these amounts into Reference approach (and also in Feedstocks, because paraffin wax and white spirit amounts are consumed in IPPU sector, not in Energy). However, as in Annual Questionnaires in other liquid fuels paraffin waxes and white spirits are reported separately, these fuel types are put under "Other liquid fossil". Waste oil consumption in 2015 was 29 TJ, and that makes difference between other oil in GHG inventory and AQ 26.89 TJ, which can be explained with differences of values between Energy Balance (precision up to 1 TJ) and AQ (precision up to 1 kt).
	Other liquid fossil		NO	374.7	0.0	100.0%	See the explanation under "Other oil".
	Liquid fossil total		53761.0	57460.9	-3699.9	0.0%	See the explanations above.
Solid fossil	Primary fuels	Anthracite	NO	NO	0.0	0.0%	
		Coking coal	NO	NO	0.0	0.0%	
		Other bituminous coal	1950.0	1936.7	13.3	0.7%	In GHG inventory fuel consumption is taken from CSB online database with values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs.
		Sub-bituminous coal	NO	NO	0.0	0.0%	

FUEL TYPES			Apparent consumption reported in GHG inventory (TJ) (3)	Apparent consumption using data reported pursuant to Regulation (EC) No 1099/2008 (TJ) (3)	Absolute difference (1) (TJ) (3)	Relative difference (2) % (3)	Explanations for differences
		Lignite	NO	NO	0.0	0.0%	
		Oil shale and tar sand	NO	NO	0.0	0.0%	
	Secondary fuels	BKB and patent fuel	NO	NO	0.0	0.0%	
		Coke oven/gas coke	NO	NO	0.0	0.0%	
		Coal tar	NO	NO	0.0	0.0%	
	Other solid fossil		NO	NO	0.0	0.0%	
	Solid fossil totals		1950.0	1936.7	13.3	0.0%	See the explanations above.
Gaseous fossil		Natural gas (dry)	46096.0	51097.0	-5001.0	-10.8%	The amounts of natural gas in Annual Questionnaires are given in GCV, while in Energy Balance the amounts are in NCV. NCV/GCV ratio is approx. 0.9, therefore the amounts of natural gas reported in GHG inventory are very similar to those reported to IEA.
Other gaseous fossil			NO	NO	0.0	0.0%	
Gaseous fossil totals			46096.0	51097.0	0.0	0.0%	See the explanation above.
	Waste (non-biomass fraction)		IE	1995.0	0.0	100.0%	To ensure consistency between Reference and Sectoral Approach, the amounts of waste consumed are reported under category "Other fossil fuels", because in Sectoral approach there is no category "Waste".
Other fossil fuels			1223.5	NO	1223.5	100.0%	Waste oils in Annual Questionnaires are included in other liquid fuels. As for waste, in GHG inventory data are taken from EU ETS reports and biomass part (at least 50% from all mun.waste) subtracted from totals and reported under biomass; in AQ all amounts of municipal waste are reported as non-biomass fraction. Also there are differences between waste types that are taken for GHG inventory (for industrial waste, neutralised polluted soil, different types of ecofuel in which biomass content is up to 95% are included), while in AQ, Central Statistical Bureau does not include certain fuel types in their reports (assuming few types of ecofuel as biomass, does not include NPS etc.).
Peat			11.0	10.1	0.9	8.6%	In GHG inventory fuel consumption is taken from CSB online database with

FUEL TYPES			Apparent consumption reported in GHG inventory (TJ) (3)	Apparent consumption using data reported pursuant to Regulation (EC) No 1099/2008 (TJ) (3)	Absolute difference (1) (TJ) (3)	Relative difference (2) % (3)	Explanations for differences
							values rounded up to 1 TJ, while in AQ values are given in kilotons which need to be transformed into TJ using NCVs.
Total			103041.54	112499.7	-9458.1	-9.2%	See the explanations above.

A.3.5 Transport

Distribution of road transport fleet by subsectors and layers, year 2015

Subsector	Technology	Population	Mileage, km
Passenger Cars			
Gasoline <1,4 l	ECE 15/03	178	2700
Gasoline <1,4 l	ECE 15/04	712	3600
Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	1917	5500
Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	6464	9000
Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	7127	12000
Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	11283	14000
Gasoline <1,4 l	PC Euro 5 - EC 715/2007	6904	19000
Gasoline <1,4 l	PC Euro 6 - EC 715/2007	1735	19000
Gasoline 1,4 - 2,0 l	ECE 15/00-01	0	0
Gasoline 1,4 - 2,0 l	ECE 15/02	0	0
Gasoline 1,4 - 2,0 l	ECE 15/03	1933	2430
Gasoline 1,4 - 2,0 l	ECE 15/04	7734	3600
Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	47299	7150
Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	40295	12000
Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	23140	15068
Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	27703	17000
Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	10744	20000
Gasoline 1,4 - 2,0 l	PC Euro 6 - EC 715/2007	1616	22000
Gasoline >2,0 l	ECE 15/00-01	0	0
Gasoline >2,0 l	ECE 15/02	0	0
Gasoline >2,0 l	ECE 15/03	214	2700
Gasoline >2,0 l	ECE 15/04	855	4228
Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	7740	9902
Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	8080	14000
Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	8250	15000
Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	8348	19000
Gasoline >2,0 l	PC Euro 5 - EC 715/2007	2397	21000
Gasoline >2,0 l	PC Euro 6 - EC 715/2007	483	21500
Diesel <2,0 l	Conventional	3928	10000
Diesel <2,0 l	PC Euro 1 - 91/441/EEC	19900	11000
Diesel <2,0 l	PC Euro 2 - 94/12/EEC	35953	12000
Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	54926	14000
Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	39650	18374
Diesel <2,0 l	PC Euro 5 - EC 715/2007	18931	24586
Diesel <2,0 l	PC Euro 6 - EC 715/2007	2818	24738
Diesel >2,0 l	Conventional	4103	11872
Diesel >2,0 l	PC Euro 1 - 91/441/EEC	14273	13000
Diesel >2,0 l	PC Euro 2 - 94/12/EEC	21604	14000
Diesel >2,0 l	PC Euro 3 - 98/69/EC Stage2000	51068	15000
Diesel >2,0 l	PC Euro 4 - 98/69/EC Stage2005	28676	18955
Diesel >2,0 l	PC Euro 5 - EC 715/2007	8580	23700
Diesel >2,0 l	PC Euro 6 - EC 715/2007	1476	25039
LPG	Conventional	2563	15000
LPG	PC Euro 1 - 91/441/EEC	10026	17471
LPG	PC Euro 2 - 94/12/EEC	13754	20000
LPG	PC Euro 3 - 98/69/EC Stage2000	10818	21000
LPG	PC Euro 4 - 98/69/EC Stage2005	7012	22040

Subsector	Technology	Population	Mileage, km
LPG	PC Euro 5 - EC 715/2007	2619	23690
LPG	PC Euro 6 - EC 715/2007	87	24620
Light Duty Vehicles			
LPG	Conventional	174	30369
LPG	LD Euro 1 - 93/59/EEC	152	30369
LPG	LD Euro 2 - 96/69/EEC	201	31000
LPG	LD Euro 3 - 98/69/EC Stage2000	130	33000
LPG	LD Euro 4 - 98/69/EC Stage2005	261	43074
LPG	LD Euro 5 - 2008 Standards	166	47984
Gasoline <3,5t	Conventional	218	17000
Gasoline <3,5t	LD Euro 1 - 93/59/EEC	195	18000
Gasoline <3,5t	LD Euro 2 - 96/69/EEC	349	19000
Gasoline <3,5t	LD Euro 3 - 98/69/EC Stage2000	294	21500
Gasoline <3,5t	LD Euro 4 - 98/69/EC Stage2005	586	28000
Gasoline <3,5t	LD Euro 5 - 2008 Standards	366	31000
Gasoline <3,5t	LD Euro 6	59	31000
Diesel <3,5 t	Conventional	2018	25000
Diesel <3,5 t	LD Euro 1 - 93/59/EEC	3300	25000
Diesel <3,5 t	LD Euro 2 - 96/69/EEC	7432	26000
Diesel <3,5 t	LD Euro 3 - 98/69/EC Stage2000	8817	27800
Diesel <3,5 t	LD Euro 4 - 98/69/EC Stage2005	12215	32460
Diesel <3,5 t	LD Euro 5 - 2008 Standards	9344	39000
Diesel <3,5 t	LD Euro 6	247	39000
Heavy Duty Trucks			
LPG	Conventional	262	24000
LPG	HD Euro I - 91/542/EEC Stage I	158	24400
LPG	HD Euro II - 91/542/EEC Stage II	63	26000
Gasoline >3,5 t	Conventional	0	18000
Gasoline >3,5 t	HD Euro I - 91/542/EEC Stage I	947	18500
Gasoline >3,5 t	HD Euro II - 91/542/EEC Stage II	76	18644
Gasoline >3,5 t	HD Euro III - 2000 Standards	13	25057
Rigid <=7,5 t	Conventional	582	20400
Rigid <=7,5 t	HD Euro I - 91/542/EEC Stage I	709	20411
Rigid <=7,5 t	HD Euro II - 91/542/EEC Stage II	599	20411
Rigid <=7,5 t	HD Euro III - 2000 Standards	551	27431
Rigid <=7,5 t	HD Euro IV - 2005 Standards	406	40071
Rigid <=7,5 t	HD Euro V - 2008 Standards	210	42079
Rigid <=7,5 t	HD Euro VI	33	42079
Rigid 7,5 - 12 t	Conventional	311	20600
Rigid 7,5 - 12 t	HD Euro I - 91/542/EEC Stage I	378	20603
Rigid 7,5 - 12 t	HD Euro II - 91/542/EEC Stage II	297	20603
Rigid 7,5 - 12 t	HD Euro III - 2000 Standards	356	28929
Rigid 7,5 - 12 t	HD Euro IV - 2005 Standards	245	40291
Rigid 7,5 - 12 t	HD Euro V - 2008 Standards	96	40565
Rigid 7,5 - 12 t	HD Euro VI	47	40565
Rigid 12 - 14 t	Conventional	100	20700
Rigid 12 - 14 t	HD Euro I - 91/542/EEC Stage I	110	20702
Rigid 12 - 14 t	HD Euro II - 91/542/EEC Stage II	66	20702
Rigid 12 - 14 t	HD Euro III - 2000 Standards	36	23111
Rigid 12 - 14 t	HD Euro IV - 2005 Standards	47	39129
Rigid 12 - 14 t	HD Euro V - 2008 Standards	16	41534
Rigid 12 - 14 t	HD Euro VI	8	41534
Rigid 14 - 20 t	Conventional	546	29000

Subsector	Technology	Population	Mileage, km
Rigid 14 - 20 t	HD Euro I - 91/542/EEC Stage I	712	29000
Rigid 14 - 20 t	HD Euro II - 91/542/EEC Stage II	1183	29000
Rigid 14 - 20 t	HD Euro III - 2000 Standards	1810	36000
Rigid 14 - 20 t	HD Euro IV - 2005 Standards	1351	62000
Rigid 14 - 20 t	HD Euro V - 2008 Standards	3073	67000
Rigid 14 - 20 t	HD Euro VI	718	67000
Rigid 20 - 26 t	Conventional	183	38000
Rigid 20 - 26 t	HD Euro I - 91/542/EEC Stage I	244	38000
Rigid 20 - 26 t	HD Euro II - 91/542/EEC Stage II	341	38000
Rigid 20 - 26 t	HD Euro III - 2000 Standards	389	53000
Rigid 20 - 26 t	HD Euro IV - 2005 Standards	360	74000
Rigid 20 - 26 t	HD Euro V - 2008 Standards	583	78000
Rigid 20 - 26 t	HD Euro VI	274	78000
Rigid 26 - 28 t	Conventional	12	38000
Rigid 26 - 28 t	HD Euro I - 91/542/EEC Stage I	20	38000
Rigid 26 - 28 t	HD Euro II - 91/542/EEC Stage II	33	38000
Rigid 26 - 28 t	HD Euro III - 2000 Standards	49	53000
Rigid 26 - 28 t	HD Euro IV - 2005 Standards	34	74000
Rigid 26 - 28 t	HD Euro V - 2008 Standards	59	78000
Rigid 26 - 28 t	HD Euro VI	42	78000
Rigid 28 - 32 t	Conventional	14	38400
Rigid 28 - 32 t	HD Euro I - 91/542/EEC Stage I	18	38400
Rigid 28 - 32 t	HD Euro II - 91/542/EEC Stage II	55	38400
Rigid 28 - 32 t	HD Euro III - 2000 Standards	59	53000
Rigid 28 - 32 t	HD Euro IV - 2005 Standards	56	74000
Rigid 28 - 32 t	HD Euro V - 2008 Standards	83	78000
Rigid 28 - 32 t	HD Euro VI	30	78000
Rigid >32 t	Conventional	17	38400
Rigid >32 t	HD Euro I - 91/542/EEC Stage I	21	38400
Rigid >32 t	HD Euro II - 91/542/EEC Stage II	39	38400
Rigid >32 t	HD Euro III - 2000 Standards	45	53000
Rigid >32 t	HD Euro IV - 2005 Standards	99	74000
Rigid >32 t	HD Euro V - 2008 Standards	38	78000
Rigid >32 t	HD Euro VI	9	78000
Articulated 14 - 20 t	Conventional	235	29200
Articulated 14 - 20 t	HD Euro I - 91/542/EEC Stage I	305	29500
Articulated 14 - 20 t	HD Euro II - 91/542/EEC Stage II	507	29550
Articulated 14 - 20 t	HD Euro III - 2000 Standards	776	38000
Articulated 14 - 20 t	HD Euro IV - 2005 Standards	579	62000
Articulated 14 - 20 t	HD Euro V - 2008 Standards	1317	67000
Articulated 14 - 20 t	HD Euro VI	308	67000
Articulated 20 - 28 t	Conventional	250	38000
Articulated 20 - 28 t	HD Euro I - 91/542/EEC Stage I	342	38000
Articulated 20 - 28 t	HD Euro II - 91/542/EEC Stage II	489	38000
Articulated 20 - 28 t	HD Euro III - 2000 Standards	586	52000
Articulated 20 - 28 t	HD Euro IV - 2005 Standards	513	74000
Articulated 20 - 28 t	HD Euro V - 2008 Standards	845	78000
Articulated 20 - 28 t	HD Euro VI	433	78000
Articulated 28 - 34 t	Conventional	38	38000
Articulated 28 - 34 t	HD Euro I - 91/542/EEC Stage I	50	38000
Articulated 28 - 34 t	HD Euro II - 91/542/EEC Stage II	121	38000
Articulated 28 - 34 t	HD Euro III - 2000 Standards	135	52000
Articulated 28 - 34 t	HD Euro IV - 2005 Standards	188	74000

Subsector	Technology	Population	Mileage, km
Articulated 28 - 34 t	HD Euro V - 2008 Standards	160	78000
Articulated 28 - 34 t	HD Euro VI	51	78000
Buses			
Urban Buses	Conventional	0	29840
Urban Buses	HD Euro I - 91/542/EEC Stage I	0	29840
Urban Buses	HD Euro II - 91/542/EEC Stage II	0	29840
Urban Buses Midi <=15 t	Conventional	130	32567
Urban Buses Midi <=15 t	HD Euro I - 91/542/EEC Stage I	256	32567
Urban Buses Midi <=15 t	HD Euro II - 91/542/EEC Stage II	259	32567
Urban Buses Midi <=15 t	HD Euro III - 2000 Standards	266	43891
Urban Buses Midi <=15 t	HD Euro IV - 2005 Standards	365	56098
Urban Buses Midi <=15 t	HD Euro V - 2008 Standards	622	62520
Urban Buses Midi <=15 t	HD Euro VI	163	62520
Coaches Standard <=18 t	Conventional	185	47805
Coaches Standard <=18 t	HD Euro I - 91/542/EEC Stage I	155	47805
Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	172	47805
Coaches Standard <=18 t	HD Euro III - 2000 Standards	165	59027
Coaches Standard <=18 t	HD Euro IV - 2005 Standards	130	72020
Coaches Standard <=18 t	HD Euro V - 2008 Standards	141	79080
Coaches Standard <=18 t	HD Euro VI	58	79080
Coaches Articulated >18 t	Conventional	48	47805
Coaches Articulated >18 t	HD Euro I - 91/542/EEC Stage I	102	47805
Coaches Articulated >18 t	HD Euro II - 91/542/EEC Stage II	171	47805
Coaches Articulated >18 t	HD Euro III - 2000 Standards	257	59027
Coaches Articulated >18 t	HD Euro IV - 2005 Standards	80	72020
Coaches Articulated >18 t	HD Euro V - 2008 Standards	18	79080
Coaches Articulated >18 t	HD Euro VI	104	79080
Mopeds and Motorcycles			
<50 cm³	Conventional	0	1000
<50 cm³	Mop - Euro I	718	1150
<50 cm³	Mop - Euro II	13604	2298
<50 cm³	Mop - Euro III	0	0
2-stroke >50 cm³	Conventional	1156	1100
2-stroke >50 cm³	Mot - Euro I	514	1600
2-stroke >50 cm³	Mot - Euro II	473	1600
2-stroke >50 cm³	Mot - Euro III	2119	2866
4-stroke <250 cm³	Mot - Euro III	717	400
4-stroke 250 - 750 cm³	Conventional	1714	1400
4-stroke 250 - 750 cm³	Mot - Euro I	782	2000
4-stroke 250 - 750 cm³	Mot - Euro II	1045	2000
4-stroke 250 - 750 cm³	Mot - Euro III	1943	4000
4-stroke >750 cm³	Conventional	839	1800
4-stroke >750 cm³	Mot - Euro I	729	2000
4-stroke >750 cm³	Mot - Euro II	816	2000
4-stroke >750 cm³	Mot - Euro III	1973	5006

A.3.6 Agriculture

Manure Management Systems distribution (MMS), 1990-2015

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dairy cows																										
Pasture/Range/Paddock	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.1	0.1	0.1	0.1	0.1	0.1	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.07	0.07
Solid storage	0.83	0.83	0.82	0.82	0.81	0.81	0.8	0.79	0.78	0.77	0.76	0.72	0.72	0.71	0.7	0.7	0.69	0.67	0.64	0.62	0.6	0.58	0.56	0.54	0.53	0.48
Liquid/ Slurry	0.054	0.06	0.07	0.07	0.08	0.08	0.09	0.1	0.11	0.12	0.13	0.18	0.19	0.19	0.2	0.21	0.22	0.24	0.27	0.29	0.27	0.28	0.25	0.24	0.27	0.33
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.04	0.05	0.11	0.14	0.13	0.13
Sheep																										
Pasture/Range/Paddock	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.24
Solid storage	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.77
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Goats																										
Pasture/Range/Paddock	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Solid storage	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.90
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Horses																										
Pasture/Range/Paddock	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.14
Solid storage	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.86
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sows and boars																										
Pasture/Range/Paddock	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid storage	0.72	0.71	0.69	0.68	0.66	0.64	0.62	0.6	0.57	0.55	0.53	0.48	0.44	0.4	0.37	0.33	0.3	0.28	0.25	0.23	0.21	0.18	0.16	0.14	0.12	0.10

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Liquid/ Slurry	0.28	0.29	0.31	0.32	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.52	0.56	0.6	0.63	0.67	0.7	0.72	0.75	0.77	0.71	0.71	0.61	0.56	0.52	0.60
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.08	0.11	0.24	0.3	0.36	0.31
Piglets																										
Pasture/Range/Paddock	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid storage	0.72	0.71	0.7	0.68	0.67	0.65	0.63	0.6	0.58	0.56	0.53	0.49	0.45	0.41	0.37	0.34	0.31	0.28	0.26	0.23	0.21	0.19	0.16	0.14	0.12	0.10
Liquid/ Slurry	0.28	0.29	0.3	0.32	0.33	0.35	0.38	0.4	0.42	0.45	0.47	0.51	0.55	0.59	0.63	0.67	0.69	0.72	0.74	0.77	0.71	0.71	0.60	0.56	0.52	0.59
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.08	0.11	0.23	0.3	0.36	0.31
Fattening and young breeding pigs																										
Pasture/Range/Paddock	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid storage	0.71	0.7	0.68	0.67	0.65	0.63	0.61	0.58	0.56	0.54	0.52	0.47	0.43	0.39	0.35	0.32	0.29	0.27	0.24	0.22	0.20	0.17	0.15	0.13	0.11	0.09
Liquid/ Slurry	0.29	0.3	0.32	0.33	0.35	0.37	0.39	0.42	0.44	0.46	0.49	0.53	0.57	0.61	0.65	0.68	0.71	0.73	0.76	0.78	0.72	0.72	0.61	0.56	0.52	0.60
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.09	0.11	0.24	0.31	0.36	0.31
Laying hens																										
Pasture/Range/Paddock	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Solid storage	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.87	0.84	0.71	0.63	0.46	0.61
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.10	0.13	0.26	0.35	0.51	0.36
Broilers																										
Pasture/Range/Paddock	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid storage	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Turkeys																										
Pasture/Range/Paddock	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.17
Solid storage	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.83
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	2013	2014	2015
Ducks																										
Pasture/Range/Paddock	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.19
Solid storage	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.81
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Geese																										
Pasture/Range/Paddock	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.18
Solid storage	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.83
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Rabbits																										
Pasture/Range/Paddock	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid storage	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fur animals																										
Pasture/Range/Paddock	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid storage	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Deer																										
Pasture/Range/Paddock	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Solid storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Dairy cattle calves under 1 year																										
Pasture/Range/Paddock	0.117	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.09	0.09	0.09	0.09	0.08	0.08	0.07

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Solid storage	0.883	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.91	0.91	0.88	0.88	0.84	0.81	0.82	0.83
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.03	0.04	0.08	0.11	0.10	0.10
Beef cattle calves under 1 year																										
Pasture/Range/Paddock	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Solid storage	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Dairy cow young cattle, aged 1-2 years																										
Pasture/Range/Paddock	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.09	0.09	0.09	0.09	0.08	0.08	0.07
Solid storage	0.88	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.91	0.91	0.88	0.88	0.84	0.81	0.82	0.83
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.03	0.04	0.08	0.11	0.097	0.10
Beef young cattle, aged 1-2 years																										
Pasture/Range/Paddock	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Solid storage	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Bulls over 2 year																										
Pasture/Range/Paddock	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Solid storage	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Heifers over 2 years																										
Pasture/Range/Paddock	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Solid storage	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other cows over 2 year																										
Pasture/Range/Paddock	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Solid storage	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Liquid/ Slurry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anaerobic digester	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

ANNEX 4: NATIONAL ENERGY BALANCE OF LATVIA IN 2015 (TJ)

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil (oven fuel inclusive)	Residual (heavy) fuel oils	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Natural gas	Fuelwood	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
NCV		39.35	45.54	43.97	43.21	43.21	43.2	42.49	40.6	41.86	41.86	41.86	41.86	41.86	29.23	23.91	10.05	0.02	26.79	34.8		27.98	17.05	30	26.8	37.2	19.02	20.49	19.02	14.4
Production	268										268							3			83986				81	2465	350	85	3239	135
Recycled products	29														29						0	84	256							
Imports	101335	39	9567	10470		4512		71066	29	42	1675	3433	335	167		1711		2	0	45435	4093	224	1722	120	306	632				
Imported for bunkering	10666							5226	5440												0									
Exports	40719	39	5510	1988				31485	609		879			209		48		2			33695			330	54	2223				
Bunkering	10666							5226	5440												0									
Interproduct transfers																					0									
Stock changes	-2361		46	176				-3106	607		-42	-84		42		287	10	-2		661	-1823		17	-60	-11	-149				
Statistical difference	4088			264				3824																						
Gross energy consumption	62640		4103	8922		4512		40299	27	42	1022	3349	335	0	29	1950	10	1	0	46096	52561	308	1995	-270	322	725	350	85	3239	135
Transformation	-45		-8					-24	-13							-165				-31791	-14737			330			-217	-85	-3008	-20
Electricity plants																														
Public CHP	-8							-8								-98				-28686	-7850						-28	-85	-2213	
Autoproducer CHP																				-401	-509						-189		-795	
Public Heat Plants	-20		-1					-6	-13							-7				-2026	-4436									
Autoproducer Heat Plants	-17		-7					-10								-60				-678	-1238									-20
Production of peat briquettes																														
Charcoal Production																					-704			330						
Energy sector	255							255												683										

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil (oven fuel inclusive)	Residual (heavy) fuel oils	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Natural gas	Fuelwood	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Losses																				338										
Final consumption	62340		4095	8922		4512		40020	14	42	1022	3349	335		29	1785	10	1	0	13284	37824	308	1995	60	322	725	133		231	115
Transport	47641		2687	8585		4512		30895			962														322	632				
International air transport	4494					4494																								
Domestic air transport	24			6		18																								
Road transport	40172		2687	8576				28001			908														322	558				
Rail transport	2819							2765			54															74				
Inland shipping	132			3				129																						
Pipeline transport																														
Industry and construction	5769		406	48				1547	13	42		3349	335		29	1014	10	1	0	5063	14963	308	1995			3			31	29
Manufacture of metals																				406										
Manufacture of chemicals and chemical products	193		139	3				9		42										323	221					1			29	
Manufacture of other fabricated metal products																1				60										
Manufacture of other non-metallic mineral products	281		1	0				280								957			0	1207	3	308	1995			2				
Manufacture of transport equipment	23		5	0				18								0				40	1									
Machinery	27		14	1				12								2		1		171	96									
Mining and quarrying	123			1				122								2	10			41	3									
Manufacture of food products, beverages and tobacco	297		148	1				111	8						29	24				1538	209								2	29
Manufacture of paper and paper products	6		4					2												95	5									

	Oil products - total	Shale oil	Liquefied petroleum gas	Motor and aviation petrol	Petrol type jet fuel	Kerosene type jet fuel	Kerosene	Diesel oil (oven fuel inclusive)	Residual (heavy) fuel oils	White spirit	Lubricants	Oil bitumen	Paraffin waxes	Other oil products	Used oils	Coal	Peat	Peat briquettes	Coke oven coke	Natural gas	Fuelwood	Used tires	Municipal waste for heating	Charcoal	Bioethanol	Biodiesel	Landfill gas	Sewage sludge gas	Other biogas	Straw
Manufacture of wood and of products of wood and cork	495		27	15				327					126							502	14223									
Construction	4087		66	27				641	4			3349				2				432	59									
Manufacture of textiles	6		0					6								24				172	5									
Manufacture of other products	231		2	0				19	1				209			2				76	138									
Other sectors	8930		1002	289				7578	1		60					771		0		8221	22861			60		90	133		200	86
Other consumers - commercial and public sector	2226		137	44				2044	1							263		0		3590	3341					15	133			14
Households	2055		773	220				1062								501				4116	19130			60						
Crop and animal production, hunting and related service activities; forestry and logging	4434		92	25				4258			59					7				512	382					75			200	72
Fishing	215		0	0				214			1									3	8									

ANNEX 5: 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:

- Standardized data entry, processing and storage procedures => process oriented data processing.
- Centralized processing and storage of all types of statistical data, including metadata, by using data warehouse technologies and OLAP tools.
- The system is connected to Business Register => direct respondent basic data retrieval and updating.
- Special import and export procedure is created for data exchange with other systems.

A link with PC Axis is created for electronic data dissemination

ANNEX 6: SUPPLEMENTARY INFORMATION UNDER ARTICLE 6., 12., 17

In 2016 there are no Joint Implementation Project (Article 6) and no Clean Development Mechanism (Article 12) projects in Latvia.
There are no specific limitation rules for the Operators and/or Person accounts in Latvia 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 2016 and doesn't include accounts that were closed after the compliance period 30/04/2016.

Legal entities authorized to participate in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol

Legal entities authorized to participate in the mechanisms under Article 6, 12 and 17 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)
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 "Ogres namsaimnieks"	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)

Legal entities authorized to participate in the mechanisms under Article 6, 12 and 17 of the Kyoto Protocol)	Account ID	Role
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)
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 "Fortum Latvia" koģenerācijas stacija	LV-HOLDING_ACCOUNT -5023038-0-81	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 "KVV 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 "KRONOSPAN Riga"	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)
SIA "Rigens"	LV-HOLDING_ACCOUNT- 5012177-0-66	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)

Legal entities authorized to participate in the mechanisms under Article 6, 12 and 17 of the Kyoto Protocol)	**Account ID**	**Role**
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 "KNAUF"	LV-HOLDING_ACCOUNT-5020444-0-53	Latvia's ETR operator (obligatory participation)
SIA „Ogres Trikotāža"	LV-HOLDING_ACCOUNT- 5012123-0-45	Latvia's ETR operator (obligatory participation)
A/S "Olainfarm"	LV-HOLDING_ACCOUNT-5023045-0-46	Latvia's ETR operator (obligatory participation)
SIA "KD LATGALE"	LV-HOLDING_ACCOUNT- 5019274-0-83	Person holding account (Legal person)
A/S AirBaltic Corporation"	LV-HOLDING_ACCOUNT-5000081-0-18	Latvia's ETR aircraft operator (obligatory participation)
Primera Air Nordic SIA	LV-HOLDING_ACCOUNT-5024780-0-4	Latvia's ETR aircraft operator (obligatory participation)
Smartlynx Airlines	LV-HOLDING_ACCOUNT-5000042-0-19	Latvia's ETR aircraft operator (obligatory participation)