



**National Centre for
Emissions Management**
Institute of Environmental Protection
National Research Institute

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MINISTRY OF CLIMATE AND ENVIRONMENT

POLAND'S NATIONAL INVENTORY DOCUMENT 2026

GREENHOUSE GAS INVENTORY 1988-2024

**SUBMISSION UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE
CHANGE AND PARIS AGREEMENT**

Warsaw 2026

Poland's National Inventory Document 2026

Greenhouse Gas Inventory 1988-2024

**Submission under the United Nations Framework Convention
on Climate Change and Paris Agreement**

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EXECUTIVE SUMMARY

ES.1. Background information on greenhouse gas inventories and climate change

The underlying report, presenting the results of national greenhouse gas inventory in 2024, with the trend since 1988, is the official inventory submission of Poland for 2026 under the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement.

The report has been prepared in accordance with the *Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement* agreed by the Conference of Parties (COP) serving as the meeting of the Parties to the Paris Agreement at its first session (decision 18/CMA.1), so called MPGs, and *Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement* (decision 5/CMA.3).

At the same time the underlying report has been elaborated for the purpose of Poland's obligations resulting from Regulation (EU) 2018/1999 of the European Parliament and of Council of 11 December 2018 on the *Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council as well as Commission Implementing Regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014.*

According to the provisions of Article 4.6 of the UNFCCC and decision 9/CP.2 Poland uses 1988 as the base year for the estimation and reporting of GHG inventories for the main gases (CO₂, CH₄ and N₂O). Different base years have been established for other groups of gases: 1995 for HFCs, PFCs and sulphur hexafluoride (SF₆) and 2000 for the nitrogen trifluoride (NF₃).

The national GHG inventory covers the emission of the following GHGs and groups of gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆), nitrogen trifluoride (NF₃) which are reported in five categories: 1. *Energy*, 2. *Industrial Processes and Product Use (IPPU)*, 3. *Agriculture*, 4. *Land Use, Land Use Change and Forestry (LULUCF)* and 5. *Waste*. Also information on emissions of sulphur dioxide (SO₂) and the following GHG precursors: carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) is reported in CRT tables.

The GHG emissions estimates, as provided in the underlying report, have been compiled in accordance with the *2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories* (IPCC 2006 Guidelines), in some cases supplemented by the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2019 IPCC Refinement), what is consistent with decisions: 18/CMA.1 and 5/CMA.3. Pursuant to these guidelines, country specific methods have been used where appropriate giving more accurate emission data.

In order to present the anthropogenic GHG emissions by sources and removals by sinks in carbon dioxide equivalents, the 100-year global warming potential (GWP) values, as indicated

in table 8.A.1 of the contribution of Working Group 1 to the Fifth Assessment Report of the IPCC (so called AR5), have been applied.

The unit responsible for compiling the GHG inventory for the purpose of the European Union and the UNFCCC regulations, according to the provisions of the Act of 17 July 2009 on the system to manage the emissions of greenhouse gases and other substances (*Journal of laws 2022, item 673 with further changes*), is the National Centre for Emissions Management (KOBiZE) in the Institute of Environmental Protection – National Research Institute, supervised by the Minister of Climate and Environment.

ES.2. Summary of trends related to national emissions and removals

The GHG emissions for 1988 and for 2024, expressed as CO₂ equivalent, are presented in table S.1. In 2024 the total national emission of GHG amounted to 341.03 million tonnes of CO₂ eq. including indirect CO₂ emissions and excluding GHG emissions and removals from category 4 (Land use, land use change and forestry – LULUCF). Compared to the 1988, the 2024 emissions have decreased by 41.2%.

Table S.1. National emissions of greenhouse gases for years 1988 and 2024

GHG	Emission in CO ₂ eq. [kt]		(2024-1988)/1988
	1988	2024	[%]
CO ₂ (with LULUCF)	423 022.49	251 317.61	-40.59
CO ₂ (without LULUCF)	471 590.23	278 945.43	-40.85
CH ₄ (with LULUCF)	77 955.32	37 726.76	-51.60
CH ₄ (without LULUCF)	77 900.23	37 715.50	-51.58
N ₂ O (with LULUCF)	31 499.82	23 511.75	-25.36
N ₂ O (without LULUCF)	30 204.53	20 518.20	-32.07
HFCs	NO	3 717.21	-
PFCs	132.31	8.64	-93.47
Unspecified mix of HFCs and PFCs	NO	NO	NO
SF ₆	NO	128.72	-
NF ₃	NO	NO	NO
TOTAL net emission (with LULUCF)	532 609.94	316 410.70	-40.59
TOTAL without LULUCF	579 827.30	341 033.71	-41.18

NA - Not applicable, NO - Not occurring

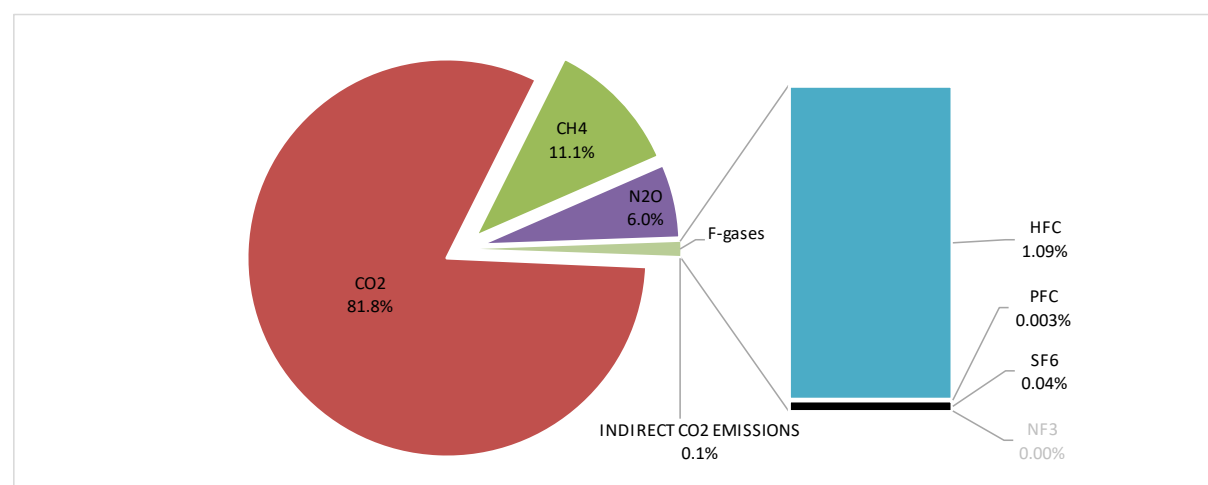


Figure S.1. Percentage share of GHG in national total emission in 2024 (excluding 4. LULUCF)

Carbon dioxide is the main GHG in Poland with the share of 81.8% in national emissions in 2024. Methane and nitrous oxide contribute respectively with: 11.1% and 6.0% share. All F-

gases are responsible for 1.1% of total GHG emissions. Percentage share of GHG in national total emissions (excluding category 4. *LULUCF*) in 2024 is presented at figure S.1.

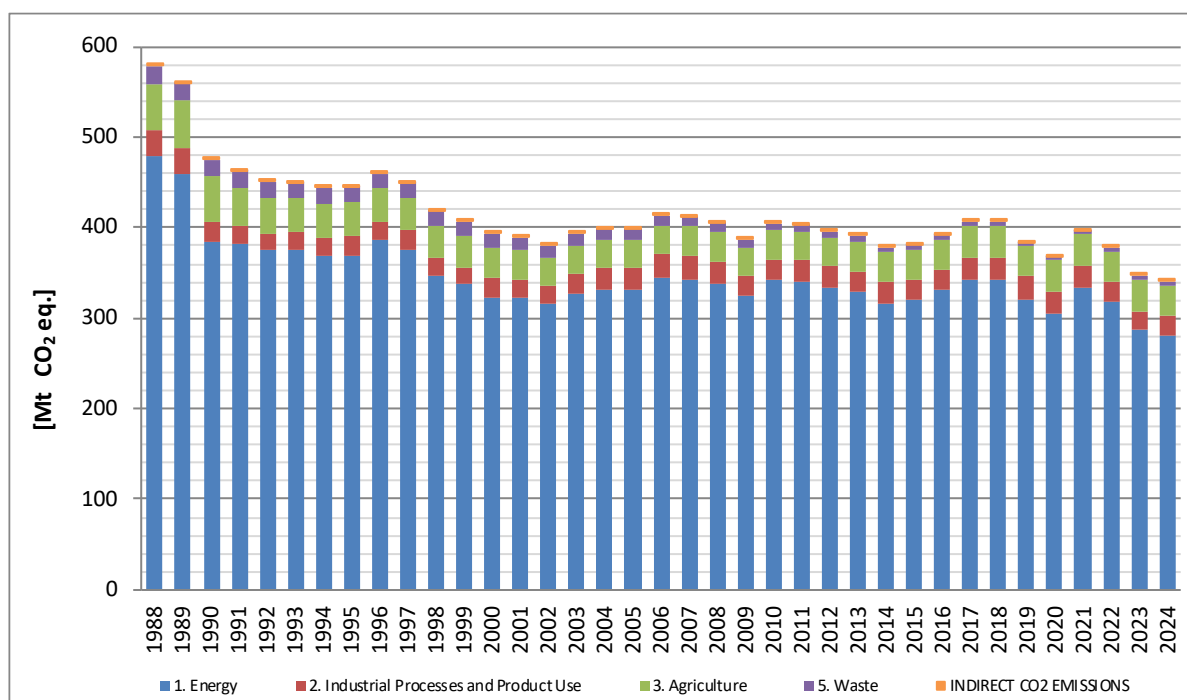


Figure S.2. GHG emissions in Poland in 1988-2024 (including indirect CO₂ emissions and excluding net balance from LULUCF by gases)

The GHGs trend for period between 1988 and 1990 indicates significant decrease triggered by substantial economic changes, especially in heavy industry. This was the time when political transformation from centrally planned to free market economy began. This drop in emissions continued up to 1992 and then emissions started to rise with a peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. Slow decline in emissions (up to 2002) characterized the succeeding years, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. In 2008-2011 stabilisation in emissions has been noted with distinct decrease in 2009 related to world economic slow-down. In 2012–2014 GHG emissions in Poland slowly decreased then starting to rise in the next years (tab. S.2 and fig. S.2). The main cause of significant increase of GHGs emissions in 2016–2017, besides economic animation, was substantial rise of fuels use in road transport driven by effective combat against grey zone at fuel market started in 2016, but also favourable fuel prices and increase in vehicles amount.

After 2018, the GHG emissions decreased by 6% in 2019 and by a further 4% in 2020 compared to the previous year. The main reason for the decrease in emissions between 2019 and 2020 was the lower consumption of fuels combusted in stationary sources (hard coal by over 6% and lignite by over 8%) and in transport (gasoline by nearly 7% and diesel by nearly 3%). In addition to the energy sector, emissions from the industrial processes sector have also decreased. This is mainly the result of a decrease in metallurgy production (reduction in the production of converter steel by 20%, pig iron by over 18% and sinter by about 24%). In 2021, national emissions increased again (by nearly 8%) compared to the previous year and exceeded 400 million tons of equivalent CO₂. The most significant increase in GHG emissions was recorded in the fuel combustion sector - by 10%. The reason was higher fuel consumption: hard coal by 10.6%, lignite by 19.0% and natural gas by 10.3% in stationary sources, as well as higher use of gasoline by 10.6%, diesel oil by 8.3% and CNG by almost 42.5% in transport

sector.

In the years 2022-2024, a gradual decline in domestic greenhouse gas emissions was observed compared to 2021: by almost 5% in 2022, by nearly 13% in 2023, and by 14% in 2024. The main factor influencing the reduction in domestic emissions in 2022-2024 was a decline in emissions from the energy sector, including from fuel combustion in stationary sources, and primarily in the electricity and heat production sector (by almost 24%) and in households (by over 18%). This significant emission reduction was driven by a systematic decline in fuel consumption in these categories between 2022 and 2024. In the case of electricity and heat production, hard coal consumption fell by over 30%, and lignite consumption by almost 23%, while in households, hard coal use decreased by approximately 26%.

Table S.2. National emissions of greenhouse gases for 1988–2024 by gases [kt CO₂ eq.]

GHG	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CO ₂ (with LULUCF)	422 399.57	403 954.83	332 729.21	340 809.43	342 802.80	338 075.20	318 205.22	299 494.92	316 647.74	303 752.70	286 352.98	279 424.82	270 941.08	275 189.20	259 683.13	270 657.92	264 168.79	263 645.41	276 772.96
CO ₂ (without LULUCF)	470 967.32	451 485.49	376 286.12	373 309.20	364 222.27	364 911.82	359 939.61	362 433.14	377 073.77	367 153.72	338 938.73	329 161.96	317 270.70	313 253.02	305 836.48	318 715.31	323 609.66	322 561.99	336 366.54
CH ₄ (with LULUCF)	77 955.32	77 343.62	71 166.54	66 172.30	64 506.83	62 275.64	61 563.55	59 877.15	58 905.90	58 585.99	56 019.25	54 530.63	52 062.97	51 860.01	51 240.37	51 270.40	50 548.03	50 845.17	50 847.19
CH ₄ (without LULUCF)	77 900.23	77 288.49	71 111.41	66 147.54	64 211.78	62 217.20	61 501.87	59 834.39	58 816.81	58 541.26	55 992.42	54 476.84	52 019.84	51 837.82	51 206.15	51 140.13	50 522.07	50 807.83	50 805.17
N ₂ O (with LULUCF)	31 499.82	32 674.03	29 447.77	25 163.67	23 461.96	24 102.42	24 101.63	24 835.70	24 733.75	24 789.36	24 601.66	24 041.13	24 165.13	24 154.19	22 874.79	22 734.19	23 203.02	23 447.76	23 764.65
N ₂ O (without LULUCF)	30 204.53	31 358.53	28 138.01	23 888.08	22 034.40	22 782.58	22 781.12	23 531.74	23 390.23	23 464.77	23 269.28	22 708.33	22 838.85	22 923.93	21 614.26	21 367.39	21 892.34	22 147.41	22 474.77
HFCs	NO	NO	NO	NO	NO	NO	NO	15.55	85.27	145.88	216.59	384.18	827.91	1 204.30	1 682.12	2 155.04	2 593.58	3 130.42	3 727.03
PFCs	132.31	132.54	127.47	126.97	120.97	130.16	137.27	154.52	144.84	156.87	158.19	153.19	160.87	181.35	189.91	184.09	187.51	171.47	176.86
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF ₆	NO	NO	NO	NO	NO	NO	13.67	30.02	24.53	23.61	24.67	24.22	23.77	23.56	24.00	21.35	23.04	27.62	34.22
NF ₃	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
INDIRECT CO ₂ EMISSIONS	622.92	580.34	258.10	297.14	325.71	364.24	396.42	371.47	389.57	394.54	396.61	399.13	462.63	459.29	510.04	500.03	573.49	571.83	671.45
TOTAL (with LULUCF)	532 609.94	514 685.35	433 729.10	432 569.50	431 218.27	424 947.65	404 417.76	384 779.30	400 931.61	387 848.95	367 769.95	358 957.30	348 644.36	353 071.90	336 204.36	347 523.03	341 297.46	341 839.69	355 994.38
TOTAL (without LULUCF)	579 827.30	560 845.38	475 921.10	463 768.93	450 915.13	450 406.00	444 769.96	446 370.82	459 925.03	449 880.66	418 996.50	407 307.86	393 604.58	389 883.28	381 062.96	394 083.35	399 401.69	399 418.57	414 256.05

Table S.2. (cont.) National emissions of greenhouse gases for 1988–2024 by gases [kt CO₂ eq.]

GHG	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CO ₂ (with LULUCF)	289 403.89	283 306.87	260 116.34	270 855.20	276 116.21	265 125.43	267 615.03	262 462.42	269 516.86	272 935.31	285 883.37	285 932.17	284 322.09	267 511.76	296 169.91	267 948.42	241 259.81	250 850.06
CO ₂ (without LULUCF)	335 712.96	329 409.36	315 867.50	334 013.11	333 383.50	325 758.67	321 752.11	309 402.89	312 536.54	323 316.56	336 471.35	335 637.28	317 367.63	301 972.86	330 626.68	314 718.50	283 685.74	278 477.88
CH ₄ (with LULUCF)	49 539.80	48 639.77	46 803.46	46 047.93	44 600.11	44 291.65	44 023.62	43 614.09	44 457.39	43 860.68	44 006.53	44 568.11	41 602.84	41 367.35	40 837.53	39 221.63	38 303.99	37 726.76
CH ₄ (without LULUCF)	49 518.22	48 617.61	46 776.85	46 033.72	44 581.76	44 245.76	44 012.75	43 594.08	44 419.61	43 846.78	43 998.62	44 547.90	41 574.96	41 308.40	40 829.82	39 194.24	38 293.49	37 715.50
N ₂ O (with LULUCF)	24 638.23	24 298.13	21 457.08	21 082.83	21 384.04	21 528.34	21 680.75	21 493.06	20 811.34	21 798.08	22 805.95	23 106.36	22 178.15	22 558.21	22 776.46	22 516.60	23 830.65	23 511.75
N ₂ O (without LULUCF)	23 293.53	22 942.17	20 098.96	19 703.88	20 000.41	20 133.19	20 308.29	20 032.90	19 334.34	19 798.49	20 763.16	21 077.55	20 126.20	20 692.14	20 938.11	20 437.17	20 886.41	20 518.20
HFCs	4 066.85	4 379.66	4 674.68	4 672.79	5 070.58	5 370.73	5 235.79	5 645.01	4 890.39	4 965.28	5 102.72	4 974.89	4 887.08	4 766.03	4 597.37	4 269.75	3 893.47	3 717.21
PFCs	168.68	149.21	18.66	17.72	16.84	16.00	15.20	14.44	13.71	13.03	12.38	11.76	11.17	10.61	10.08	9.58	9.10	8.64
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF ₆	32.12	33.88	38.76	36.45	40.22	43.21	49.00	54.41	79.39	80.78	84.97	110.67	93.54	92.29	92.61	126.06	116.48	128.72
NF ₃	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
INDIRECT CO ₂ EMISSIONS	668.09	840.66	669.35	579.57	598.38	551.15	466.36	508.41	561.12	544.40	541.36	488.29	463.45	572.16	518.29	432.14	422.85	467.55
TOTAL (with LULUCF)	368 517.65	361 648.17	333 778.33	343 292.51	347 826.37	336 926.49	339 085.74	333 791.84	340 330.21	344 197.56	358 437.27	359 192.25	353 558.32	336 878.41	365 002.24	334 524.18	307 836.35	316 410.70
TOTAL (without LULUCF)	413 460.43	406 372.55	388 144.75	405 057.25	403 691.68	396 118.70	391 839.50	379 252.13	381 835.12	392 565.31	406 974.55	406 848.35	384 524.03	369 414.50	397 612.95	379 187.45	347 307.54	341 033.71

ES.3. Overview of source and sink category emission estimates and trends

Total GHG emissions presented in CO₂ equivalent for 1988 and for 2024 together with change between 2024 and 1988 by main categories are given in tables S.3, S.4 and figure S.3. In all categories emission reduction has been observed while in LULUCF sector increase in carbon sink has been noted. The highest percentage drop in emissions has occurred in 5. *Waste* sector (by 78.4%) in result of significant development of waste treatment technologies and policies, including wastewater treatment evolution, as well as recycling advancement associated with decline of treatment by disposal on land. Another sector with the significant GHG emission decline is 3. *Agriculture* (by 32.1%) what was caused by significant structural and economic changes after 1989 in this sector, including diminishing animal and crop production (i.e. cattle population drop from 10 million to 6 million or sheep population – from 4 million to 0.3 million in 1988-2024). Next category with high emission reduction in 1988-2024 is 1. *Energy* (by about 41.2%) what was caused by transformation of heavy industry in Poland as well as by decreasing coal use and mining and energy efficiency measures implemented.

Table S.3. GHG emissions according to main sectors in 1988 and in 2024

IPCC category	Total [kt eq. CO ₂]		(2024-1988)/1988 [%]
	1988	2024	
TOTAL with LULUCF	532 609.94	316 410.70	-40.59
TOTAL without LULUCF	579 827.30	341 033.71	-41.18
1. Energy	478 929.36	281 530.88	-41.22
2. Industrial Processes and Product Use	29 865.86	20 563.93	-31.15
3. Agriculture	50 240.26	34 106.08	-32.11
4. Land-Use, Land-Use Change and Forestry	-47 217.36	-24 623.01	-47.85
5. Waste	20 168.90	4 365.27	-78.36
INDIRECT CO ₂ EMISSIONS	622.92	467.55	-24.94

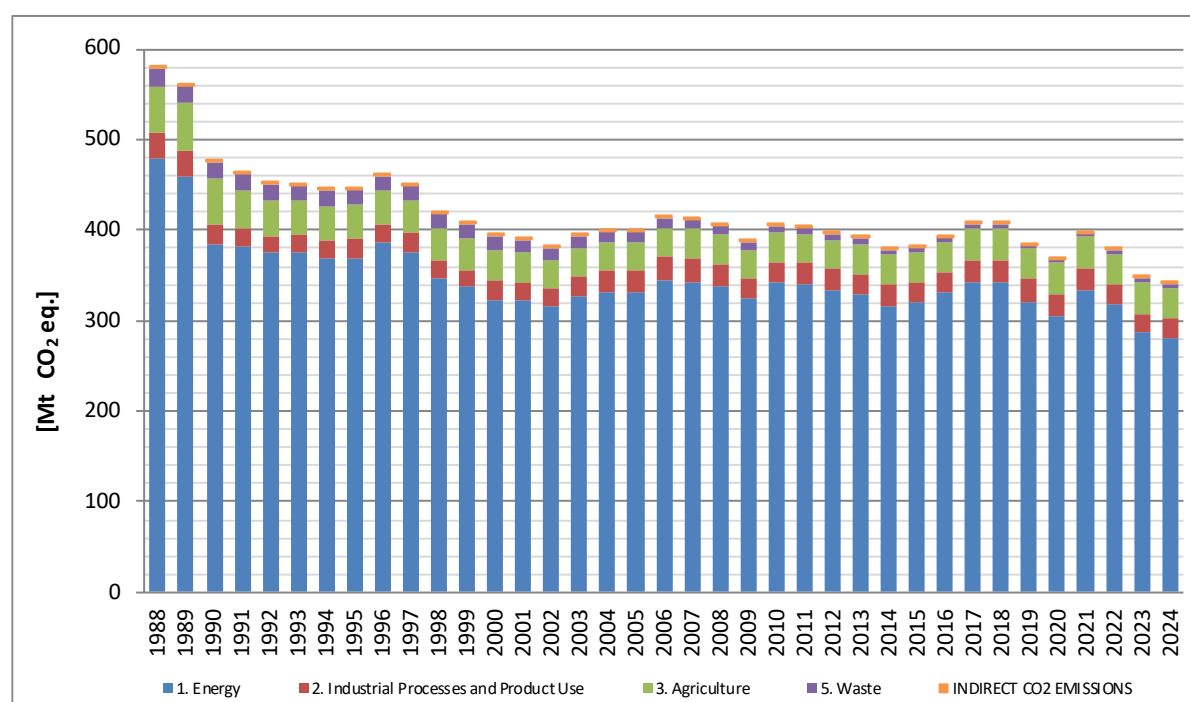


Figure S.3. Trend of aggregated GHGs emissions (excluding category 4) for 1988–2024 according to source categories

Table S.4. National emissions of greenhouse gases for 1988–2024 by source categories [kt CO₂ eq.]

IPCC sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Energy	478 929.36	458 422.81	384 589.43	382 457.03	374 552.98	375 949.53	368 751.50	369 845.06	385 750.25	374 544.23	345 821.57	337 063.37	323 125.37	322 158.12	316 204.84	327 720.22	331 881.56	332 340.00	345 092.26
2. Industrial Processes and Product Use	29 865.86	28 937.48	21 971.96	19 265.17	18 546.07	18 531.93	20 750.83	21 995.43	21 131.80	22 006.98	20 412.25	19 436.00	22 029.78	20 498.97	19 093.81	21 819.38	23 382.61	23 100.98	25 293.93
3. Agriculture	50 240.26	52 946.63	49 489.07	42 715.19	38 836.95	37 421.48	37 134.01	36 947.24	35 987.40	36 791.81	36 684.23	35 209.85	33 427.00	32 825.31	31 855.90	31 361.41	31 412.20	31 803.85	32 281.56
4. Land-Use, Land-Use Change and Forestry	-47 217.36	-46 160.04	-42 192.01	-31 199.43	-19 696.86	-25 458.35	-40 352.20	-61 591.52	-58 993.42	-62 031.71	-51 226.54	-48 350.57	-44 960.21	-36 811.38	-44 858.60	-46 560.32	-58 104.23	-57 578.88	-58 261.67
5. Waste	20 168.90	19 958.12	19 612.55	19 034.40	18 653.42	18 138.82	17 737.20	17 211.63	16 666.00	16 143.10	15 681.84	15 199.51	14 559.79	13 941.58	13 398.38	12 682.31	12 151.83	11 601.90	10 916.85
INDIRECT CO ₂ EMISSIONS	622.92	580.34	258.10	297.14	325.71	364.24	396.42	371.47	389.57	394.54	396.61	399.13	462.63	459.29	510.04	500.03	573.49	571.83	671.45
TOTAL (with LULUCF)	532 609.94	514 685.35	433 729.10	432 569.50	431 218.27	424 947.65	404 417.76	384 779.30	400 931.61	387 848.95	367 769.95	358 957.30	348 644.36	353 071.90	336 204.36	347 523.03	341 297.46	341 839.69	355 994.38
TOTAL (without LULUCF)	579 827.30	560 845.38	475 921.10	463 768.93	450 915.13	450 406.00	444 769.96	446 370.82	459 925.03	449 880.66	418 996.50	407 307.86	393 604.58	389 883.28	381 062.96	394 083.35	399 401.69	399 418.57	414 256.05

Table S.4. (cont.) National emissions of greenhouse gases for 1988–2024 by source categories [kt CO₂ eq.]

IPCC sector	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1. Energy	341 986.32	336 979.68	325 631.79	342 804.58	339 271.12	333 105.06	329 342.03	315 650.32	319 790.45	330 437.81	343 046.84	342 147.83	321 343.00	305 723.32	334 002.12	317 557.23	288 166.25	281 530.88
2. Industrial Processes and Product Use	27 580.64	26 136.80	20 756.93	21 955.39	24 602.73	23 660.23	22 896.28	24 248.87	23 662.62	23 832.79	24 396.32	24 957.41	24 665.20	24 169.93	24 210.26	23 420.42	20 038.37	20 563.93
3. Agriculture	32 977.36	33 062.26	32 373.73	31 770.48	32 043.73	31 865.02	32 542.47	32 481.02	31 849.09	32 230.93	33 571.31	33 867.33	32 867.52	34 153.29	34 199.54	33 308.22	34 185.97	34 106.08
4. Land-Use, Land-Use Change and Forestry	-44 942.78	-44 724.37	-54 366.42	-61 764.74	-55 865.31	-59 192.21	-52 753.76	-45 460.29	-41 504.91	-48 367.76	-48 537.28	-47 656.10	-30 965.71	-32 536.09	-32 610.71	-44 663.27	-39 471.19	-24 623.01
5. Waste	10 248.02	9 353.14	8 712.95	7 947.22	7 175.72	6 937.24	6 592.35	6 363.51	5 971.83	5 519.38	5 418.72	5 387.48	5 184.84	4 795.79	4 682.73	4 469.43	4 494.10	4 365.27
INDIRECT CO ₂ EMISSIONS	668.09	840.66	669.35	579.57	598.38	551.15	466.36	508.41	561.12	544.40	541.36	488.29	463.45	572.16	518.29	432.14	422.85	467.55
TOTAL (with LULUCF)	368 517.65	361 648.17	333 778.33	343 292.51	347 826.37	336 926.49	339 085.74	333 791.84	340 330.21	344 197.56	358 437.27	359 192.25	353 558.32	336 878.41	365 002.24	334 524.18	307 836.35	316 410.70
TOTAL (without LULUCF)	413 460.43	406 372.55	388 144.75	405 057.25	403 691.68	396 118.70	391 839.50	379 252.13	381 835.12	392 565.31	406 974.55	406 848.35	384 524.03	369 414.50	397 612.95	379 187.45	347 307.54	341 033.71

ES.4. Other information

The indirect CO₂ emissions from the atmospheric oxidation of NMVOC, as described in the Chapter 4.5.2.3.1, is reported separately to the IPPU sector, in the CRT Table 6.

As relates to indirect N₂O emissions, resulted from livestock manure management as well as from managed soils (atmospheric deposition and Nitrogen leaching and run-off) – these are reported within the Agricultural sector, see Chapter 5 of the NID as well as in CRT Tables 3.B(b) and 3.D.

ES.5. Key category analysis

The source/sink categories in all sectors are identified to be *key categories* on the basis of their contribution to the total level and/or trend assessment established in accordance with 2006 IPCC GLs following quantitative Approach 1 and qualitative criteria. In 2024, 30 sources were identified as Poland's key categories excluding LULUCF and 39 including LULUCF, while in 1988 - 22 and 26 respectively with the application of quantitative approach. Analysis with use of qualitative criteria identified no additional categories as key categories.

About 77% of GHG emissions in 2024 (excluding LULUCF) were generated in the sector 1.A *Fuel combustion*, of which three biggest source categories are: 1.A.1 *Energy Industries (Solid fuels)*, 1.A.3.b *Road Transportation (Fossil fuels)* and 1.A.4 *Other Sectors (Solid fuels)*. This sector is of significant influence on a country's total GHG emissions in terms of both: level and trend of emissions.

Table 1.2 presents the general information on identified key categories in the national inventory for 2024. Those categories contribute to over 96.74% of the total GHG emission (without LULUCF). The complete tables with level and trend assessments for 1988 and 2024 are given in Annex 1.

Table 1.2. Key category analysis results in 2024 (without LULUCF)

No.	IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)			Comments
1	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	L	T		
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	L			
3	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	L	T		
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	L	T		
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	L			
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	L	T		
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	L	T		
8	1.A.3.b Road Transportation	CO2	L	T		
9	1.A.3.c Railways	CO2		T		
10	1.A.4 Other Sectors - Biomass	CH4	L	T		
11	1.A.4 Other Sectors - Gaseous Fuels	CO2	L	T		
12	1.A.4 Other Sectors - Liquid Fuels	CO2	L	T		
13	1.A.4 Other Sectors - Solid Fuels	CO2	L	T		
14	1.A.4 Other Sectors - Solid Fuels	CH4		T		
15	1.B.1 Fugitive emissions from Solid Fuels	CH4	L	T		
16	1.B.1 Fugitive emissions from Solid Fuels	CO2	L			
17	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	L	T		
18	2.A.1 Cement Production	CO2	L	T		
19	2.A.4 Other Process Uses of Carbonates	CO2	L	T		
20	2.B.1 Ammonia Production	CO2	L			
21	2.B.2 Nitric Acid Production	N2O		T		
22	2.C.1 Iron and Steel Production	CO2		T		
23	2.F.1 Refrigeration and Air conditioning	F-gases	L	T		
24	3.A Enteric Fermentation	CH4	L	T		
25	3.B Manure Management	N2O	L			
26	3.B Manure Management	CH4	L			
27	3.D.1 Direct N2O Emissions From Managed Soils	N2O	L	T		
28	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	L			
29	5.A Solid Waste Disposal	CH4		T		
30	5.D Wastewater Treatment and Discharge	CH4	L			

ES.6. Improvements introduced

The national GHG inventory is undergoing continuous improvement to take into account the latest methodologies, including evolution to higher Tier methods, available data and recommendations given by the Expert Review Teams. Constant improvements usually lead to GHG emissions recalculations for single years or entire trends presented within subsequent national inventories.

The impact of recalculations on national totals are summarised in Chapter 10, and the details related to sectoral inventory improvements and recalculations are presented in Chapters 3-7. The main methodological improvements, introduced in Submission 2025, are described by sector, below.

Energy

1.A.3.b (*Road transport*) – the modernization and data update of the CEPiK vehicle registry (Polish Central Vehicle and Driver Register database) included, among other measures, the removal of vehicles that showed no operational activity, specifically those lacking mandatory third-party liability insurance (OC) and valid technical inspections, what resulted in GHG emissions recalculation in years 1988 – 2023.

IPPU

F-gases emission from disposal emission from refrigeration and AC equipment category was reanalyzed in result activity data and emission were revised.

Agriculture

No significant methodological changes were introduced in underlying submission.

LULUCF

The land-use change (LUC) assessment has been conducted using an innovative wall-to-wall approach. This comprehensive methodology involves mapping and analyzing the entire area of interest with full-coverage data, rather than relying on sampling of selected plots, statistical extrapolations, or expert judgments. This pioneering application of wall-to-wall represents a significant methodological advancement, enabling precise detection and quantification of LUC transitions (e.g., forest to cropland or settlements) across the entire national territory. It enhances the transparency, accuracy, and verifiability of emissions and sequestration estimates in line with the IPCC 2006 Guidelines, particularly for categories such as 4.A Forest Land and 4.E Settlements. Key advantages include full spatial coverage that captures fine-scale changes missed by sampling (reducing uncertainty in activity data), temporal consistency for repeatable annual updates using time-series imagery, and seamless integration with other data sources like National Forest Inventories and geometric datasets to support Tier 2/3 approaches. The implementation of wall-to-wall is the first step toward full compliance with the relevant provisions of the EU Governance Regulation (Regulation (EU) 2018/1999), which imposes increasingly stringent methodological requirements for GHG inventories, including spatially explicit land-use tracking.

Moreover, for category 4.A (Forest Land), annual carbon stock changes in soils now incorporate updated national soil organic carbon (SOC) values. This methodological upgrade improves precision in tracking forestry-related sequestration. For category 4.B (Cropland), calculations for annual soil carbon stock changes rely on refreshed national SOC values combined with new data on soil valuation classes for land areas. These inputs better reflect agricultural practices' effects on cropland SOC. For category 4.C (Grasslands), annual soil carbon stock changes similarly use updated national SOC values and soil valuation class data for grassland areas. This approach captures management-driven variations in perennial vegetation and grazing impacts, such as through tillage, residue retention, or grazing intensity. Updated data reveals land management's significant influence on soil carbon stocks at the aggregated level across LULUCF categories, reflecting combined effects from national-scale updates in SOC values and soil valuation classes.

Furthermore, it should be noted that there has been an advancement in the estimation of carbon stock changes for non-forest woody areas (i.e. agroforestry systems), shifting toward a Tier 2 approach for biomass and dead wood estimations. This upgraded methodology involves estimating annual carbon stock changes at the national level, taking into account the major tree species in these areas. Tier 2 methods incorporate more detailed, region-specific data from the National Forest Inventory, offering higher precision than Tier 1. This approach reflects pragmatic adaptation to data availability and quality capturing carbon dynamics more accurately.

Waste

5.D.1 (*Wastewater treatment and discharge*) – enhancement of application of IPCC 2019 Refinement to IPCC 2006 GLs and new activity data.

1. National circumstances, institutional arrangements and cross-cutting information

1.1. Background information on greenhouse gas inventories and climate change

The underlying report, presenting the results of national greenhouse gas inventory in 2024, with the trend since 1988, is the official inventory submission of Poland for 2026 under the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement.

The report has been prepared in accordance with the *Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement* agreed by the Conference of Parties (COP) serving as the meeting of the Parties to the Paris Agreement at its first session (decision 18/CMA.1), so called MPGs, and *Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement* (decision 5/CMA.3).

At the same time the underlying report has been elaborated for the purpose of Poland's obligations resulting from Regulation (EU) 2018/1999 of the European Parliament and of Council of 11 December 2018 on the *Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council as well as Commission Implementing Regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014.*

According to the provisions of Article 4.6 of the UNFCCC and decision 9/CP.2 Poland uses 1988 as the base year for the estimation and reporting of GHG inventories for the main gases (CO₂, CH₄ and N₂O). Different base years have been established for other groups of gases: 1995 for HFCs, PFCs and sulphur hexafluoride (SF₆) and 2000 for the nitrogen trifluoride (NF₃).

The national inventory covers the emission of the following GHGs and groups of gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆), nitrogen trifluoride (NF₃) which are reported in five categories: 1. *Energy*, 2. *Industrial Processes and Product Use (IPPU)*, 3. *Agriculture*, 4. *Land Use, Land Use Change and Forestry (LULUCF)* and 5. *Waste*. Also information on emissions of sulphur dioxide (SO₂) and the following GHG precursors: carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) is reported in CRT tables.

The GHG emissions estimates, as provided in the underlying report, have been compiled in accordance with the *2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories* (IPCC 2006 Guidelines), in some cases supplemented by the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2019 IPCC Refinement), what is consistent with decisions: 18/CMA.1 and 5/CMA.3. Pursuant to these guidelines, country specific methods have been used where appropriate giving more accurate emission data.

The unit responsible for compiling the GHG inventory for the purpose of the European Union and the UNFCCC regulations, according to the provisions of the Act of 17 July 2009 on the system to manage the emissions of greenhouse gases and other substances (*Journal of laws 2022, item 673 with further changes*), is the National Centre for Emissions Management (KOBiZE) in the Institute of Environmental Protection – National Research Institute, supervised by the Minister of Climate and Environment.

1.2. A description of national circumstances and institutional arrangements

1.2.1. National entity and focal point

The Act of 17 July 2009 on the system to manage the emissions of greenhouse gases and other substances (*Journal of Laws 2022, item 673 as amended*) established a legal base to manage the national emissions cap for greenhouse gases or other substances in a way that should ensure that Poland complies with the EU and international commitments and will allow for cost-effective reductions of the emission. Pursuant to the above mentioned law, the National Centre for Emissions Management (Krajowy Ośrodek Bilansowania i Zarządzania Emisjami – KOBiZE) that has been established in the Institute of Environmental Protection – National Research Institute in Warsaw:

- carries out tasks associated with functioning of the national system to balance and forecast emissions, including managing a National Emission Database,
- elaborates methodologies to estimate emissions for individual types of installations or activities and methodologies to estimate emission factors per unit of produced good, fuel used or raw material applied,
- elaborates emission reports and projections for GHG and air pollutants,
- manages the national registry for Kyoto Protocol units,
- acts as the national EU Emission Trading Scheme administrator.

The Minister of Climate and Environment supervises the activity and performance of the National Centre for Emissions Management.

The national entity with overall responsibility for the national GHG inventory in Poland is:

Ministry of Climate and Environment
 Department of Air Protection and Climate Negotiations
 Greenhouse Gas Emissions Management Unit
 Location: Wawelska 52/54 str., 00-922 Warszawa, Poland

According to Article 11 of above mentioned Act, the National Centre prepares and submits to the Minister of Climate and Environment, 30 days before the deadlines established in the European Union law or international environmental agreements, annual greenhouse gas inventories carried out in accordance with the UNFCCC guidelines and annual inventories of the substances listed in the Convention on Long-range Transboundary Air Pollution (UNECE CLRTAP). Prior to the submission, the elaborated inventories undergo internal process of the official scrutiny and approval carried out by the Ministry of Climate and Environment.

The emission calculation, choices of activity data, emission factors and methodology are performed by the Emission Inventory and Reporting Unit in the National Centre for Emissions Management. To ensure consistency of the reported data the inventories established on a yearly basis for the purpose of both conventions: CLRTAP and UNFCCC and the EU obligations apply the same activity data sets covering first of all energy balances, but also industrial and agricultural production, land use and waste management.

The National Centre collaborates with a number of individual experts as well as institutions when compiling inventories. Among the latter are: Statistics Poland (GUS), Agency of Energy Market (ARE), Institute for Ecology of Industrial Areas in Katowice (IETU), Polish Geological Institute - National Research Institute (PIG PIB), State Mining Authority (WUG) as well as Office for Forest Planning and Management (BULGiL). These institutions are mainly involved in providing activity data for inventory estimates.

The experts of the National Centre have access to different emission and activity data sources, among which the most important are:

- individual data of entities participating in the European Union Emission Trading System (EU-ETS). These independently verified data are included in the GHG inventory for some IPCC subcategories (e.g. in some subsectors in industrial processes);
- data submitted by entities to the E-PRTR database pursuant to Regulation (EC) no 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC;
- aggregated data collected by operators under Article 3(6) of Regulation (EC) No 842/2006;
- emission data submitted by individual entities to the National Emission Database – the biggest database with individual emission reports available in Poland.

Since early 2000s, data from individual entities in the EU member States are gathered and publicized in the European Pollutant Release and Transfer Register (E-PRTR, earlier called EPER – European Pollutant Emission Register). The usefulness of E-PRTR data for the inventory preparation needs is limited, as in most cases the register contains only fragmentary information based on part of the installations belonging to a given sector or emitting certain greenhouse gas. Nevertheless, they can be helpful to a certain extent in a process of data cross-checking, what is possible especially if the E-PRTR data cover a whole sector or gas. Polish national inventory system includes this database as a potential source of valuable data and the inventory team has been granted full access to the Polish PRTR reporting system.

Also the National Emission Database, that presently contains almost 60 thousand reports yearly on about 80 different GHGs and pollutants, is helpful in the inventory preparation process, it cannot however replace the inventory assessments as such, as it doesn't cover all the emission sources (i.a. it doesn't contain individual transport and households) and the methodology for emission calculation is not homogenous.

The three existing independent emission databases mentioned above enable crosschecking of emission data and improving their quality. This is even more possible as two of them (the EU ETS database and the National Emission Database) are run by the same institution that also prepares the inventories (KOBIZE in the Institute of Environmental Protection - National Research Institute) and – as was said – the third one (E-PRTR) is open to the public.

The National Centre for Emissions Management, as the entity directly responsible for GHG inventory preparation, is also in charge of coordination and implementation of QA/QC procedures within inventory. The QA/QC programme has been elaborated in line with the 2006 IPCC Guidelines to assure high quality of the Polish annual greenhouse gas inventory.

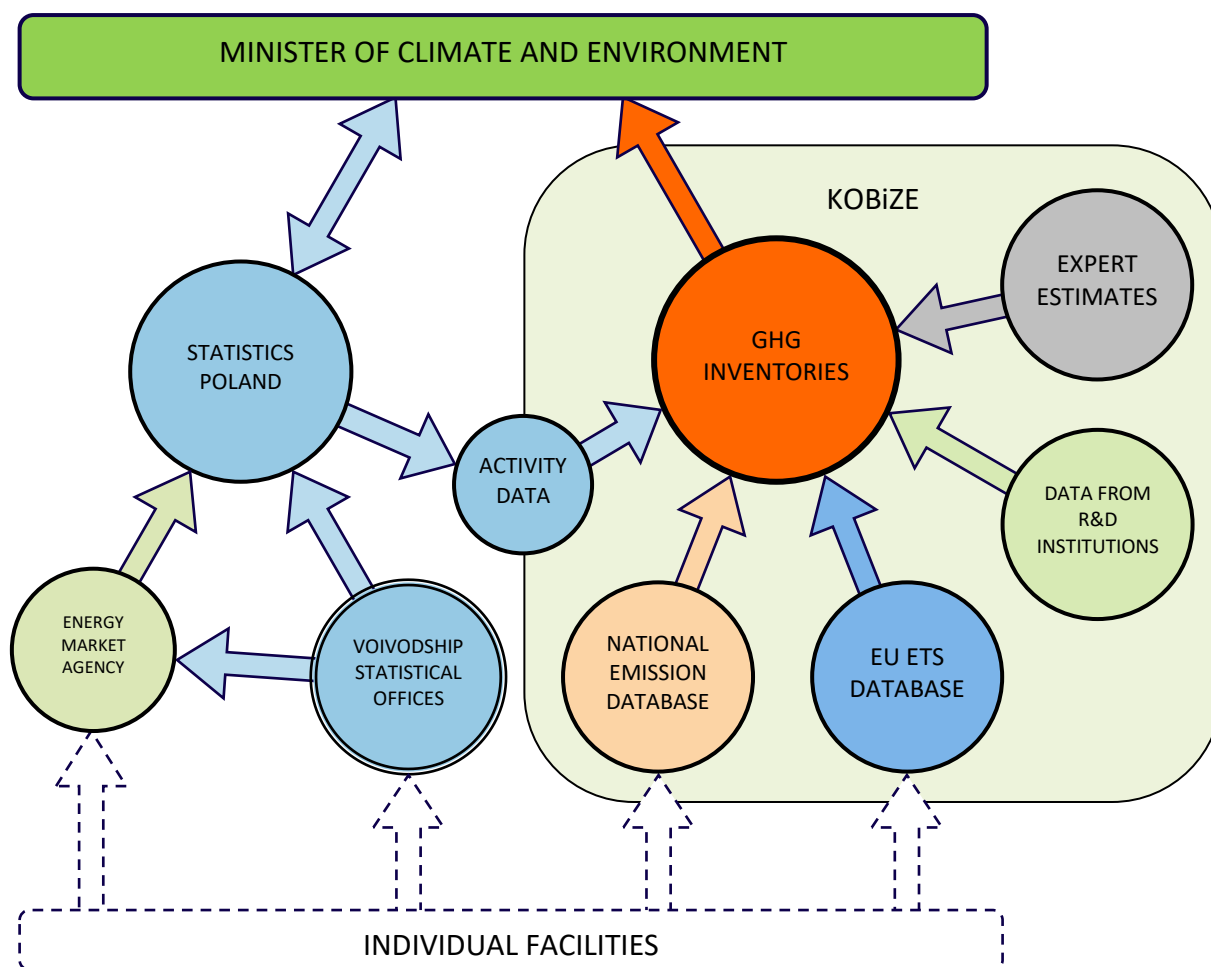


Figure 1.1. National GHG emissions inventory system scheme

1.2.2. Inventory preparation process

The GHG emission estimates are based on methodologies elaborated by the Intergovernmental Panel on Climate Change (IPCC) and recommended by the UNFCCC, while emissions of precursor gases (CO, NO_x, NMVOCs) as well as SO_x, according to methodology elaborated by EMEP/EEA. Wherever necessary and possible, country specific methodologies and emission factors have been developed to reflect domestic conditions. The most important features of the inventory preparation and archiving can be briefly summarized in the following way:

- activity data are mostly taken from official public statistics (GUS, EUROSTAT) or, when required data are not directly available, (commissioned) research reports or expert estimates are used instead; in very detailed categories, estimates made by individual industries or market players can be also useful if available,
- emission factors for the main emission categories are mostly taken from reports on domestic research; IPCC default data are used in cases where the emission factors are highly uncertain, or when particular source category contribution to national total is insignificant,
- all activity data, emission factors and resulting emission data are stored in a database in KOBIZE, which is constantly updated and extended to meet the ever changing requirements for emission reporting, with respect to UNFCCC and CLTRAP as well as their protocols.

1.2.3. Archiving of information

GHG inventory archiving system is based on network file servers and covers official submissions files, compiled inventory data, not compiled sectoral working files and other necessary documents. All those locations are regularly backed up taking into account disaster protection rules.

Official reports and data submitted to the UNFCCC are available at the website:

<https://www.kobize.pl/pl/fileCategory/id/16/krajowa-inwentaryzacja-emisji>

Information on data and reports archiving and management was elaborated in form of Data Management Manual.

1.2.4. Process for official consideration and approval of inventory

The national GHG inventory, as prepared by the National Centre for Emissions Management, is submitted to the Department of Air Protection and Climate Negotiations in the Ministry of Climate and Environment, where it is a subject of internal process of the official scrutiny. Then, the inventory report is sent by the Minister of Climate and Environment to the Committee for European Affairs, acting on behalf of the Council of Ministers, in order to collect further possible comments and final approval.

The final decision of approval of the national GHG inventory by the Committee of European Affairs is then sent to the National Centre for Emissions Management with indication for official submission to the European Union and UNFCCC.

1.3. Brief general description of methodologies and data sources used

The GHG emissions and removals inventory presented in this report follow the recommended by decision 18/CMA.1 the *2006 IPCC Guidelines for national inventories* [IPCC 2006]. As subsequent version of the IPCC Guidelines, namely *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, is agreed for voluntary use (decision 5/CMA.3), it has been started to be applied in some categories.

According to the IPCC guidelines country specific methods have been used where appropriate giving more accurate emission data especially in case of key categories. For categories where emissions do not occur or are not estimated the abbreviations NO and NE were used in tables. More detail description of methodologies used in Polish GHG inventory is given in sections 3–7.

The non-CO₂ GHG emissions from fuel combustion (1.A. category) were estimated based on fuel consumption estimates and respective emission factors. Data on fuel consumption for stationary sources with disaggregation into fuel type and source category come from official fuel balances elaborated by Statistics Poland and reported to Eurostat pursuant to Article 4 of Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics.

Table 1.1. Hard coal consumption in 2024

National fuel balance	Hard coal (Eurostat)	
	kt	TJ
In	52297.79	1264211.81
From national sources	44176.00	1063065.22
1) Indigenous production	43945.27	1057066.32
2) Transformation output or return	230.73	5998.90
3) Stock decrease	0.00	0.00
Import	8121.79	201146.59
Out	52297.79	1264211.81
National consumption	50136.62	1198996.01
1) Transformation input	40536.51	957903.05
a) input for secondary fuel production	10012.66	295537.71
b) fuel combustion	30523.85	662365.33
2) Direct consumption	9600.10	241092.96
Non-energy use	12.99	337.66
Combusted directly	9587.12	240755.30
Combusted in Poland	40110.96	903120.64
Stock increase	-1129.71	-29019.35
Export	4508.11	124585.51
Losses and statistical differences	-1217.22	-30350.35
Net calorific value	MJ/kg	22.52

One of the steps of emission inventorying from the 1.A. *Energy* category is preparation of energy budgets for main fuels (energy carriers). These budgets are prepared based on the national energy balances published by Statistics Poland and Agency of Energy Market. The tables of the national energy balance include detailed information on the ins and outs of all the energy carriers used in Poland, as well as information on their conversions to other energy carriers and on their direct consumption. The data for international bunker are also assessed.

The example data on quantity of coal combusted in whole country in a given year (tab. 1.1) is used for calculation of the average net calorific value of this fuel. This calculated net calorific value provides then the basis for the estimation of average country specific CO₂ emission factor based on empirical formula that applies the relationship between net calorific value and elemental carbon content in fuel (see chapter 3.1.1). This factor can be used for estimation of the potential CO₂ emission from coal combustion. The amount of fuel combusted in a given year, calculated in fuel budget, can be compared with total consumption of this fuel in all sectors. It is one of the ways of verifying of sectoral approach.

Basic information on activity data regarding IPCC categories comes from Eurostat and Statistics Poland (GUS) databases. The activity data that are not available in the GUS have been worked out in experts studies commissioned specifically for the GHG emission inventory purposes.

Eurostat database containing domestic data provided by the Statistics Poland (GUS) is the main source of activities for Energy sector, covering stationary and mobile sources. Detail information on fuel use is given in Annex 3 and Annex 5.3 while the data on fuel consumption in Transportation subcategory is presented in Chapter 3.2.8.

1.4. Brief description of key categories

The source/sink categories in all sectors are identified to be *key categories* on the basis of their contribution to the total level and/or trend assessment established in accordance with 2006 IPCC GLs following quantitative Approach 1 and qualitative criteria. In 2024, 30 sources were identified as Poland's key categories excluding LULUCF and 39 including LULUCF, while in 1988 - 22 and 26 respectively with the application of quantitative approach. Analysis with use of qualitative criteria identified no additional categories as key categories.

About 77% of GHG emissions in 2024 (excluding LULUCF) were generated in the sector 1.A *Fuel combustion*, of which three biggest source categories are: 1.A.1 *Energy Industries (Solid fuels)*, 1.A.3.b *Road Transportation (Fossil fuels)* and 1.A.4 *Other Sectors (Solid fuels)*. This sector is of significant influence on a country's total GHG emissions in terms of both: level and trend of emissions.

Table 1.2 presents the general information on identified key categories in the national inventory for 2024. Those categories contribute to over 96.74% of the total GHG emission (without LULUCF). The complete tables with level and trend assessments for 1988 and 2024 are given in Annex 1.

Table 1.2. Key category analysis results in 2024 (without LULUCF)

No.	IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)			Comments
1	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	L	T		
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	L			
3	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	L	T		
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	L	T		
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	L			
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	L	T		
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	L	T		
8	1.A.3.b Road Transportation	CO2	L	T		
9	1.A.3.c Railways	CO2		T		
10	1.A.4 Other Sectors - Biomass	CH4	L	T		
11	1.A.4 Other Sectors - Gaseous Fuels	CO2	L	T		
12	1.A.4 Other Sectors - Liquid Fuels	CO2	L	T		
13	1.A.4 Other Sectors - Solid Fuels	CO2	L	T		
14	1.A.4 Other Sectors - Solid Fuels	CH4		T		
15	1.B.1 Fugitive emissions from Solid Fuels	CH4	L	T		
16	1.B.1 Fugitive emissions from Solid Fuels	CO2	L			
17	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	L	T		
18	2.A.1 Cement Production	CO2	L	T		
19	2.A.4 Other Process Uses of Carbonates	CO2	L	T		
20	2.B.1 Ammonia Production	CO2	L			
21	2.B.2 Nitric Acid Production	N2O		T		
22	2.C.1 Iron and Steel Production	CO2		T		
23	2.F.1 Refrigeration and Air conditioning	F-gases	L	T		
24	3.A Enteric Fermentation	CH4	L	T		
25	3.B Manure Management	N2O	L			
26	3.B Manure Management	CH4	L			
27	3.D.1 Direct N2O Emissions From Managed Soils	N2O	L	T		
28	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	L			
29	5.A Solid Waste Disposal	CH4		T		
30	5.D Wastewater Treatment and Discharge	CH4	L			

1.5. Brief general description of QA/QC plan and implementation

The QA/QC programme contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures. The following elements of the Quality Assurance and Quality Control system have been addressed:

- Inventory agency responsible for coordinating QA/QC activities,
- QA/QC plan,
- General QC procedures (Tier 1 method),
- Source category-specific QC procedures (Tier 2),
- QA review procedures,
- Reporting, documentation and archiving procedures.

For more detailed information on QA/QC procedures see Annex 4.

1.6. General uncertainty evaluation, including data on the overall uncertainty for the inventory totals

Uncertainty evaluation made for 2024 is based on calculations and national expert's judgments/ estimations as well as opinions expressed by international experts during the review led by UNFCCC Secretariat in the years 2007-2012.

The estimate of emission uncertainty for the year 2024 was made using Tier 1 approach. The uncertainty ranges varied significantly among various source categories and are presented within sectoral chapters 3-7. More details, including sectoral information on uncertainty ranges, are given in Annex 2.

1.7. General assessment of the completeness

1.7.1. Information on completeness

The Polish GHG emission inventory includes calculation of emissions from all relevant sources recommended by the mandatory guidelines.

1.7.2. Description of insignificant categories

Not relevant.

1.7.3. Total aggregate emissions considered insignificant

Not relevant.

1.8. Metrics

Consistent with paragraph 37 of the Annex to the decision 18/CMA.1 on *Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement* (so called MPGs), underlying report with the greenhouse gas emissions expressed in CO₂ equivalents, is prepared using 100-year time-horizon global warming potential (GWP) values as set out in table 8.A.1 of the Working Group 1 contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (so called AR5).

2. Trends in greenhouse gas emissions and removals

2.1. Description of emission and removal trends for aggregated greenhouse gas emissions and removals

For carbon dioxide, net emission is calculated by subtracting from the total CO₂ emission – the emissions and removals from category 4. *Land Use, Land Use Change and Forestry* (LULUCF). According to the IPCC methodology, CO₂ emissions are given with and without contributions from category 4. Also following IPCC, emission of CO₂ from biomass, is not included in the national total. On the other hand indirect CO₂ emissions related to NMVOC emissions are presented separately following UNFCCC review 2022 recommendation and are summed up to the national totals with and without LULUCF.

For non-CO₂ gases, the inventory results can also be presented (table 2.1) in units of CO₂ equivalents by applying values of the so called Global Warming Potentials - GWP. GWPs applied in the underlying inventory come from IPCC AR5 report (see chapter 1.1). Carbon dioxide is the main GHG in Poland with the 81.8% (excluding category 4) share in 2024, while the methane contributes with 11.1% (excluding category 4) to the national total. Nitrous oxide contribution is 6.0% (excluding category 4) and all industrial GHG together contribute 1.1%. Percentage shares of individual GHGs in national total emissions in 2024 are presented in table 2.1. and figure 2.1.

Table 2.1. Greenhouse gas emissions in 2024 in CO₂ eq.

Pollutant	2024	
	Emission in CO ₂ eq. [kt]	Share [%]
CO ₂ (with LULUCF)	251317.61	79.43
CO ₂ (without LULUCF)	278945.43	81.79
CH ₄ (with LULUCF)	37726.76	11.92
CH ₄ (without LULUCF)	37715.50	11.06
N ₂ O (with LULUCF)	23511.75	7.43
N ₂ O (without LULUCF)	20518.20	6.02
HFCs	3717.21	1.09
PFCs	8.64	0.003
Mix of HFC & PFC	NO	NO
SF ₆	128.72	0.04
NF ₃	NO	NO
TOTAL net emission (with LULUCF)	316410.70	100.00
TOTAL (without LULUCF)	341033.71	100.00

Emissions of main GHGs in 2024, disaggregated into main source sub-sectors, are given in table 2.2. Respective values for the fluorinated industrial gases are presented in table 2.3. Discussion of these results is given in the following sections.

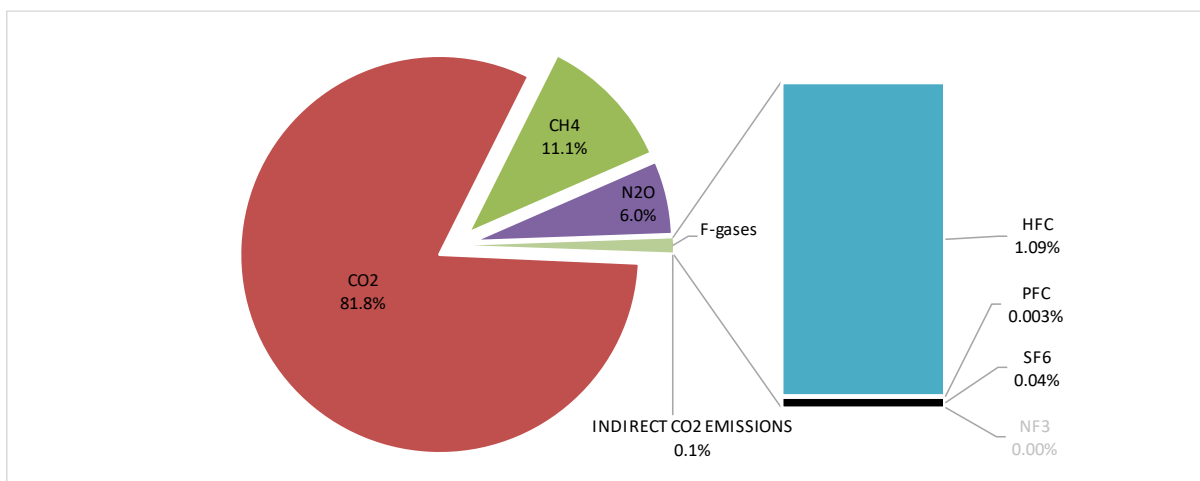


Figure 2.1. Percentage share of greenhouse gases in national total emission in 2024 (excluding LULUCF)

Table 2.2. Emissions of CO₂, CH₄ and N₂O in 2024 [kt]

GHG	CO ₂	CH ₄	N ₂ O
TOTAL without LULUCF	278945.43	1346.98	77.43
TOTAL with LULUCF	251317.61	1347.38	88.72
1. Energy	261282.93	641.90	8.58
A. Fuel combustion	257832.83	122.15	8.58
1. Energy industries	123432.94	1.09	1.89
2. Manufacturing industries and construction	25689.92	3.97	0.54
3. Transport	69262.74	2.92	2.51
4. Other sectors	39447.24	114.17	3.64
B. Fugitive emissions from fuels	3450.10	519.74	0.001
1. Solid fuels	1794.92	481.96	NA
2. Oil and natural gas and other emissions from energy production	1655.18	37.78	0.001
2. Industrial processes and product use	16113.86	1.79	2.06
A. Mineral industry	10178.72	NA	NA
B. Chemical industry	4023.20	1.44	1.60
C. Metal industry	1597.36	0.35	NA
D. Non-energy products from fuels and solvent use	314.57	NE	NE
G. Other product manufacture and use	NO	NO	0.46
3. Agriculture	1081.09	592.78	61.99
A. Enteric fermentation	NA	533.94	NA
B. Manure management	NA	57.79	9.69
D. Agricultural soils	NA	NA	52.26
F. Field burning of agricultural residues	NA	1.06	0.04
G. Liming	714.79	NA	NA
H. Urea application	243.73	NA	NA
I. Other carbon-containing fertilizers	122.57	NA	NA
4. Land use, land-use change and forestry	-27627.82	0.40	11.30
A. Forest land	-35447.94	0.36	0.57
B. Cropland	-3290.71	IE, NO	0.11
C. Grassland	783.46	0.04	0.002
D. Wetlands	1332.96	NA, NO	0.02
E. Settlements	12778.59	NA, NO	8.37
F. Other land	NA, NO	NA, NO	NA, NO
G. Harvested wood products	-3784.17	NA, NO	NA, NO
5. Waste	NA, NO	110.51	4.80
A. Solid waste disposal	NO, NA	31.49	NO, NA
B. Biological treatment of solid waste	NO, NA	10.93	0.64
C. Incineration and open burning of waste	NO	NO	NO
D. Wastewater treatment and discharge	NO, NA	68.08	4.16
INDIRECT CO ₂ EMISSIONS	467.55	NO	NO

Table 2.3. Emissions of industrial gases: HFCs, PFCs and SF₆ in 2024 [kt eq. CO₂]

2024	HFCs	PFCs	SF ₆	Total in eq. CO ₂
Total Industrial gases [kt eq. CO ₂]	3717.21	8.64	128.72	3854.58
C. Metal Industry	NE	NE	NE	NE
4. Magnesium production	NE	NE	NE	NE
F. Product uses as substitutes for ODS	3717.21	8.64	NO	3725.86
1. Refrigeration and air conditioning	3572.13	NO	NO	3572.13
2. Foam blowing agents	61.58	NO	NO	61.58
3. Fire protection	79.40	8.64	NA	88.04
4. Aerosols	3.41	NA	NA	3.41
5. Solvents	0.69	NA	NA	0.69
G. Other product manufacture and use	NO	NO	128.72	128.72
1. Electrical equipment	NO	NO	128.72	128.72

As a supplement to the tables 2.2 and 2.3, table 2.4 includes percentage contributions of main source sectors to the national totals (excluding category 4) in 2024 for CO₂, CH₄ and N₂O.

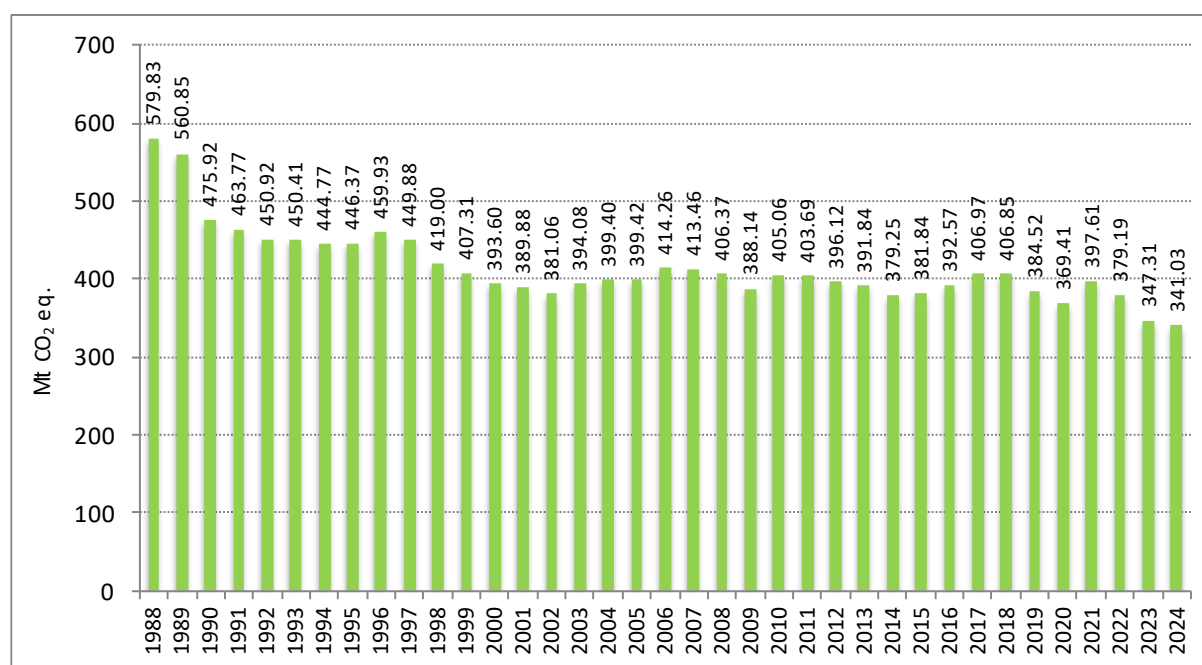


Figure 2.2. Overall GHG emission trend for 1988–2024 in Poland

The GHG trend since the base year 1988 is presented at Figure 2.2 as well as tables 2.6 (by sectors) and 2.11 (by gases). It can be seen sharp decrease in GHG emissions between 1988 and 1990 triggered by substantial economic changes, especially in heavy industry. This was the time when political transformation from centrally planned to free market economy began. This drop in emissions continued up to 1992 and then emissions started to rise with a peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. Slow decline in emissions (up to 2002) characterized the succeeding years, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. In 2008–2011 stabilisation in emissions has been noted with distinct decrease in 2009 related to world economic slow-down. In 2012–2014 GHG emissions in Poland slowly decreased then starting to rise in the next years. The main cause of significant increase of GHGs emissions in 2016–2017, besides economic animation, was substantial rise of fuels use in road transport driven by effective combat against grey zone at fuel market started in 2016, but also favourable fuel prices and increase

in vehicle amount.

After 2018, the GHG emissions decreased by 6% in 2019 and by a further 4% in 2020 compared to the previous year. The main reason for the decrease in emissions between 2019 and 2020 was the lower consumption of fuels combusted in stationary sources (hard coal by over 6% and lignite by over 8%) and in transport (gasoline by nearly 7% and diesel by nearly 3%). In addition to the energy sector, emissions from the industrial processes sector have also decreased. This is mainly the result of a decrease in metallurgy production (reduction in the production of converter steel by 20%, pig iron by over 18% and sinter by about 24%). In 2021, national emissions increased again (by nearly 8%) compared to the previous year and exceeded 400 million tons of equivalent CO₂. The most significant increase in GHG emissions was recorded in the fuel combustion sector - by 10%. The reason was higher fuel consumption: hard coal by 10.6%, lignite by 19.0% and natural gas by 10.3% in stationary sources, as well as higher use of gasoline by 10.6%, diesel oil by 8.3% and CNG by almost 42.5% in transport sector.

In the years 2022-2024, a gradual decline in domestic greenhouse gas emissions was observed compared to 2021: by almost 5% in 2022, by nearly 13% in 2023, and by 14% in 2024. The main factor influencing the reduction in domestic emissions in 2022-2024 was a decline in emissions from the energy sector, including from fuel combustion in stationary sources, and primarily in the electricity and heat production sector (by almost 24%) and in households (by over 18%). This significant emission reduction was driven by a systematic decline in fuel consumption in these categories between 2022 and 2024. In the case of electricity and heat production, hard coal consumption fell by over 30%, and lignite consumption by almost 23%, while in households, hard coal use decreased by approximately 26%.

Table 2.4. Percentage shares of individual source sectors in 2024 emissions (excluding category 4)

Percentage share of emissions of source sectors in current year without LULUCF	Share [%]		
	CO ₂	CH ₄	N ₂ O
TOTAL	100.00	100.00	100.00
1. Energy	93.67	47.65	11.09
A. Fuel combustion	92.43	9.07	11.09
1. Energy industries	44.25	0.08	2.45
2. Manufacturing industries and construction	9.21	0.30	0.70
3. Transport	24.83	0.22	3.24
4. Other sectors	14.14	8.48	4.70
B. Fugitive emissions from fuels	1.24	38.59	0.002
1. Solid fuels	0.64	35.78	NA
2. Oil and natural gas and other emissions from energy production	0.59	2.81	0.002
2. Industrial processes and product use	5.78	0.13	2.66
A. Mineral industry	3.65	NA	NA
B. Chemical industry	1.44	0.11	2.07
C. Metal industry	0.57	0.03	NA
D. Non-energy products from fuels and solvent use	0.11	NE	NE
G. Other product manufacture and use	NO	NO	0.59
3. Agriculture	0.39	44.01	80.06
A. Enteric fermentation	NA	39.64	NA
B. Manure management	NA	4.29	12.52
D. Agricultural soils	NA	NA	67.49
F. Field burning of agricultural residues	NA	0.08	0.05
G. Liming	0.26	NA	NA
H. Urea application	0.09	NA	NA
I. Other carbon-containing fertilizers	0.04	NA	NA
4. Land use, land-use change and forestry	-	-	-
A. Forest land	-	-	-
B. Cropland	-	-	-
C. Grassland	-	-	-
D. Wetlands	-	-	-
E. Settlements	-	-	-
F. Other land	-	-	-
G. Harvested wood products	-	-	-
5. Waste	NO,NA	8.20	6.19
A. Solid waste disposal	NO,NA	2.34	NO,NA
B. Biological treatment of solid waste	NO,NA	0.81	0.82
C. Incineration and open burning of waste	NO	NO	NO
D. Wastewater treatment and discharge	NO,NA	5.05	5.37
INDIRECT CO ₂ EMISSIONS	0.17	NO	NO

2.2. Description of emission and removal trends by sector and by gas

2.2.1. Description of emission and removal trends by sector

Table 2.5 includes emissions of greenhouse gases from all categories for the 1988 and for year 2024 by main categories. In 2024 total GHG emissions accounted for 341.03 million tonnes CO₂ eq. excluding sector 4. *LULUCF*. Comparing to the 1988 emissions in 2024 decreased by 41.2%.

Table 2.5. GHG emissions by main sector in the 1988 and in 2024

IPCC category	Total [kt eq. CO ₂]		(2024-1988)/1988 [%]
	1988	2024	
TOTAL with LULUCF	532 609.94	316 410.70	-40.59
TOTAL without LULUCF	579 827.30	341 033.71	-41.18
1. Energy	478 929.36	281 530.88	-41.22
2. Industrial Processes and Product Use	29 865.86	20 563.93	-31.15
3. Agriculture	50 240.26	34 106.08	-32.11
4. Land-Use, Land-Use Change and Forestry	-47 217.36	-24 623.01	-47.85
5. Waste	20 168.90	4 365.27	-78.36
INDIRECT CO ₂ EMISSIONS	622.92	467.55	-24.94

Table 2.6. National emissions of greenhouse gases for 1988–2024 by source categories [kt CO₂ eq.]

IPCC sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Energy	478 929.36	458 422.81	384 589.43	382 457.03	374 552.98	375 949.53	368 751.50	369 845.06	385 750.25	374 544.23	345 821.57	337 063.37	323 125.37	322 158.12	316 204.84	327 720.22	331 881.56	332 340.00	345 092.26
2. Industrial Processes and Product Use	29 865.86	28 937.48	21 971.96	19 265.17	18 546.07	18 531.93	20 750.83	21 995.43	21 131.80	22 006.98	20 412.25	19 436.00	22 029.78	20 498.97	19 093.81	21 819.38	23 382.61	23 100.98	25 293.93
3. Agriculture	50 240.26	52 946.63	49 489.07	42 715.19	38 836.95	37 421.48	37 134.01	36 947.24	35 987.40	36 791.81	36 684.23	35 209.85	33 427.00	32 825.31	31 855.90	31 361.41	31 412.20	31 803.85	32 281.56
4. Land-Use, Land-Use Change and Forestry	-47 217.36	-46 160.04	-42 192.01	-31 199.43	-19 696.86	-25 458.35	-40 352.20	-61 591.52	-58 993.42	-62 031.71	-51 226.54	-48 350.57	-44 960.21	-36 811.38	-44 858.60	-46 560.32	-58 104.23	-57 578.88	-58 261.67
5. Waste	20 168.90	19 958.12	19 612.55	19 034.40	18 653.42	18 138.82	17 737.20	17 211.63	16 666.00	16 143.10	15 681.84	15 199.51	14 559.79	13 941.58	13 398.38	12 682.31	12 151.83	11 601.90	10 916.85
INDIRECT CO ₂ EMISSIONS	622.92	580.34	258.10	297.14	325.71	364.24	396.42	371.47	389.57	394.54	396.61	399.13	462.63	459.29	510.04	500.03	573.49	571.83	671.45
TOTAL (with LULUCF)	532 609.94	514 685.35	433 729.10	432 569.50	431 218.27	424 947.65	404 417.76	384 779.30	400 931.61	387 848.95	367 769.95	358 957.30	348 644.36	353 071.90	336 204.36	347 523.03	341 297.46	341 839.69	355 994.38
TOTAL (without LULUCF)	579 827.30	560 845.38	475 921.10	463 768.93	450 915.13	450 406.00	444 769.96	446 370.82	459 925.03	449 880.66	418 996.50	407 307.86	393 604.58	389 883.28	381 062.96	394 083.35	399 401.69	399 418.57	414 256.05

Table 2.6. (cont.) National emissions of greenhouse gases for 1988–2024 by source categories [kt CO₂ eq.]

IPCC sector	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1. Energy	341 986.32	336 979.68	325 631.79	342 804.58	339 271.12	333 105.06	329 342.03	315 650.32	319 790.45	330 437.81	343 046.84	342 147.83	321 343.00	305 723.32	334 002.12	317 557.23	288 166.25	281 530.88
2. Industrial Processes and Product Use	27 580.64	26 136.80	20 756.93	21 955.39	24 602.73	23 660.23	22 896.28	24 248.87	23 662.62	23 832.79	24 396.32	24 957.41	24 665.20	24 169.93	24 210.26	23 420.42	20 038.37	20 563.93
3. Agriculture	32 977.36	33 062.26	32 373.73	31 770.48	32 043.73	31 865.02	32 542.47	32 481.02	31 849.09	32 230.93	33 571.31	33 867.33	32 867.52	34 153.29	34 199.54	33 308.22	34 185.97	34 106.08
4. Land-Use, Land-Use Change and Forestry	-44 942.78	-44 724.37	-54 366.42	-61 764.74	-55 865.31	-59 192.21	-52 753.76	-45 460.29	-41 504.91	-48 367.76	-48 537.28	-47 656.10	-30 965.71	-32 536.09	-32 610.71	-44 663.27	-39 471.19	-24 623.01
5. Waste	10 248.02	9 353.14	8 712.95	7 947.22	7 175.72	6 937.24	6 592.35	6 363.51	5 971.83	5 519.38	5 418.72	5 387.48	5 184.84	4 795.79	4 682.73	4 469.43	4 494.10	4 365.27
INDIRECT CO ₂ EMISSIONS	668.09	840.66	669.35	579.57	598.38	551.15	466.36	508.41	561.12	544.40	541.36	488.29	463.45	572.16	518.29	432.14	422.85	467.55
TOTAL (with LULUCF)	368 517.65	361 648.17	333 778.33	343 292.51	347 826.37	336 926.49	339 085.74	333 791.84	340 330.21	344 197.56	358 437.27	359 192.25	353 558.32	336 878.41	365 002.24	334 524.18	307 836.35	316 410.70
TOTAL (without LULUCF)	413 460.43	406 372.55	388 144.75	405 057.25	403 691.68	396 118.70	391 839.50	379 252.13	381 835.12	392 565.31	406 974.55	406 848.35	384 524.03	369 414.50	397 612.95	379 187.45	347 307.54	341 033.71

Energy

The emission of GHGs from *Energy* sector in 2024 was 281.5 million tonnes of CO₂ equivalent. CO₂ emission share amounted to 92.81% of the total GHG emissions within 1. *Energy* category (table 2.7). The most emission intensive subcategory was 1.A.1. *Energy industries* with the CO₂ emission share 43.84% in GHG emission from 1. *Energy* category.

Table 2.7. GHG emissions from sub-sectors in category 1. *Energy* in 2024

GHG emission categories	GHG emission [kt CO ₂ eq.]	% share in the total emission from sector 1. <i>Energy</i>	% share in total 1. <i>Energy</i> emission per GHG		
			CO ₂	CH ₄	N ₂ O
1. TOTAL ENERGY	281530.88	100.00	92.81	6.38	0.81
A. Fuel Combustion	263527.57	93.61	91.58	1.21	0.81
1. Energy Industries	123965.63	44.03	43.84	0.01	0.18
2. Manufacturing Industries and Construction	25944.27	9.22	9.13	0.04	0.05
3. Transport	70009.64	24.87	24.60	0.03	0.24
4. Other Sectors	43608.04	15.49	14.01	1.14	0.34
5. Other	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	18003.31	6.39	1.23	5.17	0.00
1. Solid Fuels	15289.85	5.43	0.64	4.79	NO
2. Oil and Natural Gas and other emissions from energy production	2713.46	0.96	0.59	0.38	0.00

Industrial Processes and Product Use

Table 2.8 shows detailed information on emissions of CO₂, CH₄, N₂O as well as HFCs, PFCs, SF₆ in 2. *Industrial Processes and Product Use* sector in 2024. CO₂ is dominating among GHGs – it's contribution reaches 78.36%. The main GHG emission sources in this category were: production processes of cement clinker and ammonia.

Table 2.8. The emissions of CO₂, CH₄ and N₂O from 2. *IPPU* in 2024

GHG emission categories	GHG emission [kt CO ₂ eq.]	% share in the total emission from sector 2. <i>IPPU</i>	% share in total 2. <i>IPPU</i> emission per GHG			
			CO ₂	CH ₄	N ₂ O	HFC, PFC and SF ₆
2. TOTAL INDUSTRIAL PROCESSES AND PRODUCT USE	20563.93	100.00	78.36	0.24	2.65	18.74
A. Mineral Industry	10178.72	49.50	49.50	0.00	0.00	0.00
B. Chemical Industry	4487.81	21.82	19.56	0.20	2.06	0.00
C. Metal Industry	1607.12	7.82	7.77	0.05	0.00	0.00
D. Non-energy products from fuels and solvent use	314.57	1.53	1.53	0.00	0.00	0.00
F. Product uses as substitutes for ODS	3725.86	18.12	0.00	0.00	0.00	18.12
G. Other product manufacture and use	249.86	1.22	0.00	0.00	0.59	0.63

Agriculture

The main sources of GHG in category 3. *Agriculture* were: 3.A *Enteric Fermentation*, 3.D *Agricultural Soils* and 3.B *Manure Management* (table 2.9). N₂O emission share was the largest in total GHG emission from 3. *Agriculture* in 2024 and came from both – direct (mineral and organic fertilization) and indirect (volatilization, leaching and runoff from applied synthetic fertilizer and animal manure) N₂O emissions from soils.

Table 2.9. GHG emissions from 3. *Agriculture* in 2024

GHG emission categories	GHG emission [kt CO ₂ eq.]	% share in the total emission from sector 3. <i>Agriculture</i>	% share in total 3. <i>Agriculture</i> emission per GHG		
			CO ₂	CH ₄	N ₂ O
3. TOTAL AGRICULTURE	34106.08	100.00	3.17	48.67	48.16
A. Enteric Fermentation	14950.30	43.83	0.00	43.83	0.00
B. Manure Management	4187.12	12.28	0.00	4.74	7.53
D. Agricultural Soils	13847.61	40.60	0.00	0.00	40.60
F. Field Burning of Agricultural Residues	39.96	0.12	0.00	0.09	0.03
G. Liming	714.79	2.10	2.10	0.00	0.00
H. Urea application	243.73	0.71	0.71	0.00	0.00
I. Other carbon-containing fertilizers	122.57	0.36	0.36	0.00	0.00

Land use, Land use change and Forestry

Table 2.10 shows detailed information on emissions of CO₂, CH₄, and N₂O in the 4. *Land Use, Land-Use Change, and Forestry* (LULUCF) sector in 2024. CO₂ dominates among GHGs, accounting for 95.0% of sectoral GHG fluxes. It is worth noting a key aspect concerning net sequestration in the most important and vulnerable category, 4.A *Forest Land*. The estimated value for 2024 exhibits the following characteristics: it is (in absolute terms) about 23.7% lower than the median net sequestration for category 4.A *Forest Land* in the period 1988–2018, and about 22.4% lower than the median net sequestration for the historical period 1988–2023. It is assumed that climate conditions again intensified ongoing stressors on Poland's forest land category, slashing net sequestration well below historical medians. Furthermore, significant fluctuations in precipitation levels, marked by prolonged droughts interspersed with erratic heavy rains, disrupted annual distribution patterns, severely reducing tree growth and photosynthetic rates. These shifts limited CO₂ uptake capacity while accelerating tree mortality through water stress, dieback, and heightened vulnerability to secondary factors like pests.

Furthermore, taking into account the conducted geospatial analysis of land use change (LUC), the updated LUC data triggered a decrease in the emissions-sequestration balance estimated for category 4.B *Cropland* by 19.6% as compared to 2021. A similar direction of change in the GHG emissions and removals balance was observed for category 4.G *Products from Harvested Wood*. For this category, the net GHG sequestration estimated for 2024 decreased by 29.7% compared to 2021. The driving factor behind this change is the observed decline in the total production volume of wood-based panels. Importantly, for category 4.E *Settlements*, a significant increase in net GHG emissions was recorded. The estimated emissions value for this category increased by 192.6% relative to 2021. This dynamic growth is primarily a consequence of the significant transformations of forest areas for non-agricultural and non-forest purposes observed in recent years. These changes were mainly associated with the development of transport and construction infrastructure, particularly road infrastructure, as well as actions aimed at expanding urban infrastructure.

Table 2.10. GHG emission fluxes in 4. *LULUCF* in 2024

GHG emission categories	GHG flux [kt CO ₂ eq.]	% share in the total emission flux from sector 4. <i>LULUCF</i>	% share in total 4. <i>LULUCF</i> emission fluxes per GHG		
			CO ₂	CH ₄	N ₂ O
4. TOTAL LULUCF*	60422.65	100.00	95.03	0.02	4.95
4.A. Forest land*	35608.80	58.93	99.55	0.03	0.42
4.B. Cropland*	3320.29	5.50	99.11	0.00	0.89
4.C. Grassland*	785.16	1.30	99.78	0.14	0.07
4.D. Wetlands	1338.71	2.22	99.57	0.00	0.43
4.E. Settlements	14996.92	24.82	85.21	0.00	14.79
4.G. Harvested wood products*	3784.17	6.26	100.00	0.00	0.00
INDIRECT N ₂ O	588.60	0.97	0.00	0.00	100.00

*absolute values of GHG's fluxes

Waste

As it can be seen in table 2.11, the emission of CH₄ dominated in *Waste* sector in 2024 (with 70.88% share). The main part of GHG emissions came from 5.D *Wastewater Treatment and Discharge*.

Table 2.11. GHG emissions from 5. *Waste* in 2024

GHG emission categories	GHG emission [kt CO ₂ eq.]	% share in the total emission from sector 5. <i>Waste</i>	% share in total 5. <i>Waste</i> emission per GHG		
			CO ₂	CH ₄	N ₂ O
5. TOTAL WASTE	4365.27	100.00	0.00	70.88	29.12
A. Solid Waste Disposal	881.80	20.20	0.00	20.20	0.00
B. Biological Treatment of Solid Waste	474.58	10.87	0.00	7.01	3.86
D. Wastewater Treatment and Discharge	3008.89	68.93	0.00	43.67	25.26

2.2.2. Description of emission and removal trends by gas

Table 2.12. National emissions of greenhouse gases for 1988–2024 by gases [kt CO₂ eq.]

GHG	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CO ₂ (with LULUCF)	422 399.57	403 954.83	332 729.21	340 809.43	342 802.80	338 075.20	318 205.22	299 494.92	316 647.74	303 752.70	286 352.98	279 424.82	270 941.08	275 189.20	259 683.13	270 657.92	264 168.79	263 645.41	276 772.96
CO ₂ (without LULUCF)	470 967.32	451 485.49	376 286.12	373 309.20	364 222.27	364 911.82	359 939.61	362 433.14	377 073.77	367 153.72	338 938.73	329 161.96	317 270.70	313 253.02	305 836.48	318 715.31	323 609.66	322 561.99	336 366.54
CH ₄ (with LULUCF)	77 955.32	77 343.62	71 166.54	66 172.30	64 506.83	62 275.64	61 563.55	59 877.15	58 905.90	58 585.99	56 019.25	54 530.63	52 062.97	51 860.01	51 240.37	51 270.40	50 548.03	50 845.17	50 847.19
CH ₄ (without LULUCF)	77 900.23	77 288.49	71 111.41	66 147.54	64 211.78	62 217.20	61 501.87	59 834.39	58 816.81	58 541.26	55 992.42	54 476.84	52 019.84	51 837.82	51 206.15	51 140.13	50 522.07	50 807.83	50 805.17
N ₂ O (with LULUCF)	31 499.82	32 674.03	29 447.77	25 163.67	23 461.96	24 102.42	24 101.63	24 835.70	24 733.75	24 789.36	24 601.66	24 041.13	24 165.13	24 154.19	22 874.79	22 734.19	23 203.02	23 447.76	23 764.65
N ₂ O (without LULUCF)	30 204.53	31 358.53	28 138.01	23 888.08	22 034.40	22 782.58	22 781.12	23 531.74	23 390.23	23 464.77	23 269.28	22 708.33	22 838.85	22 923.93	21 614.26	21 367.39	21 892.34	22 147.41	22 474.77
HFCs	NO	NO	NO	NO	NO	NO	NO	15.55	85.27	145.88	216.59	384.18	827.91	1 204.30	1 682.12	2 155.04	2 593.58	3 130.42	3 727.03
PFCs	132.31	132.54	127.47	126.97	120.97	130.16	137.27	154.52	144.84	156.87	158.19	153.19	160.87	181.35	189.91	184.09	187.51	171.47	176.86
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF ₆	NO	NO	NO	NO	NO	NO	13.67	30.02	24.53	23.61	24.67	24.22	23.77	23.56	24.00	21.35	23.04	27.62	34.22
NF ₃	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
INDIRECT CO ₂ EMISSIONS	622.92	580.34	258.10	297.14	325.71	364.24	396.42	371.47	389.57	394.54	396.61	399.13	462.63	459.29	510.04	500.03	573.49	571.83	671.45
TOTAL (with LULUCF)	532 609.94	514 685.35	433 729.10	432 569.50	431 218.27	424 947.65	404 417.76	384 779.30	400 931.61	387 848.95	367 769.95	358 957.30	348 644.36	353 071.90	336 204.36	347 523.03	341 297.46	341 839.69	355 994.38
TOTAL (without LULUCF)	579 827.30	560 845.38	475 921.10	463 768.93	450 915.13	450 406.00	444 769.96	446 370.82	459 925.03	449 880.66	418 996.50	407 307.86	393 604.58	389 883.28	381 062.96	394 083.35	399 401.69	399 418.57	414 256.05

Table 2.12. (cont.) National emissions of greenhouse gases for 1988–2024 by gases [kt CO₂ eq.]

GHG	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CO ₂ (with LULUCF)	289 403.89	283 306.87	260 116.34	270 855.20	276 116.21	265 125.43	267 615.03	262 462.42	269 516.86	272 935.31	285 883.37	285 932.17	284 322.09	267 511.76	296 169.91	267 948.42	241 259.81	250 850.06
CO ₂ (without LULUCF)	335 712.96	329 409.36	315 867.50	334 013.11	333 383.50	325 758.67	321 752.11	309 402.89	312 536.54	323 316.56	336 471.35	335 637.28	317 367.63	301 972.86	330 626.68	314 718.50	283 685.74	278 477.88
CH ₄ (with LULUCF)	49 539.80	48 639.77	46 803.46	46 047.93	44 600.11	44 291.65	44 023.62	43 614.09	44 457.39	43 860.68	44 006.53	44 568.11	41 602.84	41 367.35	40 837.53	39 221.63	38 303.99	37 726.76
CH ₄ (without LULUCF)	49 518.22	48 617.61	46 776.85	46 033.72	44 581.76	44 245.76	44 012.75	43 594.08	44 419.61	43 846.78	43 998.62	44 547.90	41 574.96	41 308.40	40 829.82	39 194.24	38 293.49	37 715.50
N ₂ O (with LULUCF)	24 638.23	24 298.13	21 457.08	21 082.83	21 384.04	21 528.34	21 680.75	21 493.06	20 811.34	21 798.08	22 805.95	23 106.36	22 178.15	22 558.21	22 776.46	22 516.60	23 830.65	23 511.75
N ₂ O (without LULUCF)	23 293.53	22 942.17	20 098.96	19 703.88	20 000.41	20 133.19	20 308.29	20 032.90	19 334.34	19 798.49	20 763.16	21 077.55	20 126.20	20 692.14	20 938.11	20 437.17	20 886.41	20 518.20
HFCs	4 066.85	4 379.66	4 674.68	4 672.79	5 070.58	5 370.73	5 235.79	5 645.01	4 890.39	4 965.28	5 102.72	4 974.89	4 887.08	4 766.03	4 597.37	4 269.75	3 893.47	3 717.21
PFCs	168.68	149.21	18.66	17.72	16.84	16.00	15.20	14.44	13.71	13.03	12.38	11.76	11.17	10.61	10.08	9.58	9.10	8.64
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF ₆	32.12	33.88	38.76	36.45	40.22	43.21	49.00	54.41	79.39	80.78	84.97	110.67	93.54	92.29	92.61	126.06	116.48	128.72
NF ₃	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
INDIRECT CO ₂ EMISSIONS	668.09	840.66	669.35	579.57	598.38	551.15	466.36	508.41	561.12	544.40	541.36	488.29	463.45	572.16	518.29	432.14	422.85	467.55
TOTAL (with LULUCF)	368 517.65	361 648.17	333 778.33	343 292.51	347 826.37	336 926.49	339 085.74	333 791.84	340 330.21	344 197.56	358 437.27	359 192.25	353 558.32	336 878.41	365 002.24	334 524.18	307 836.35	316 410.70
TOTAL (without LULUCF)	413 460.43	406 372.55	388 144.75	405 057.25	403 691.68	396 118.70	391 839.50	379 252.13	381 835.12	392 565.31	406 974.55	406 848.35	384 524.03	369 414.50	397 612.95	379 187.45	347 307.54	341 033.71

Table 2.13. Greenhouse gas emissions in 2024 including indirect emission with respect to base year (1988)

GHG	Emission in CO ₂ eq. [kt]		(2024-1988)/1988
	1988	2024	[%]
CO ₂ (with LULUCF)	423 022.49	251 317.61	-40.59
CO ₂ (without LULUCF)	471 590.23	278 945.43	-40.85
CH ₄ (with LULUCF)	77 955.32	37 726.76	-51.60
CH ₄ (without LULUCF)	77 900.23	37 715.50	-51.58
N ₂ O (with LULUCF)	31 499.82	23 511.75	-25.36
N ₂ O (without LULUCF)	30 204.53	20 518.20	-32.07
HFCs	NO	3 717.21	-
PFCs	132.31	8.64	-93.47
Unspecified mix of HFCs and PFCs	NO	NO	NO
SF ₆	NO	128.72	-
NF ₃	NO	NO	NO
TOTAL net emission (with LULUCF)	532 609.94	316 410.70	-40.59
TOTAL without LULUCF	579 827.30	341 033.71	-41.18

Comparison of GHG emissions in 2024 and the base year given in table 2.13 indicates significant drop in all gases, except HFCs and SF₆, in case of CO₂, methane and nitrous oxides emissions, where decrease reached ca. 40.9%, 51.6% and 32.1% respectively in 1988-2024 (excluding LULUCF). This was mainly caused by significant changes in fuel mix as well as serious drop in coal mining and livestock population.

Carbon dioxide

In 2024, the CO₂ emissions (without LULUCF) were estimated to be 278.95 million tonnes, while - when sector 4. *LULUCF* is included - the figure reaches 251.32 million tonnes (table 2.1). CO₂ share in total GHG emissions in 2024 amounted to 81.8%.

CO₂ emission (excluding category 4) decreased by app. 40.9% from the base year (1988) to 2024. The following changes took place in the structure of fuel use within this period:

- share of solid fuels decreased from 78.9% in the base year to 34.9% in 2024,
- share of liquid fuels increased from 12.0% in the base year to 34.7 % in 2024,
- share of gaseous fuels increased from 7.4% in the base year to 18.5% in 2024.

The main CO₂ emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO₂ emission (without LULUCF) with 92.4% share in 2024 (fig. 2.3). The shares of the main subcategories in 1.A were as follows: *Energy industries* - 44.2%, *Manufacturing Industries and Construction* – 9.2%, *Transport* – 24.8% and *Other Sectors* – 14.1%. Sector 2. *Industrial Processes* contributed to the total CO₂ emission with 5.8% share in 2024. *Mineral industry* (especially *Cement Production*) is the main emission source in this sector. The CO₂ emission/removal in LULUCF sector in 2024, was calculated to be approximately – 27.6 million tonnes what means that removals prevail emissions significantly in this sector.

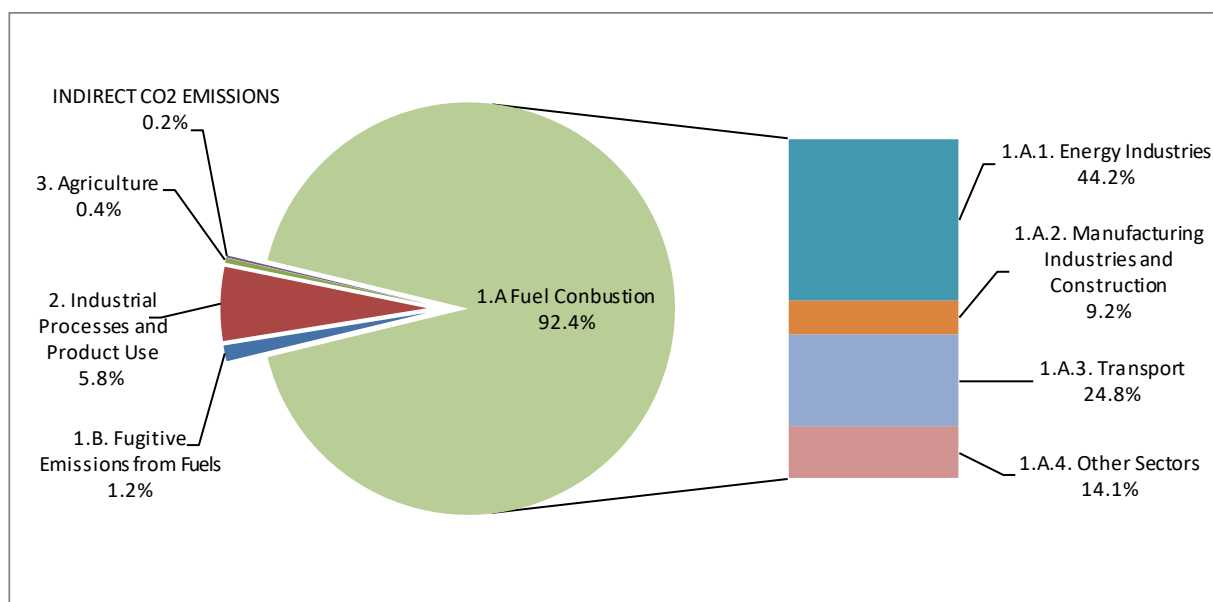


Figure 2.3. Carbon dioxide emission (excluding category 4) in 2024 by sector

Methane

The CH₄ emission (excluding category 4) amounted to 1 346.98 kt in 2024 i.e. 37.72 million tonnes of CO₂ equivalents (table 2.1). CH₄ share in total GHG emissions in 2024 amounted to 11.1%.

CH₄ emission (excluding category 4) decreased by app. 51.6% from the base year (1988) to 2024 triggered by the following biggest sectoral emission changes:

- the decrease in emission from Waste sector by 83.9%,
- the decrease in emission from Enteric Fermentation by 33.4%,
- the decrease in Fugitive Emission by 47.2%.

Three of main CH₄ emission sources include the following categories: *Fugitive Emissions from Fuels*, *Agriculture* and *Fuel Combustion*. They contributed with 38.6%, 44.0% and 9.1% shares to the national methane emission in 2024, respectively (fig. 2.4). The emission from the first mentioned sector was covered by emission from coal and lignite mines (app. 35.8% of total CH₄ emission) and *Oil and Natural Gas* system (about 2.8% of total emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 39.6% of total methane emission in 2024. *Waste* sector contributed to 8.2% of the methane emission.

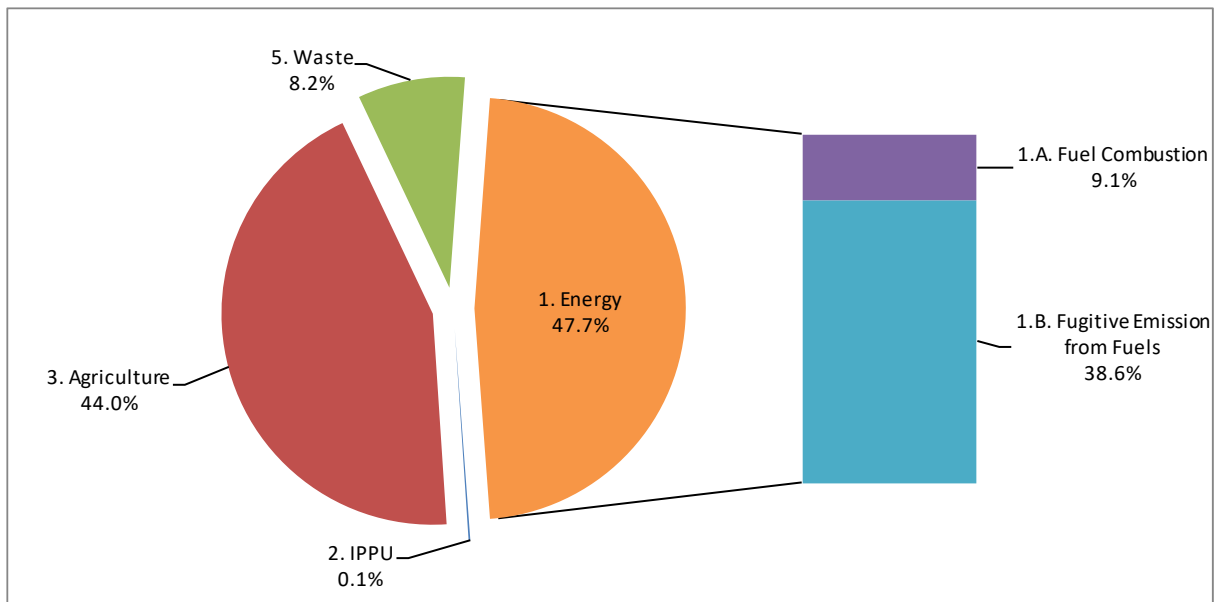


Figure 2.4. Methane emission (excluding category 4) in 2024 by sector

Nitrous oxide

The nitrous oxide emissions (excluding category 4) in 2024 were 77.43 kt i.e. 20.52 million tonnes of CO₂ equivalents (table 2.1). N₂O share in total GHG emissions in 2024 amounted to 6.0%. The main N₂O emission sources and their shares in total N₂O emission in 2024 are: *Agricultural Soils* – 67.5%, *Manure Management* – 12.5%, *Fuel Combustion* – 11.1% and *Domestic wastewater treatment* – 5.4% and *Chemical Industry* – 2.1% (fig. 2.5).

The nitrous oxide emissions (excluding category 4) in 2024 were app. 32.1% lower than the respective figure for the base year (1988) what was caused mostly by diminishing agricultural and chemical production where: N₂O emissions from *Manure Management* decreased by 29.9%, from *Agricultural Soils* by 27.0% and from *Chemical Industry* decreased by 90.1% in 1988-2024.

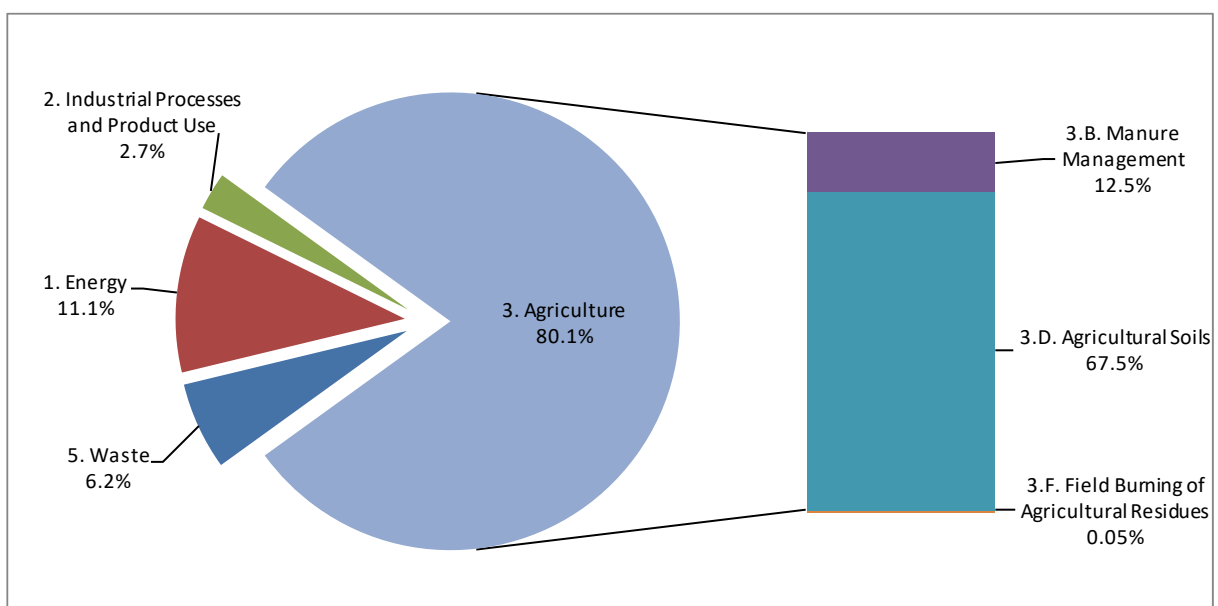


Figure 2.5. Nitrous oxide emission (excluding category 4) in 2024 by sector

Fluorinated gases: HFCs, PFCs, NF₃ and SF₆

The total emission of industrial gases (HFCs, PFCs SF₆ and NF₃) in 2024 was 3854.58 kt CO₂ equivalent what accounts for 1.1% of total GHG emissions share in 2024. The total emissions in 2024 according to groups of industrial gases are as follows: HFCs – 3.72 million tonnes of CO₂ equivalents, PFCs – 0.01 million tonnes of CO₂ equivalents and SF₆ – 0.13 million tonnes of CO₂ equivalents.

Industrial gases emissions were by 2813.2% higher comparing to the base year. This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. Shares of HFCs, PFCs and SF₆ in total 2024 GHG emissions was respectively as follows: 1.09%, 0.003% and 0.04%. NF₃ emissions did not occur.

HFCs emissions in 2024 were 239 times higher than in base year for f-gases (1995). This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. PFCs emissions in 2024 were by 94% lower than in base year (1995). The PFCs emission changes between 2024 and the preceding years depend on the aluminium production levels (main PFC source) and the use of C₄F₁₀ in fire extinguishers. SF₆ emissions in 2024 were higher by about 429% than in base year (1995). Leakage from electrical equipment during its use and production is the main SF₆ emission.

Large percentage increase of industrial gases emissions, compared to the base year (1995), does not influence significantly the national total GHG emission trend, because all the fluorinated industrial gases together contributed merely with app. 1.1% to the national total in 2024.

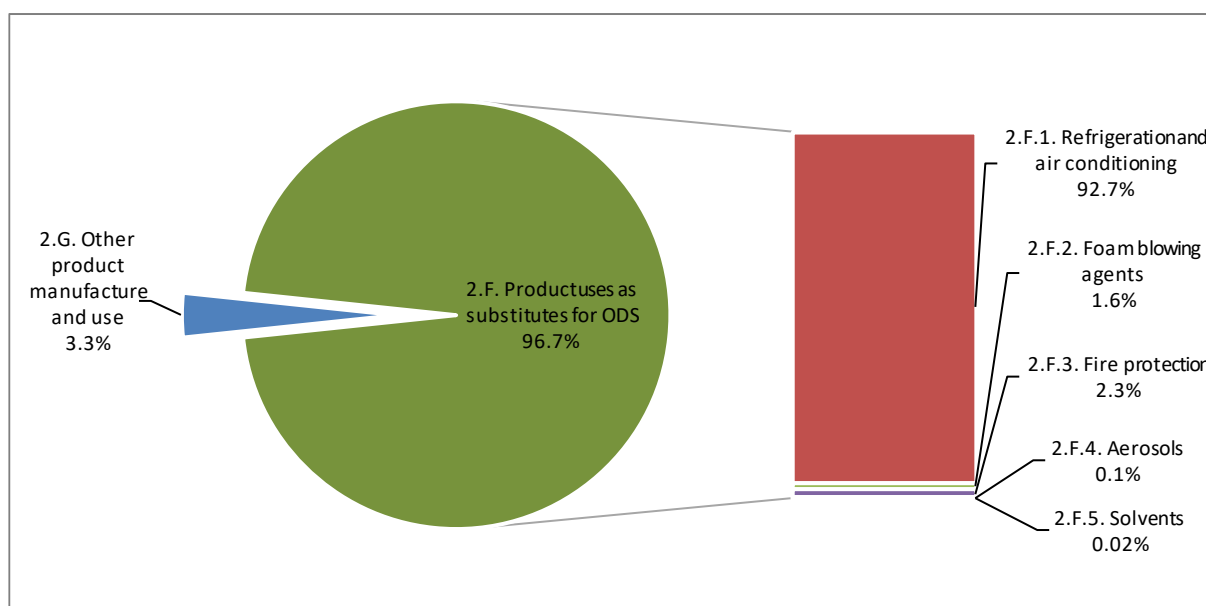


Figure 2.6. Aggregated fluorinated gases emissions in 2024 by sector

3. Energy (CRT sector 1)

3.1. Overview of sector

Following subcategories from sector 1 have been identified as key category (excluding LULUCF):

IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)		
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO ₂	L	T	
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO ₂	L		
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO ₂	L	T	
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO ₂	L	T	
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO ₂	L		
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO ₂	L	T	
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO ₂	L	T	
1.A.3.b Road Transportation	CO ₂	L	T	
1.A.3.c Railways	CO ₂		T	
1.A.4 Other Sectors - Biomass	CH ₄	L	T	
1.A.4 Other Sectors - Gaseous Fuels	CO ₂	L	T	
1.A.4 Other Sectors - Liquid Fuels	CO ₂	L	T	
1.A.4 Other Sectors - Solid Fuels	CO ₂	L	T	
1.A.4 Other Sectors - Solid Fuels	CH ₄		T	
1.B.1 Fugitive emissions from Solid Fuels	CH ₄	L	T	
1.B.1 Fugitive emissions from Solid Fuels	CO ₂	L		
1.B.2.d Fugitive Emissions from Fuels - Other	CO ₂	L	T	

Share of these subcategories in total Poland's GHG emissions amounts ca. 81%.

Figure 3.1.1 shows emission trend in *Energy* sector while figure 3.1.2 shows emission trend according to subcategories 1.A *Fuel combustion* and 1.B *Fugitive emission*. Emission from entire 1. *Energy* sector is the largest contributor to national GHG emissions – in 2024 ca. 82.6%.

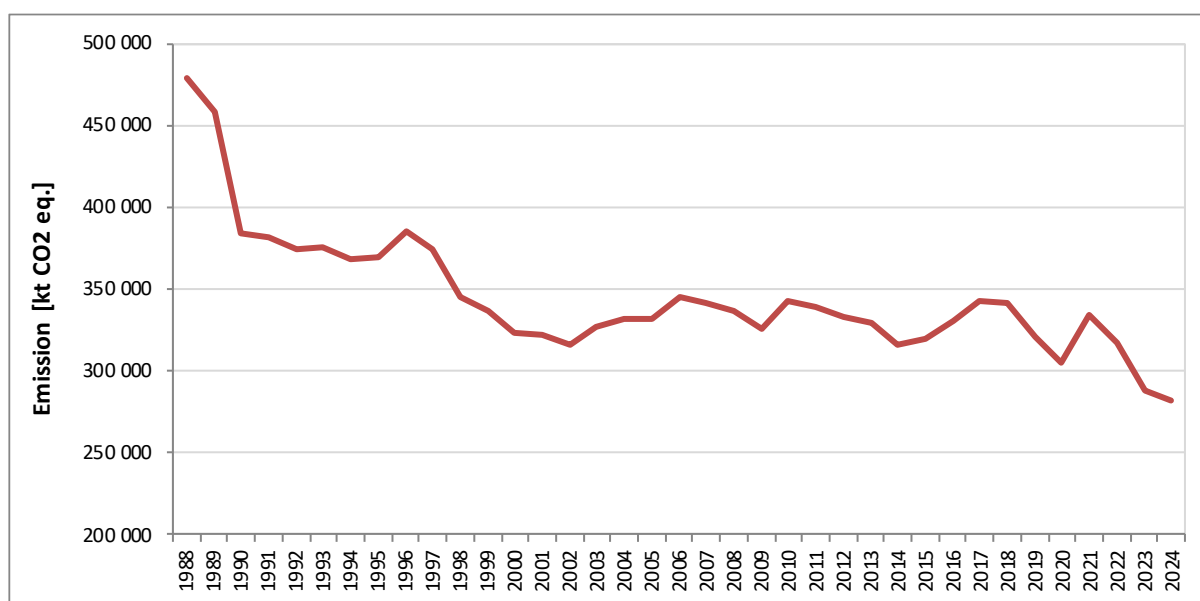


Figure 3.1.1. GHG emission trend in period 1988-2024 in sector *Energy*

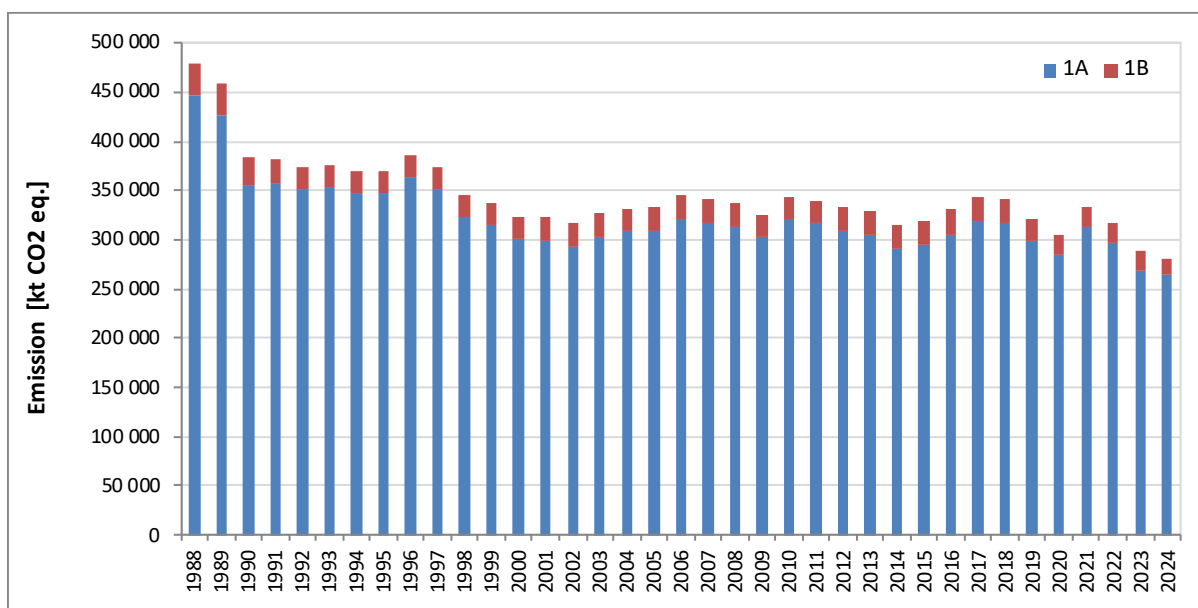


Figure 3.1.2. GHG emission trend in period 1988-2024 in subsectors 1.A and 1.B

3.1.1. Fuel combustion (CRT sector 1.A)

Combustion as a category of GHG emission occurs in the following category groups:

1.A.1. *Energy industries*

1.A.2. *Manufacturing industries and construction*

1.A.3. *Transport*

1.A.4. *Other sectors:*

a. *Commercial/institutional*

b. *Residential*

c. *Agriculture/forestry/fishing*

Share of sector in total GHG emission in 2024 is 77.3%. Subsector 1.A.1 *Energy Industries* is by far the largest contributor to emissions from fuel combustion (see figure 3.1.3).

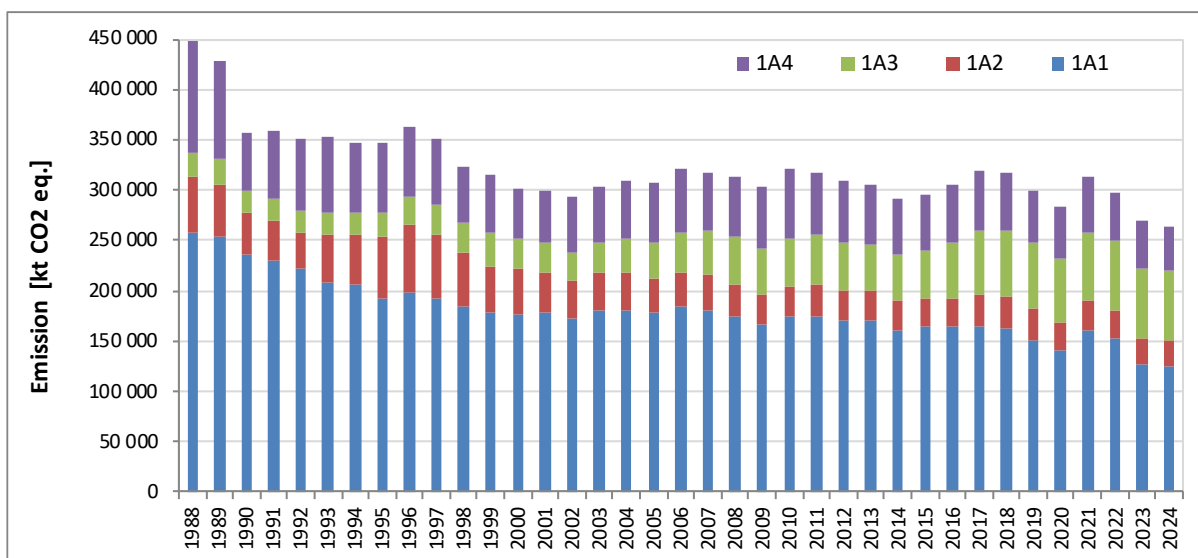


Figure 3.1.3. GHG emissions from fuel combustion in 1988-2024 according to subcategories

Emissions in 1.A.1 *Energy industries* category are estimated for each detailed sub-categories as follows:

a) 1.A.1.a *Public electricity and heat production*

- *Electricity generation* - 1.A.1.a.i
- *Combined heat and power generation* - 1.A.1.a.ii
- *Heat plants* - 1.A.1.a.iii

b) 1.A.1.b *Petroleum refining*;

c) 1.A.1.c *Manufacture of solid fuels and other energy industries*:

- *Manufacture of solid fuels* - 1.A.1.c.i (coke-oven plants, gas-works plants, mines, patent fuel/briquetting plants)
- *Oil and gas extraction* - 1.A.1.c.ii
- *Other energy industries* - 1.A.1.c.iii (own use in electricity, CHP and heat plants).

Emissions in 1.A.2 *Manufacturing industries and construction* category are estimated for each fuel in detailed sub-categories as follows:

a) *Iron and steel* - 1.A.2.a

b) *Non-ferrous metals* - 1.A.2.b

c) *Chemicals* - 1.A.2.c

d) *Pulp, paper and print* - 1.A.2.d

e) *Food processing, beverages and tobacco* - 1.A.2.e

f) *Non-metallic minerals* - 1.A.2.f

g) *Other* - 1.A.2.g:

- *Manufacturing of machinery* - 1.A.2.g.i
- *Manufacturing of transport equipment* - 1.A.2.g.ii
- *Mining (excluding fuels) and quarrying* - 1.A.2.g.iii
- *Wood and wood products* - 1.A.2.g.iv
- *Construction* - 1.A.2.g.v
- *Textile and leather* - 1.A.2.g.vi
- *Other* - 1.A.2.g.vii - other industry branches not included elsewhere

Estimation of emissions in 1.A.3 *Transport* are carried out for each fuel in sub-categories listed below:

a) *Civil aviation* (1.A.3.a)

b) *Road transportation* (1.A.3.b)

c) *Railways* (1.A.3.c)

d) *Navigation* (1.A.3.d)

e) *Other transportation* (1.A.3.e)

Emissions in 1.A.4 *Other sectors* are estimated for each fuel in detailed sub-categories given below:

- a) Commercial/institutional (1.A.4.a)
- b) *Residential* (1.A.4.b)
- c) *Agriculture/forestry/fishing* (1.A.4.c)
 - *Stationary* - 1.A.4.c.i
 - *Off-road vehicles and other machinery* - 1.A.4.c.ii
 - *Fishing* - 1.A.4.c.iii.

The amount of CO₂ emissions from fuel combustion in stationary sources were estimated on the level determined as IPCC *Tier 2 or Tier 1 depending on EF type (country specific or default)*. In this case the calculation was based on the following equation:

$$E = \sum (EF_{ab} * A_{ab})$$

where: E - emission

EF - emission factor

A - fuel consumption

a - fuel type, b - sector

The amount of combusted fuel was accepted according to data included in the energy balance submitted by GUS to Eurostat [EUROSTAT].

List of combusted fuels for which GHG emissions were estimated based upon selected or calculated emission factors is as follows:

- liquid fuels: fuel oil, diesel oil, liquid petroleum gas (LPG), crude oil, motor gasoline, jet kerosene, refinery gas, feedstocks, other petroleum products and petroleum coke
- gaseous fuels: natural gas
- solid fuels: hard coal, lignite, coke, hard coal briquettes, lignite briquettes, coke oven gas, blast furnace gas, gas works gas and other recovered gases
- other fuels: industrial wastes, municipal waste (non-biogenic fraction)
- biomass: solid biomass, biogas, municipal waste – biogenic fraction.

Country specific emission factors for estimation of CO₂ emission from fuel combustion in stationary sources have been developed for hard coal, lignite, natural gas and fuel oil. For the other fuels default CO₂ emission factors derived from 2006 IPCC GLs have been applied.

CO₂ country specific emission factors for hard coal and lignite are based on empirical functions, that link the amount of carbon in fuel with the corresponding net calorific value. That empirical functions are the following:

- for hard coal:

$$C_{hc} = 10(2.4898 * NCV + 3.3132)/NCV$$

where:

C_{hc} – emission factor/carbon content for hard coal [kg C/GJ],

NCV – net calorific value of hard coal [MJ/kg] in the given sub-category calculated based upon hard coal combusted expressed in both physical and energy units.

- for lignite:

$$C_{bc} = 10(1.9272 * NCV + 9.3856)/NCV$$

where:

- C_{bc} – emission factor for lignite [kg C/GJ],
- NCV – net calorific value of lignite [MJ/kg] in the given sub-category calculated based upon lignite combusted expressed in both physical and energy units

The function describing the dependence of carbon content on NCV was developed on the basis of domestic measurements of over 100 hard coal samples, in a wide range of NCV values for this fuel. The measurement results and the calculation file with the function development are presented in Annex 5.2. The function used in the inventory was developed in the same way as in the article [Fott 1999].

An empirical function describing the dependence of carbon content on NCV for lignite was developed analogously. Equation is based on data collected from all Polish lignite mines. Aggregated data is presented in the Annex 5.2.

CS EFs for natural gas are elaborated on the basis of plant specific data on the values of CO₂ emissions and the amounts of fuel consumed reported to KOBiZE by installations covered by the ETS [KOBiZE database]. EFs for high-methane natural gas, nitrified natural gas and colliery gas were estimated for individual years starting in 2005. For the years before 2005, i.e. for years preceding the functioning of the ETS, the average EF values for individual gas types were calculated based on the CS EF values obtained for the years 2005-2016. These calculations for individual natural gas types were used to estimate the overall CO₂ emission factors for all inventory years, for natural gas combusted in the energy and industry sectors (1.A.1 and 1.A.2) and in the category: other sectors (1.A.4). The share estimation of individual natural gas types in the total natural gas consumption in a given sub-category was based on the national study [Waśniewska et al. 2016, Kargulewicz et al. 2023].

CO₂ country specific emission factors for fuel oil were based on the plant specific data from installations covered by the emissions trading system in which fuel oil was combusted (data specified in ETS reports as level 3 relating to EF was used [KOBiZE database]). Due to the fact that for 2005 representative measurement data on fuel oil combustion was not available, the data from ETS reports was applied starting from 2006, and for earlier years the average value was adopted from the indicators specified for 2006-2018.

Values of country specific CO₂ EFs for hard coal, lignite, natural gas and fuel oil applied in GHG emission inventory were presented in the table in Annex 5.3.

Default emission factors [IPCC 2006] for the following fuels were applied: coke, hard coal briquettes, lignite briquettes, coke oven gas, blast furnace gas, diesel oil, LPG, crude oil, motor gasoline, jet kerosene, refinery gas, feedstock, other petroleum products, petroleum coke, biomass (solid biomass, biogas), waste (industrial and municipal waste), gas works gas and other recovered gases.

It should be mentioned here, in response to the ERT recommendation that CO₂ EF for gasoline applied in road transportation sector in previous submissions was not implemented for combustion processes in stationary sources. The reason is that since 2017 Submission new methodology for 1.A.3 category applying the COPERT model with its emission factors has been used, which is not relevant for stationary combustion as CS one.

Generally, share of CO₂ emission from liquid fuels in total emission from combustion in stationary sources is not significant. This is especially visible when the analysis focuses on the

share of individual liquid fuels and not as entire group, which covers several items. The table 3.1.1. provides an example of mentioned analysis for 1.A.1 category for 2024. Fuels classified as liquid fuels are marked in bold in the table. The share of individual fuels from this group in combustion in category 1.A.1 amounts only 0-2% in 2024.

Table 3.1.1. Percentage of emissions from individual fuels in total emissions in 1.A.1 category for 2024

Individual fuels	Share in CO ₂ emission in 1.A.1 category [%]
Hard coal	51.2
Lignite	30.0
Hard coal briquettes (patent fuels)	0.0
Brown coal briquettes	0.0
Crude oil	0.0
Natural gas	10.3
Solid biomass	-
Biogas	-
Industrial wastes	0.1
Municipal waste - non-biogenic fraction	0.6
Municipal waste – biogenic fraction	-
Other petroleum products	0.0
Petroleum coke	0.0
Coke	0.0
Liquid petroleum gas (LPG)	0.0
Motor gasoline	0.0
Aviation gasoline	0.0
Jet kerosene	0.0
Diesel oil	0.3
Fuel oil	2.2
Feedstocks	0.0
Refinery gas	1.0
Coke oven gas	1.9
Blast furnace gas	2.3
Gas works gas and other recovered gases	0.0
Fuel groups	
Liquid fuels	3.5
Gaseous fuels	10.3
Solid fuels	85.4
Other fuels	0.8
Biomass	-
Total	100.0

The data in the table 3.1.1. shows that the adoption of emission factors from category 1.A.3 for fuels such as diesel oil, motor gasoline, LPG will not affect the inventory result, because the share of these fuels in emissions from stationary combustion is insignificant.

The above analysis shows that almost 94% of CO₂ emissions in category 1.A.1 are estimated based on country specific EFs.

The share of CO₂ emissions estimated based on national indicators in total emissions from the combustion of fuels in stationary sources in 2024 was approximately 89%. In the entire reporting period, this share ranged between 86% and 92%.

For coal and lignite, where the CS EFs were used, the oxidation factor was assumed as 0.980. In other cases oxidation factor assumed to be 1, in accordance with 2006 IPCC GLs.

CH₄ emission estimation from fuel combustion in stationary sources is based on the fuel consumption submitted by GUS to Eurostat (Eurostat database). In case of 1.A.1 IPCC subcategory for coal, lignite and biomass the country specific EFs of CH₄ were developed

(following the recommendation E4 of the FCCC/ARR/2020/POL). Those EFs were established based on country study: *Development of methane country specific emission factors from the combustion of hard coal, lignite and biomass, ENERGOPOMIAR, Warsaw 2022*. The mentioned study was elaborated on the basis of data from national measurements and includes CH₄ emission factors for various types of boilers used in the Polish energy industry. It was necessary then to elaborate data set on corresponding boiler type share in Poland. Such analysis of the structure of boilers in large combustion plants was made using information contained in National Emission Database managed since 2010 by the KOBIZE. All these information allowed to establish the CH₄ emission factors based on the cited above study. Based on the analysis for selected years since 2010, the following emission factors were applied for the entire reporting period: 0.11 kg CH₄/TJ for hard coal, 0.335 kg CH₄/TJ for lignite and 0.6 kg CH₄/TJ for biomass. Other CH₄ emission factors used to estimate emissions from fuel combustion in stationary sources are default ones [IPCC 2006].

Estimation of N₂O emission from fuel combustion in stationary sources is based on fuel consumption submitted by GUS to Eurostat (Eurostat database) and the recommended default emission factors [IPCC 2006].

All emission factors used in the GHG emission inventory for stationery combustion in 1.A IPCC category are presented in the tables in Annex 5.3 (tab. 14-29).

Trend of fuel use and methodology over the years 1988-2024

Estimation of CO₂ emission from fuel combustion in stationary sources for the years 1988-2024 is based on the way corresponding to the methodology presented above. Fuel consumptions from the Eurostat database were used. The Eurostat database does not cover fuel use data for Poland for the years before 1990. Therefore, fuel use data for the period: 1988-1989 were taken from IEA database [IEA]. The use of a different source of data on fuel consumption for the years 1988-1989 than for the period after 1990 does not affect data consistency in time-series. Evidence of data compliance between two AD sources is given by the consistency of fuel consumption since 1990 in the IEA database and Eurostat. Comparison of data from both sources for selected fuels is presented in the Annex 5.1 (the tables in the annex present comparison of the main fuel balance items for 7 significant fuels in selected years). Analysis of data source consistency proved full compliance of fuel consumption data for entire reported series and in the detail subsectors of individual categories of activity.

Fuel consumption in individual subsectors: 1.A.1, 1.A.2 and 1.A.4 was presented in the tables 1-13 (Annex 5.3). The country specific EFs of CO₂ for hard coal, lignite, natural gas and fuel oil for the years 1988-2024 are compiled in Annex 5.3 – table 14-26. CO₂ emission factors for other fuels are the IPCC default ones [IPCC 2006] and are included in Annex 5.3 – tab. 27. Applied CH₄ EFs are presented in table 28 while the default EFs of N₂O for particular fuel are given in the table 29 of this annex.

The time series of consumption for particular fuel groups and GHG emissions for the main subsectors of 1.A IPCC category are presented in the following chapters.

3.1.2. Fugitive emissions (CRT sector 1.B)

The GHG emission sources in fugitive emissions sector cover: fugitive emission from solid fuels (CO₂ and CH₄) and fugitive emission from oil and gas (CO₂, CH₄ and N₂O).

Total emission of GHGs as carbon dioxide equivalent in 1.B subcategory amounted to 18 003 kt in 2024 and decreased since 1988 by 43%. Figure 3.1.4 shows emissions from 1.B.1 and 1.B.2 subcategories in period 1988-2024.

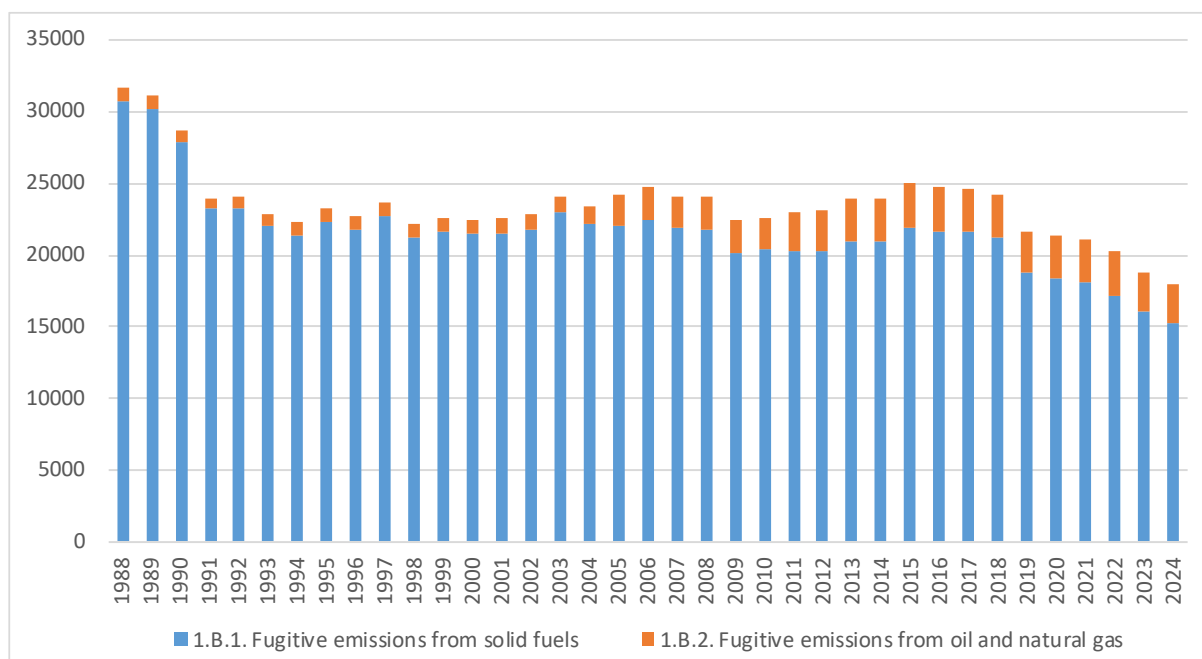


Figure 3.1.4. GHG emissions from 1.B.1 and 1.B.2 subcategories in 1988-2024

3.2. Fuel combustion (CRT 1.A)

3.2.1. Comparison of the sectoral approach with the reference approach

The Reference Approach is a top-down approach, using a country's energy supply data to calculate the emissions of CO₂ from combustion of mainly fossil fuels. Comparability between the sectoral and reference approaches continues to allow a country to produce a second independent estimate of CO₂ emissions from fuel combustion. It allows to compare the results of these two independent estimates and indicate possible problems with the activity data, net calorific values, carbon content, carbon stored calculation, etc.

The Reference Approach is designed to calculate the emissions of CO₂ from fuel combustion, starting from high level energy supply data. The Reference Approach does not distinguish between different source categories within the energy sector and only estimates total CO₂ emissions from source category 1.A *Fuel Combustion*. The IPCC Reference Approach is based on determining carbon dioxide emissions from domestic consumption of fuels and its secondary products.

CO₂ emissions from fuel combustion were estimated based on recommended IPCC methodology [IPCC 2006, equation 6.1]:

$$CO_2 \text{ Emissions} = \sum_i [((AP_i \times CF_i \times CC_i)10^{-3} - EC_i)COF_i \times 44/12]$$

where:

i – fuel type

AP – apparent consumption of fuel, TJ or kt

CF – conversion factor for the fuel to energy unit, TJ/kt

CC – carbon content, t C/TJ

EC – excluded carbon, kt C

COF – carbon oxidation factor

44/12 – mass ratio of CO₂/C

CO₂ emissions were estimated based on adjusted fuel consumption data and default oxidation factors. National carbon emission factors were assumed for hard coal and lignite (based on empirical functions described in chapter 3.2.1). For fuels used in transport (gasoline, jet kerosene, diesel oil, LPG) average emission factors were applied from subcategories of 1.A. For other fuels default carbon emission factors were applied.

Apparent consumption of fuels was calculated as below:

$$AP_i = Production_i + Imports_i - Exports_i - Bunkers_i - Stock Change_i$$

Data about production, imports, exports, international bunkers and stock change are based on Eurostat database. For calculations only data in energy unit (TJ) were used, therefore conversion factors for all fuels is equal 1 TJ/kt (CRT table 1.A(b)).

Total apparent consumption was corrected by subtracting the amount of carbon (excluded carbon) which does not lead to fuel combustion emission (carbon which is emitted in another sector of the inventory or is stored in a product manufactured from the fuel). The main sources of such carbon are those used as non-energy products and feedstocks. The quantity of carbon to be excluded is calculated according to following equation:

$$\text{Excluded carbon} = AD \times CC \times 10^{-3}$$

where:

AD – activity data – non energy use of fuel and feedstock, TJ

CC – carbon content, t C/TJ

As the use of energy products for non-energy purposes can lead to emissions Poland has calculated these emission and report them under category 2.D *Non-energy products from fuels and solvent use* (chapter 4.5).

In 2024 the difference between reference and sectoral approaches in CO₂ emissions is equal - 0.54%. Comparison of both methods is given in table 3.2.1.

Table 3.2.1. Differences between CO₂ emissions in sectoral and reference approach

Year	Reference approach [kt]	Sectoral approach [kt]	Difference [%]
2024	256 439	257 833	-0.54
2023	262 475	263 404	-0.35
2022	292 246	291 037	0.42
2021	309 836	306 122	1.21
2020	281 600	277 615	1.44
2019	295 265	292 829	0.83
2018	315 120	310 310	1.55
2017	312 226	311 930	0.09
2016	300 184	299 331	0.29
2015	285 957	288 748	-0.97
2014	286 334	285 707	0.22
2013	303 509	298 989	1.51
2012	298 367	303 341	-1.64
2011	317 201	309 776	2.40
2010	317 189	313 326	1.23
2009	296 694	296 972	-0.09
2008	311 216	306 699	1.47
2007	312 124	311 896	0.07
2006	317 623	313 870	1.20
2005	303 553	301 894	0.55
2004	301 376	302 620	-0.41
2003	303 709	297 941	1.94
2002	296 885	287 264	3.35
2001	300 392	293 487	2.35
2000	298 912	294 801	1.39
1999	317 507	307 931	3.11
1998	325 214	317 297	2.50
1997	354 437	343 607	3.15
1996	361 691	355 379	1.78
1995	349 324	339 334	2.94
1994	340 340	339 253	0.32
1993	360 381	345 421	4.33
1992	361 726	344 189	5.10
1991	370 798	352 340	5.24
1990	374 335	350 626	6.76
1989	451 822	419 755	7.64
1988	482 016	438 896	9.82

The Reference Approach and the Sectoral Approach often have different results which may be caused by:

- statistical differences - is the difference between energy available for final consumption covering the energy placed at the disposal of final users and final energy consumption covering energy supplied to the final consumer's door for all energy uses;

Eurocontrol		2019	2020	2021	2022	2023	2024
Domestic	kt	35.34	17.65	18.98	34.65	41.67	40.51
International	kt	1529.36	603.11	785.77	864.35	1063.44	1181.97
Total	kt	1564.71	620.76	804.75	899.00	1105.11	1222.48
Eurostat	kt	1 077	459	574	978	1 189	1 340
Share							
Domestic	%	2.26	2.84	2.36	3.85	3.77	3.31
International	%	97.74	97.16	97.64	96.15	96.23	96.69
Total	%	100.00	100.00	100.00	100.00	100.00	100.00

Due to the lack of Eurocontrol data for the years before 2005, the share for years 1988-2004 was assumed as a 5-years average from Eurocontrol data for years 2005-2009. The 5-years average, taken from the nearest years to data lack period, was evaluated as the most representative in consultations with experts in the area of transport and energy. The 94.35% share of international use was then accepted for the whole period before 2005. Such assumption seems to be reliable and not affecting accuracy of the inventory.

For the estimation of GHG emissions from aviation bunker fuels, the same IPCC 2006 default emission factors for jet fuel were assumed as those used for emission estimation for domestic aviation: for CO₂ – 71.50 kg/GJ, for CH₄ – 0.0005 kg/GJ and for N₂O – 0.002 kg/GJ.

The fuel use data and the corresponding emission estimates of CO₂, CH₄ and N₂O for international aviation bunker for the 1988-2024 period are presented in table 3.2.3. Between 1988 and early 1990-ties dramatic decrease in fuel consumption and heavy industry production occurred triggered by significant economic changes related to political transformation from centralized to market economy. These changes affected all energy sectors and this is the main reason why Poland choose 1988 as a base year (as being more representative in trend than 1990 with collapsing industry).

Table 3.2.3. Fuel consumption and GHG emissions in international aviation in 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Jet Kerosene	PJ	14.16	19.47	8.95	9.24	10.03	9.99	10.11	10.90	12.82	11.48
CO₂ emission	kt	1 012	1 392	640	660	717	714	723	779	916	821
CH₄ emission	kt	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01
N₂O emission	kt	0.03	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Jet Kerosene	PJ	11.69	10.44	11.11	10.94	10.74	11.61	11.40	12.79	17.19	17.99
CO₂ emission	kt	836	747	794	782	768	830	815	915	1 229	1 286
CH₄ emission	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
N₂O emission	kt	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jet Kerosene	PJ	21.79	19.19	20.09	19.58	21.15	21.16	23.72	26.27	28.04	35.58
CO₂ emission	kt	1 558	1 372	1 437	1 400	1 513	1 513	1 696	1 878	2 005	2 544
CH₄ emission	kt	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
N₂O emission	kt	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.07
		2018	2019	2020	2021	2022	2023	2024			
Jet Kerosene	PJ	42.29	45.25	19.18	24.11	40.43	49.21	55.95			
CO₂ emission	kt	3024	3235	1372	1724	2891	3518	4001			
CH₄ emission	kt	0.02	0.02	0.01	0.01	0.02	0.02	0.03			
N₂O emission	kt	0.08	0.09	0.04	0.05	0.08	0.10	0.11			

3.2.2.2. International navigation

This category include emissions from journeys that depart in one country and arrive in a different country. It includes emissions from fuels used by vessels of all flags that engaged in international water-borne navigation, and exclude consumption by fishing vessels.

1990-2024 fuel use data for fuels classified to the international marine bunker were taken directly from the Eurostat database. For the years 1988-1989, the respective data were taken

from the database of the International Energy Agency (IEA).

For the estimation of GHG emissions from bunker fuels, the same IPCC 2006 default emission factors were assumed as those used for maritime navigation for CO₂: 74.10 kg/GJ for diesel oil and 77.40 kg/GJ for fuel oil. The emission factors for CH₄ and N₂O for both fuels are: 0.007 kg/GJ and 0.002 kg/GJ, respectively. The fuel use data and the corresponding emission estimates of CO₂, CH₄ and N₂O for international marine bunker for the 1988-2024 period are presented in table 3.2.4.

Table 3.2.4. Fuel consumption and GHG emissions in international navigation in 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Diesel oil	PJ	14.23	11.16	6.02	2.71	3.18	2.45	1.29	1.20	1.76	2.54
Fuel oil	PJ	9.00	9.37	10.58	3.80	6.83	3.19	4.28	4.65	5.13	6.34
CO ₂ emission	kt	1 751	1 552	1 265	495	764	429	427	449	528	679
CH ₄ emission	kt	0.163	0.144	0.116	0.046	0.070	0.039	0.039	0.041	0.048	0.062
N ₂ O emission	kt	0.046	0.041	0.033	0.013	0.020	0.011	0.011	0.012	0.014	0.018
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel oil	PJ	2.88	4.43	1.89	0.95	1.85	1.98	1.68	4.99	3.74	2.15
Fuel oil	PJ	8.16	10.91	10.02	9.90	9.41	9.90	8.89	8.56	8.65	8.24
CO ₂ emission	kt	845	1172	916	836	866	913	812	1 033	946	797
CH ₄ emission	kt	0.077	0.107	0.083	0.076	0.079	0.083	0.074	0.095	0.087	0.073
N ₂ O emission	kt	0.022	0.031	0.024	0.022	0.023	0.024	0.021	0.027	0.025	0.021
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Diesel oil	PJ	2.11	2.77	2.34	2.90	2.86	3.29	3.25	6.19	5.55	9.07
Fuel oil	PJ	9.41	7.60	6.68	4.24	3.20	2.60	2.92	1.88	2.12	2.12
CO ₂ emission	kt	885	794	690	543	459	445	467	604	575	836
CH ₄ emission	kt	0.081	0.073	0.063	0.050	0.042	0.041	0.043	0.057	0.054	0.078
N ₂ O emission	kt	0.023	0.021	0.018	0.014	0.012	0.012	0.012	0.016	0.015	0.022
		2018	2019	2020	2021	2022	2023	2024			
Diesel oil	PJ	8.14	8.25	9.10	12.05	9.88	9.46	5.99			
Fuel oil	PJ	3.17	3.30	3.53	2.57	1.58	1.56	1.51			
CO ₂ emission	kt	848	867	947	1 092	855	822	561			
CH ₄ emission	kt	0.079	0.081	0.088	0.102	0.080	0.077	0.052			
N ₂ O emission	kt	0.023	0.023	0.025	0.029	0.023	0.022	0.015			

Figure 3.2.1 shows emissions of greenhouse gases from international navigation and aviation bunker in period 1988-2024.

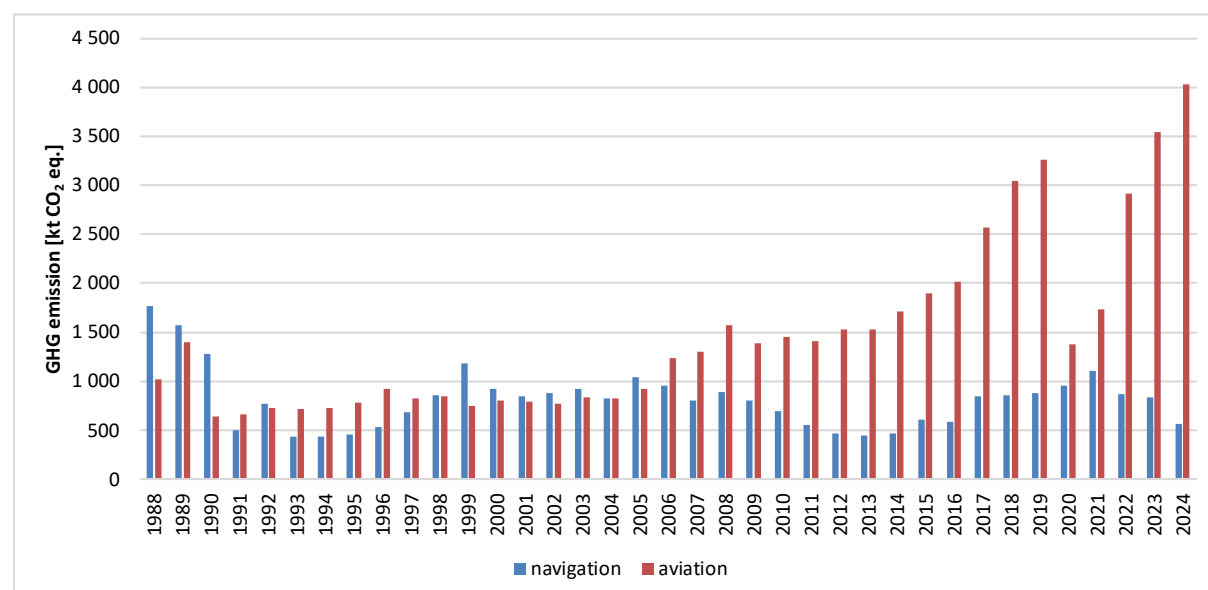


Figure 3.2.1. GHG emissions from international navigation and aviation bunker in period 1988-2024

3.2.3. Feedstocks and non-energy use of fuels

As the use of energy products for non-energy purposes can lead to emissions, Poland has calculated emissions from lubricant and paraffin waxes use and report them under category 2.D *Non-energy products from fuels and solvent use*. For more description see chapter 4.5.

3.2.4. CO₂ capture from flue gases and subsequent CO₂ storage

Not applicable in Poland.

3.2.5. Country-specific issues

Information on country specific fuel structure and GHG emission factors for fuels important for national emission level is presented in chapters 3.1.1, 3.2.6 - 3.2.9 and in Annex 5.3.

3.2.6. Energy Industries (CRT sector 1.A.1)

3.2.6.1. Source category description

Emissions in 1.A.1 *Energy Industries* category are estimated for each detailed sub-categories as follows:

a) 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*

b) 1.A.1.b *Petroleum refining*

c) 1.A.1.c *Manufacture of solid fuels and other energy industries*

- 1.A.1.c.i *Manufacture of solid fuels* (coke-oven plants, gas-works plants, mines, patent fuel/briquetting plants)
- 1.A.1.c.ii *Oil and gas extraction*
- 1.A.1.c.iii *Other energy industries* (own use in Electricity, CHP and heat plants)

Subsector 1.A.1.a *Public Electricity and Heat Production* is by far the largest contributor to emissions from this category (see figure 3.2.6.1) – over 93.5% in 2024.

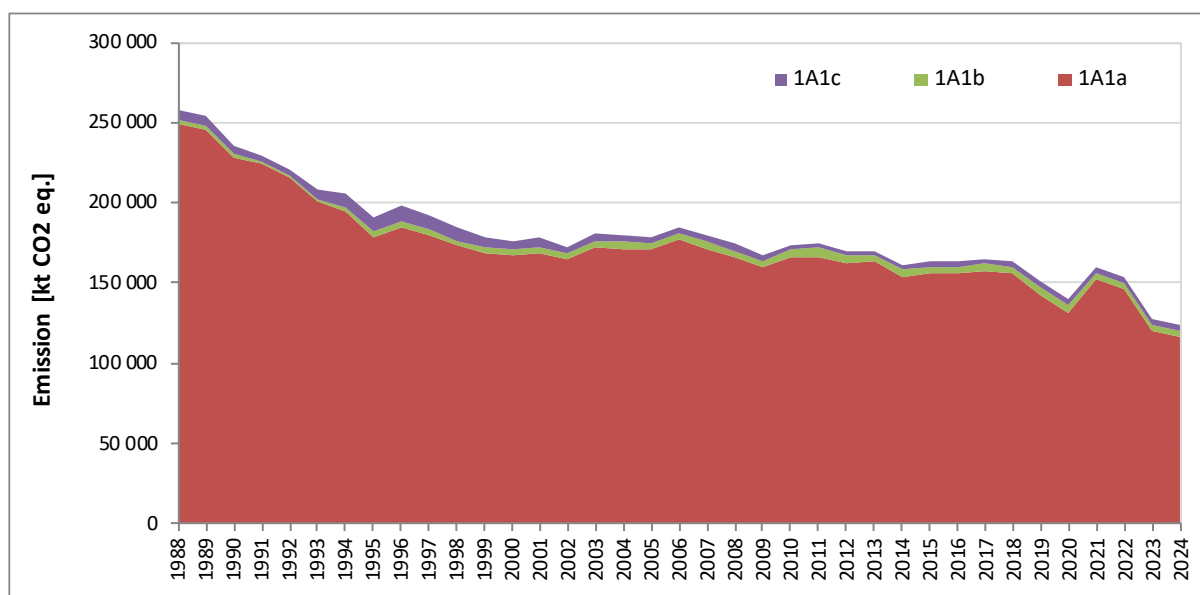


Figure 3.2.6.1. GHG emissions from *Energy Industries* in years 1988-2024 according to subcategories

3.2.6.2. Methodological issues

Methodology of emission estimation in 1.A.1 subcategory corresponds with methodology described for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for subcategories mentioned below are presented in Annex 5.3.

3.2.6.2.1. Public electricity and heat production (CRT sector 1.A.1.a)

Table 3.2.6.1 presents the structure and amounts of fuel used in the sub-category 1.A.1.a *Public electricity and heat production* for the years 1988-2024.

Table 3.2.6.1. Fuel consumption for the years 1988-2024 in 1.A.1.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	75.134	72.672	67.606	63.237	58.167	56.902	57.781	26.492
Gaseous Fuels	21.274	21.900	21.641	16.329	9.562	3.106	4.095	4.738
Solid Fuels	2374.674	2346.290	2189.015	2165.482	2092.877	1945.459	1884.409	1758.969
Other Fuels	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878
Biomass	16.699	15.129	14.585	14.387	17.289	13.783	14.057	1.447
TOTAL	2491.522	2459.864	2298.112	2268.349	2185.248	2025.908	1967.218	1795.524
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	29.158	29.277	27.432	28.292	24.618	29.650	28.582	29.195
Gaseous Fuels	7.157	7.950	10.769	16.210	21.626	28.242	38.700	45.495
Solid Fuels	1828.531	1774.067	1713.596	1667.926	1645.950	1660.843	1607.298	1687.883
Other Fuels	3.393	3.267	0.550	0.575	0.883	1.031	1.520	0.372
Biomass	2.793	3.381	3.877	3.747	3.904	5.449	5.424	6.642
TOTAL	1871.032	1817.942	1756.223	1716.750	1696.981	1725.215	1681.524	1769.587
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	27.431	25.820	27.082	25.136	24.611	23.604	25.124	19.596
Gaseous Fuels	53.627	57.099	52.877	49.691	51.163	51.653	52.289	57.959
Solid Fuels	1666.839	1667.789	1725.837	1680.076	1617.899	1558.535	1613.359	1609.737
Other Fuels	0.459	0.541	0.477	0.440	0.593	0.682	0.809	0.861
Biomass	9.439	17.789	21.527	26.269	40.001	57.022	67.892	81.917
TOTAL	1757.795	1769.038	1827.800	1781.611	1734.266	1691.497	1759.473	1770.070
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	18.070	15.704	13.756	17.603	18.983	17.617	16.670	15.538
Gaseous Fuels	61.965	53.395	52.016	60.428	70.589	83.471	101.008	114.019
Solid Fuels	1555.795	1573.823	1475.713	1482.039	1479.913	1485.793	1456.596	1322.226
Other Fuels	0.791	0.718	0.813	1.552	4.378	6.159	8.501	10.243
Biomass	109.804	92.581	102.737	101.980	81.635	66.065	68.628	81.898
TOTAL	1746.424	1736.220	1645.036	1663.603	1655.498	1659.104	1651.403	1543.925
	2020	2021	2022	2023	2024			
Liquid Fuels	16.691	19.043	21.623	18.431	19.796			
Gaseous Fuels	131.248	128.891	100.272	136.087	167.183			
Solid Fuels	1208.003	1418.522	1357.458	1087.862	1026.545			
Other Fuels	9.956	9.456	10.341	9.633	9.852			
Biomass	92.074	89.219	84.072	89.611	86.575			
TOTAL	1457.972	1665.130	1573.766	1341.625	1309.951			

The data in table 3.2.6.1 shows that the use of solid fuels is dominant in 1.A.1.a – mainly hard coal and lignite. In 2024, the use of hard coal was approximately 632 PJ i.e. almost 51% of the entire energy of all fuels used in that sub-sector. Lignite made over 25% of the energy, accordingly. Detailed data concerning individual fuel consumptions in 1.A.1.a subcategory for the entire period 1988-2024 was presented in Annex 5.3 (tab. 1).

Figure 3.2.6.2 shows CO₂ emission changes over the period 1988-2024. A significant emission decrease took place over the years 1988-1995 followed by a period of emission stabilization.

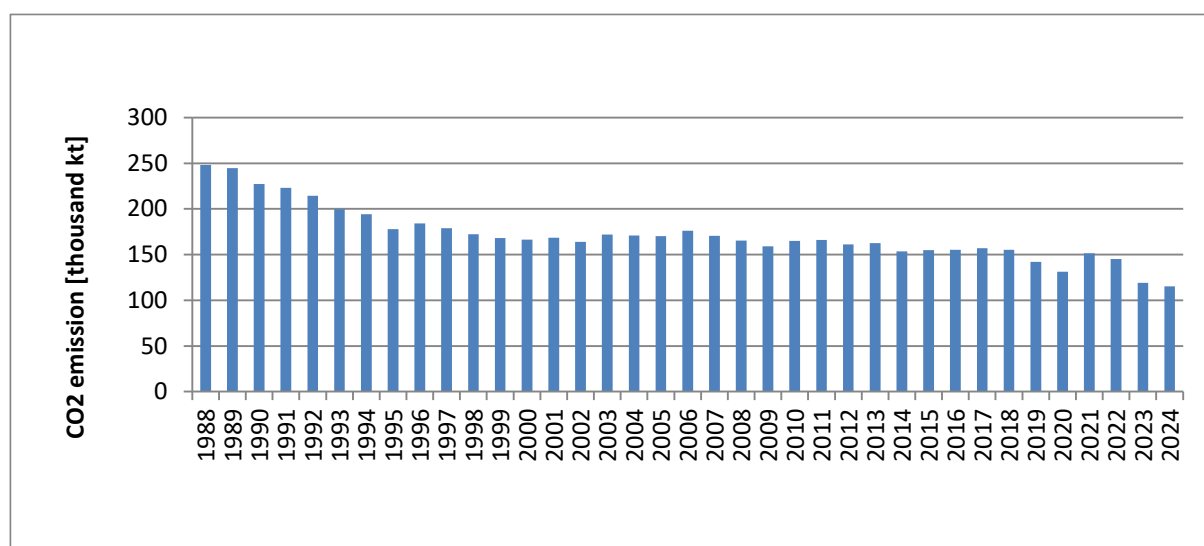


Figure 3.2.6.2. CO₂ emission for 1.A.1.a category in 1988-2024

Figure 3.2.6.3 shows emission trends for CH₄ and N₂O between the base year and 2024. Similarly to CO₂ a significant emission decrease for these gases happened in the period 1988-1995. In submission 2024, the country specific CH₄ EFs for coal, lignite and solid biomass were introduced, that are much lower than the default ones (see chapter 3.1.1 and the table 28 in Annex 5.3).

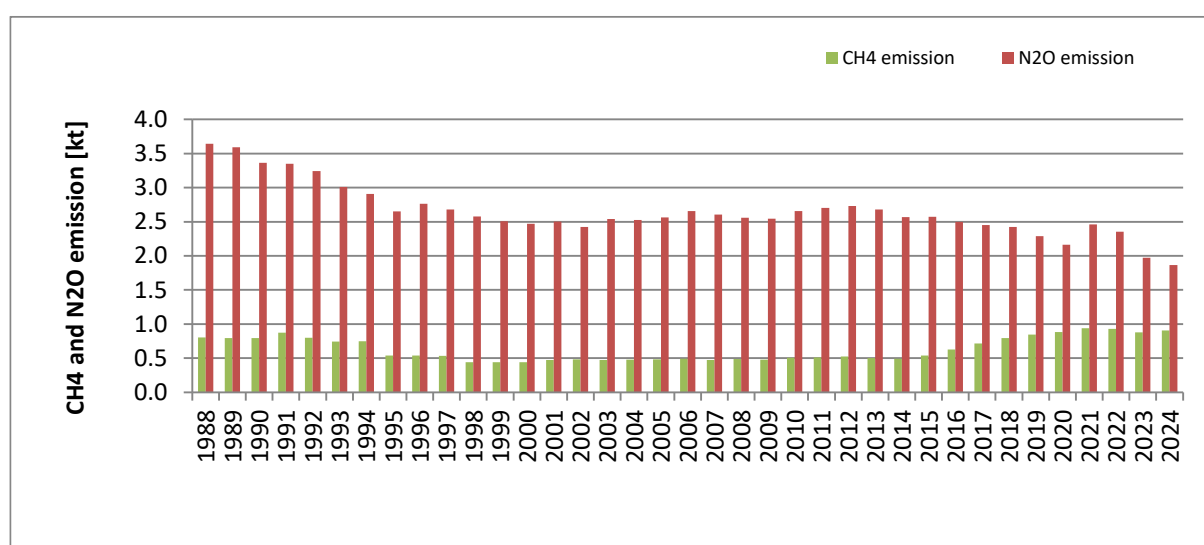


Figure 3.2.6.3. CH₄ and N₂O emissions for 1.A.1.a category in 1988-2024

3.2.6.2.2. Petroleum refining (CRT sector 1.A.1.b)

Table 3.2.6.2 shows fuel consumption data in sub-category 1.A.1.b *Petroleum refining* for the years 1988-2024. Detailed data on fuel consumptions in 1.A.1.b subcategory for the entire period 1988-2024 was presented in Annex 5.3 (table 2).

Table 3.2.6.2. Fuel consumption in 1988-2024 in 1.A.1.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	23.660	23.106	19.072	18.332	24.432	22.271	22.610	44.925
Gaseous Fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562

	1988	1989	1990	1991	1992	1993	1994	1995
Solid Fuels	0.142	0.140	0.045	0.118	0.070	0.248	0.067	1.296
Other Fuels	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	33.921	33.129	26.010	20.261	26.691	24.129	24.527	49.701
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	50.579	44.067	39.930	34.331	38.739	41.005	41.243	39.700
Gaseous Fuels	1.749	2.529	8.244	10.832	12.110	11.354	10.124	12.770
Solid Fuels	1.509	1.315	0.701	0.610	0.269	0.135	0.022	0.000
Other Fuels	0.350	0.163	0.000	0.310	0.219	0.095	0.253	0.176
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	54.187	48.073	48.875	46.082	51.337	52.589	51.642	52.646
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	40.590	37.929	38.479	44.626	46.202	44.637	53.171	50.181
Gaseous Fuels	15.535	14.482	14.900	20.816	18.816	17.511	19.363	27.467
Solid Fuels	0.000	0.000	0.000	0.000	0.000	0.130	0.134	0.171
Other Fuels	0.221	0.285	0.224	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	56.346	52.696	53.603	65.442	65.018	62.278	72.668	77.819
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	50.212	35.081	29.978	42.429	44.013	30.737	33.491	31.653
Gaseous Fuels	30.639	34.778	35.102	25.958	25.801	43.844	36.056	42.920
Solid Fuels	0.122	0.178	0.198	1.045	0.935	0.890	0.778	0.695
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	80.973	70.037	65.278	69.433	70.749	75.470	70.325	75.268
	2020	2021	2022	2023	2024			
Liquid Fuels	33.079	36.523	39.383	39.846	41.076			
Gaseous Fuels	41.086	33.795	21.204	31.131	33.257			
Solid Fuels	0.539	0.602	0.589	0.599	0.676			
Other Fuels	0.000	0.000	0.000	0.000	0.000			
Biomass	0.000	0.000	0.000	0.000	0.000			
TOTAL	74.704	70.920	61.177	71.575	75.009			

Figure 3.2.6.4 shows CO₂ emission changes in 1988-2024 in sub-category 1.A.1.b.

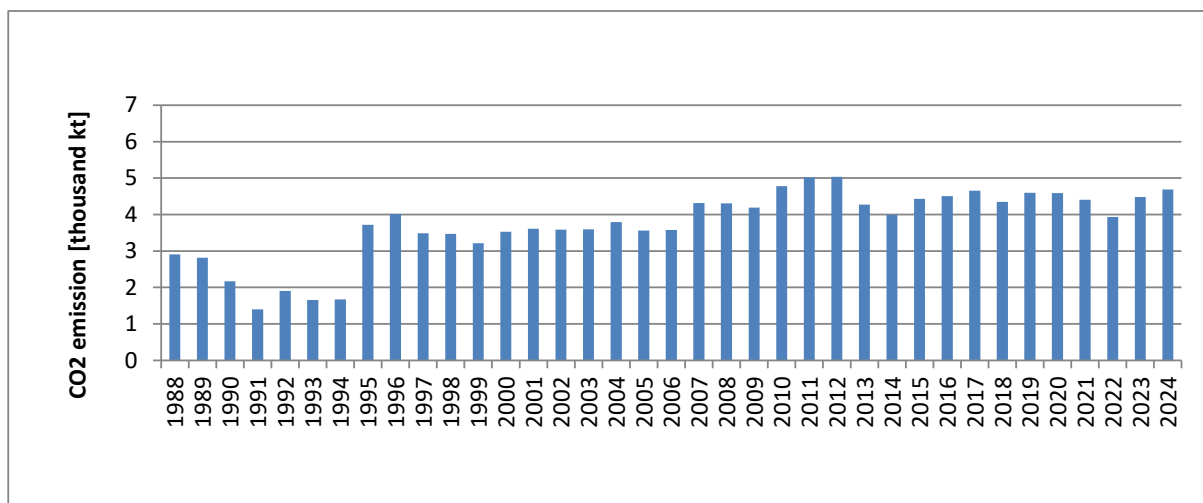


Figure 3.2.6.4. CO₂ emission for 1.A.1.b category in 1988-2024

Figure 3.2.6.5 shows the corresponding CH₄ and N₂O emission in that source sub-category between the base year and 2024.

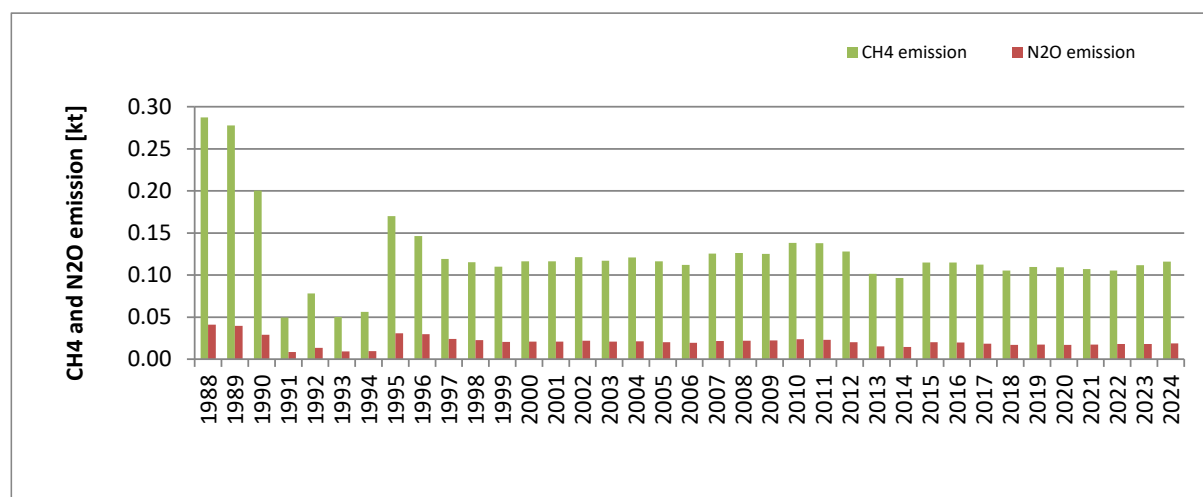


Figure 3.2.6.5. CH₄ and N₂O emissions for 1.A.1.b category in 1988-2024

3.2.6.2.3. Manufacture of solid fuels and other energy industries (CRT sector 1.A.1.c)

Table 3.2.6.3 shows the fuel use data in the sub-category 1.A.1.c over the period: 1988-2024. Particular fuel consumptions in 1.A.1.c subcategory for the entire period 1988-2024 were tabulated in Annex 5.3 (table 3).

Table 3.2.6.3. Fuel consumption in 1988-2024 in 1.A.1.c subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	2.550	2.180	2.073	2.374	2.543	5.017	4.209	4.259
Gaseous Fuels	13.736	15.364	12.371	12.432	14.666	12.353	17.401	14.851
Solid Fuels	70.465	66.330	58.471	49.165	47.205	61.441	101.445	98.892
Other Fuels	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004
TOTAL	86.815	83.875	72.921	63.970	64.417	79.130	123.301	118.190
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	3.731	3.173	2.978	2.225	2.216	1.716	1.738	1.657
Gaseous Fuels	23.270	21.155	17.779	19.458	19.490	12.987	12.515	9.741
Solid Fuels	100.110	94.190	88.470	74.141	67.310	64.088	48.914	55.888
Other Fuels	0.158	0.138	0.000	0.000	0.014	0.008	0.005	0.013
Biomass	0.014	0.031	0.026	0.027	0.037	0.052	0.047	0.026
TOTAL	127.283	118.686	109.252	95.850	89.067	78.851	63.218	67.325
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	1.447	1.696	1.418	1.496	1.448	1.631	1.755	2.178
Gaseous Fuels	11.190	10.106	10.363	9.680	9.239	8.858	10.322	9.804
Solid Fuels	60.786	51.647	53.458	66.074	63.469	44.062	47.350	47.519
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.010
Biomass	0.020	0.014	0.026	0.085	0.037	0.137	0.349	0.162
TOTAL	73.443	63.464	65.265	77.335	74.193	54.687	59.778	59.674
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	1.574	1.891	1.429	1.892	1.376	1.414	1.441	1.835
Gaseous Fuels	11.206	12.013	12.823	24.092	18.211	16.210	15.154	18.944
Solid Fuels	41.801	42.683	43.085	45.386	44.217	43.478	44.972	44.272
Other Fuels	0.001	0.002	0.002	0.002	0.005	0.006	0.012	0.001
Biomass	0.160	0.122	0.039	0.000	0.026	0.015	0.033	0.020
TOTAL	54.742	56.711	57.379	71.372	63.835	61.122	61.611	65.072
	2020	2021	2022	2023	2024			
Liquid Fuels	1.297	1.179	1.136	0.998	1.165			
Gaseous Fuels	22.676	24.627	23.193	25.954	26.183			
Solid Fuels	38.071	44.620	40.663	40.548	38.432			
Other Fuels	0.001	0.001	0.001	0.000	0.000			

Biomass	0.026	0.019	0.022	0.026	0.028
TOTAL	62.072	70.445	65.015	67.527	65.808

The emission trends of CO₂, CH₄ and N₂O in the 1988-2024 period are shown in figures 3.2.6.6 and 3.2.6.7.

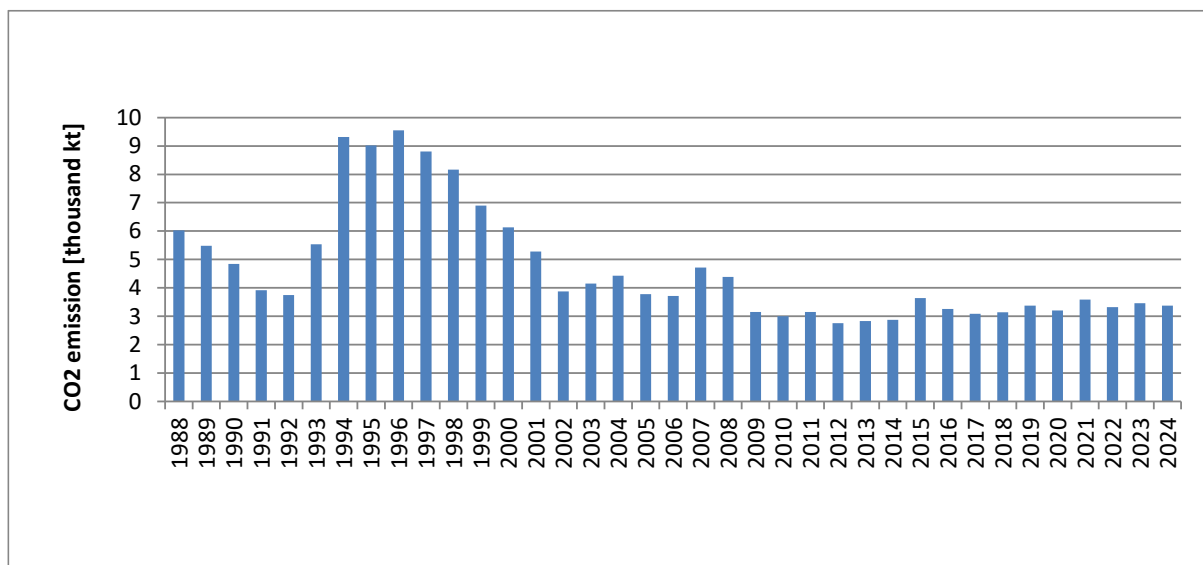


Figure 3.2.6.6. CO₂ emission for 1.A.1.c category in 1988-2024

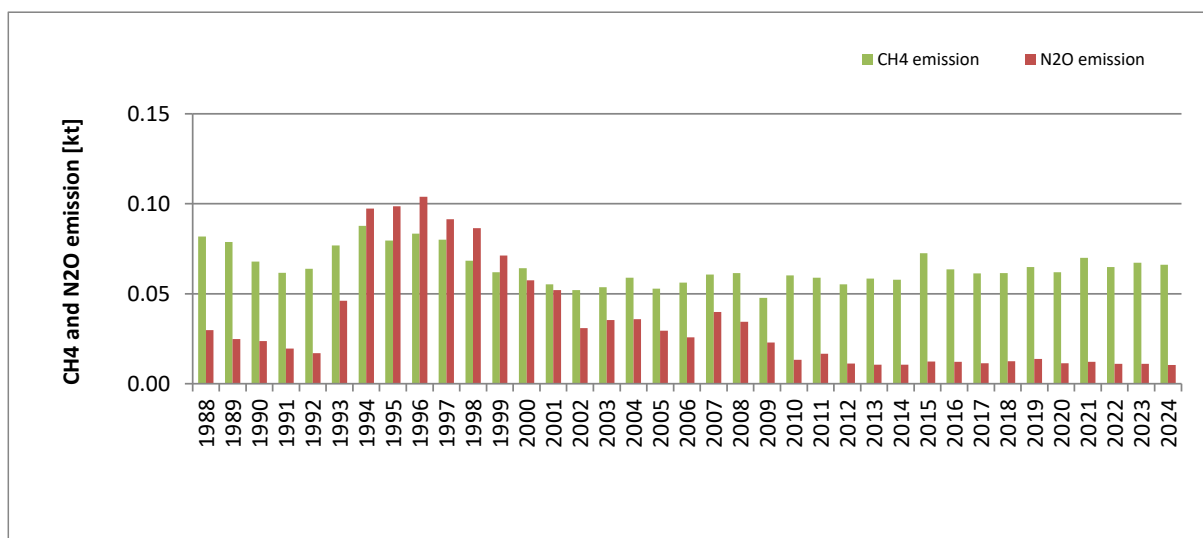


Figure 3.2.6.7. CH₄ and N₂O emissions for 1.A.1.c category in 1988-2024

3.2.6.3. Uncertainties and time-series consistency

Uncertainty analysis for the year 2024 for IPCC sector 1. *Energy* was estimated with use of approach 1 described in 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in Annex 2.

Recalculation of data for years 1988-2023 ensured consistency for whole time-series.

2023	CO ₂ [kt]	CH ₄ [kt]	N ₂ O [kt]	CO ₂ Emission uncertainty [%]	CH ₄ Emission uncertainty [%]	N ₂ O Emission uncertainty [%]
1. Energy	261 327.50	641.04	8.59	2.0%	34.8%	11.1%

2023	CO ₂ [kt]	CH ₄ [kt]	N ₂ O [kt]	CO ₂ Emission uncertainty [%]	CH ₄ Emission uncertainty [%]	N ₂ O Emission uncertainty [%]
A. Fuel combustion	257 839.18	122.15	8.59	2.0%	14.4%	11.1%
1. Energy industries	123 443.16	1.09	1.90	2.4%	9.5%	28.6%
2. Manufacturing industries and construction	25 689.92	3.97	0.54	2.4%	13.1%	26.8%
3. Transport	69 268.30	2.92	2.51	5.8%	9.6%	19.0%
4. Other sectors	39 437.80	114.17	3.64	3.8%	15.5%	16.8%
5. Other	-	-	-	-	-	-
B. Fugitive emissions from fuels	3 488.33	518.89	0.00	9.0%	42.9%	71.2%
1. Solid fuels	1 794.92	481.96	-	15.0%	46.2%	-
2. Oil and natural gas and other from energy production	1 693.41	36.93	0.00	9.7%	13.1%	71.2%

3.2.6.4. Source-specific QA/QC and verification

Activity data used in the GHG inventory concerning energy sector come from Eurostat Database which is fed by the Statistics Poland (GUS). As this database covers period since 1990, IEA database before 1990 is used for years 1988 and 1989. It should be underlined that data in both databases are fully consistent and based on the same questionnaires sent by Polish national statistics. Evidence of data compliance between two AD sources is given by the consistency of fuel consumption since 1990 in the IEA database and Eurostat. Comparison of data from both sources for selected fuels is presented in the Annex 5.1.

GUS is responsible for QA/QC of collected and published data. Activity data applied in GHG inventory are regularly checked and updated if necessary according to adjustments made in Eurostat Database.

The source of data on the consumption of fuels and energy for national statistics are based on reports, which enterprises are obliged to report to the Statistics Poland (GUS). This is done through the reporting portal. The forms for all statistical reports are available on GUS website: <http://form.stat.gov.pl/formularze/2023/index.htm>

The main energy forms are G-03 and G-02. Among enterprises obligated to this reporting there are also entities participating in the ETS system. Based on the data collected via the reporting portal, a database is created from which information for national energy balances elaboration and filling out questionnaires reporting Polish energy data to international statistical institutions (Eurostat, IEA, OECD) are taken. This ensures data consistency. Data from individual reports are subject to cross-check procedures. There are also algorithms comparing the data from the reporting year with the previous submission. Questionnaires with data on fuel and energy consumption reported to Eurostat, IEA and OECD are also subject to verification by these institutions. The questions regarding data from the entire long-term time series are directed to GUS. Doubts are clarified and, if necessary, the data is corrected (the entire adjusted trend is submitted in the questionnaire to the above-mentioned statistical organizations). Therefore the data in the mentioned databases can be treated as consistent, coherent and verified.

In the context of the information given above the drop in fuels consumption between 1989 and 1990 is not the result of source data change. Main driver of the significant decline in AD and emissions in the energy sector between these years is political system change and transformation of the economy in Poland where sudden drop in production in many energy-intensive industries occurred followed by energy efficiency measures.

One of the quality control elements of activity data check in national GHG inventories is preparation of fuel balances (see Chapter 1.4, tab. 1.1). For the main fuels (i.e. coal, lignite)

calorific values are analysed for avoiding significant errors. Close cooperation is developed between inventory experts and institutions responsible for energy data. Any doubtful fuel consumption values are systematically verified - it is often required to obtain additional confirmation of data by installations/entities submitting the energy questionnaire. In case of any doubts energy data are also validated based on Statistics Poland's Energy Statistics published annually.

Additional verification of data in energy sector covers comparison of sectoral and reference approaches within the GHG inventory.

Information from reports on emissions from installations covered by the ETS, reported to KOBiZE on an annual basis, is also taken into account for preparation the national greenhouse gas inventory. Country specific EFs are used in GHG inventory in category 1A - *Fuel combustion* for natural gas and fuel oil which were developed on the basis of data on CO₂ emissions and fuel consumption contained in reports prepared by companies under ETS. CO₂ emission factors for hard coal and lignite from ETS reports for public power plants are also analysed for comparison with the CS EFs applied in inventory. The results of the national GHG inventory in comparison with relevant ETS data according to the main IPCC subcategories are reported to the EU in the form of the Annex XII under Art. 14 of the Implementation Regulation No 2020/1208. In some cases methodological differences influence reported emissions under inventory and ETS. The example of such different approaches covers fuel consumption published by energy statistic used in the GHG inventory and data on fuel use given in ETS reports. National statistics include data in which the division of fuels into the production of commercial and non-commercial heat is distinguished for Autoproducers (Autoproducer CHP Plants and Autoproducer Heat Plants), which is not differentiated in ETS reports. Fuel consumptions connected with the production of commercial heat at Autoproducers are aggregated and added in inventory to category 1.A.1.a, due to unavailability in statistical data of detail division of input for commercial heat production into individual industry sectors. Fuels used for the production of non-commercial heat at Autoproducers are qualified in statistics as final energy consumption in a given industry sector, and are reported in inventory in given sub-category 1.A.2. Additional problem in comparison of fuel consumption between ETS and energy statistics/GHG inventory AD can be the results of differences in NCVs. There are cases where different NCVs are used for calculations in ETS and in statistics applied in the GHG inventory. It should be mentioned here that the amounts of fuel expressed in energy units (TJ) are used in the inventory.

Calculations in energy sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 4.

3.2.6.5. Source-specific recalculations

Slight adjustments for 2010-2023 were introduced as a result of data updates from EUROSTAT database (mainly for fuel oil in 2023, natural gas in the period 2010-2022, LPG and diesel oil in 2022).

Table 3.2.6.4. Changes of GHG emission values in 1.A.1 subcategory as a result of recalculations

Changes	1988	1989	1990	1991	1992	1993	1994	1995	1996
CO ₂									
kt	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
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	1997	1998	1999	2000	2001	2002	2003	2004	2005
CO ₂									
kt	0.00	3.21	3.21	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
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO ₂									
kt	0.00	0.00	0.00	0.00	0.145	-0.235	0.181	-0.039	1.847
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂									
kt	0.332	22.425	11.984	7.742	19.819	10.778	18.526	-4.709	24.627
%	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.02
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
%	0.00	0.05	0.02	0.01	0.04	0.02	0.03	-0.01	0.09
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

3.2.6.6. Source-specific planned improvements

- No improvements are planned at the moment.

3.2.7. Manufacturing Industries and Construction (CRT sector 1.A.2)

3.2.7.1. Source category description

Emissions in 1.A.2 *Manufacturing industries and construction* category are estimated for each fuel in detailed sub-categories as follows:

- a) *Iron and steel* - 1.A.2.a
- b) *Non-ferrous metals* - 1.A.2.b
- c) *Chemicals* - 1.A.2.c
- d) *Pulp, paper and print* - 1.A.2.d
- e) *Food processing, beverages and tobacco* - 1.A.2.e
- f) *Non-metallic minerals* - 1.A.2.f
- g) *Other* - 1.A.2.g:
 - *Manufacturing of machinery* - 1.A.2.g.i
 - *Manufacturing of transport equipment* - 1.A.2.g.ii
 - *Mining (excluding fuels) and quarrying* - 1.A.2.g.iii
 - *Wood and wood products* - 1.A.2.g.iv
 - *Construction* - 1.A.2.g.v
 - *Textile and leather* - 1.A.2.g.vi
 - *Other (other industry branches not included elsewhere)* - 1.A.2.g.vii

Subsector 1.A.2.f *Non-metallic minerals*, 1.A.2.c *Chemicals* and 1.A.2.a *Iron and Steel* are the largest contributors to emissions from this category (see figure 3.2.7.1) – respectively 31.2%, 18.9% and 13.8% in 2024.

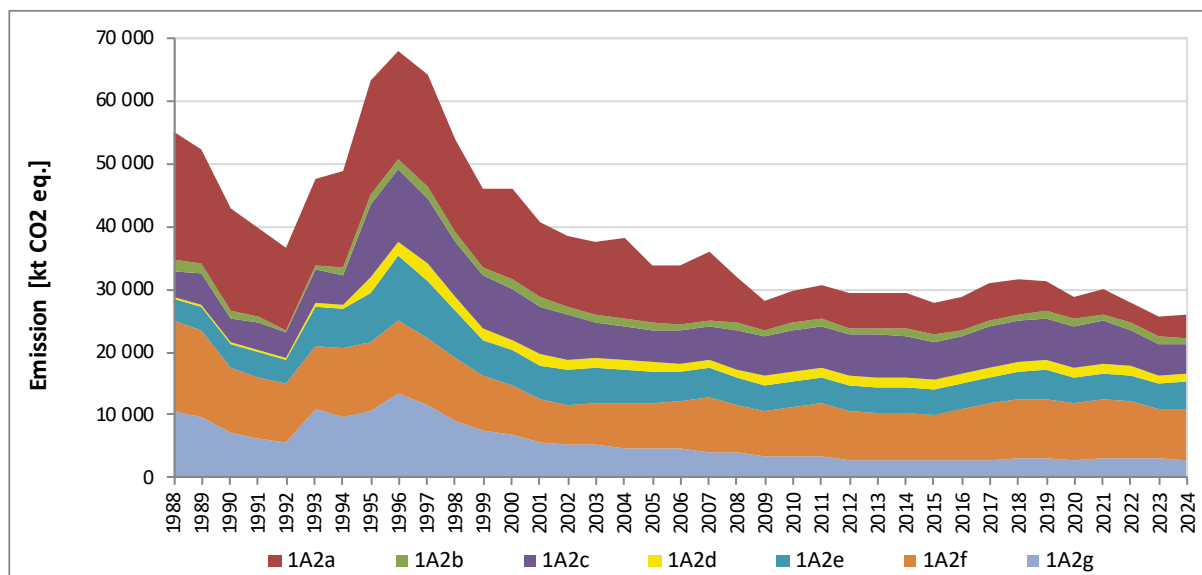


Figure 3.2.7.1. Emissions from *Manufacturing Industries and Construction* category in years 1988-2024 according to subcategories

3.2.7.2. Methodological issues

Methodology of emission estimation in 1.A.2 subcategory corresponds with methodology described for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for subcategories listed below are presented in Annex 5.3.

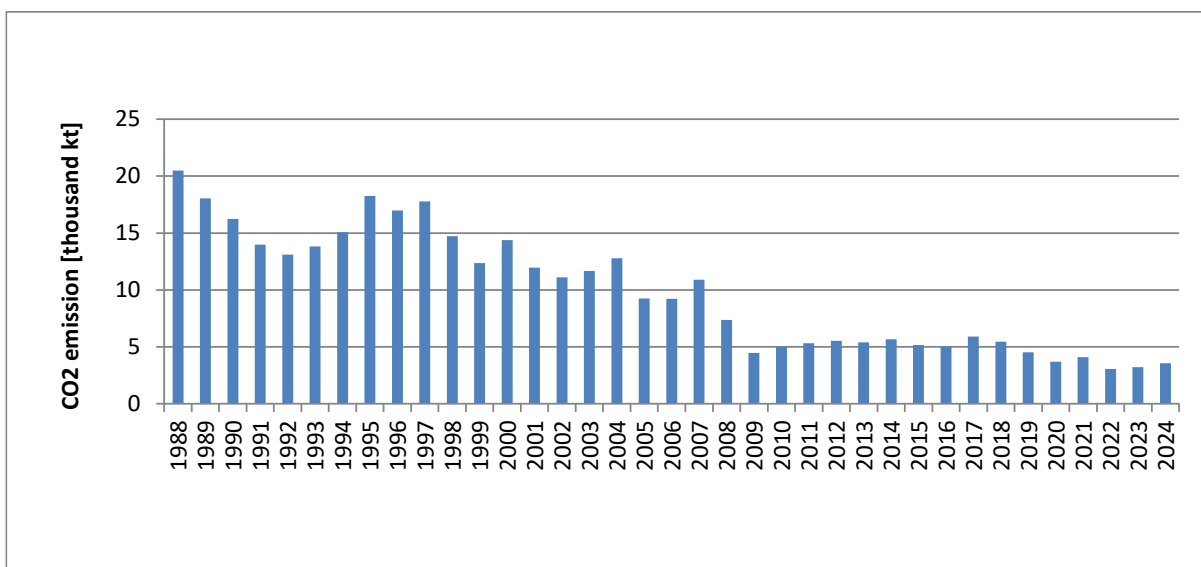
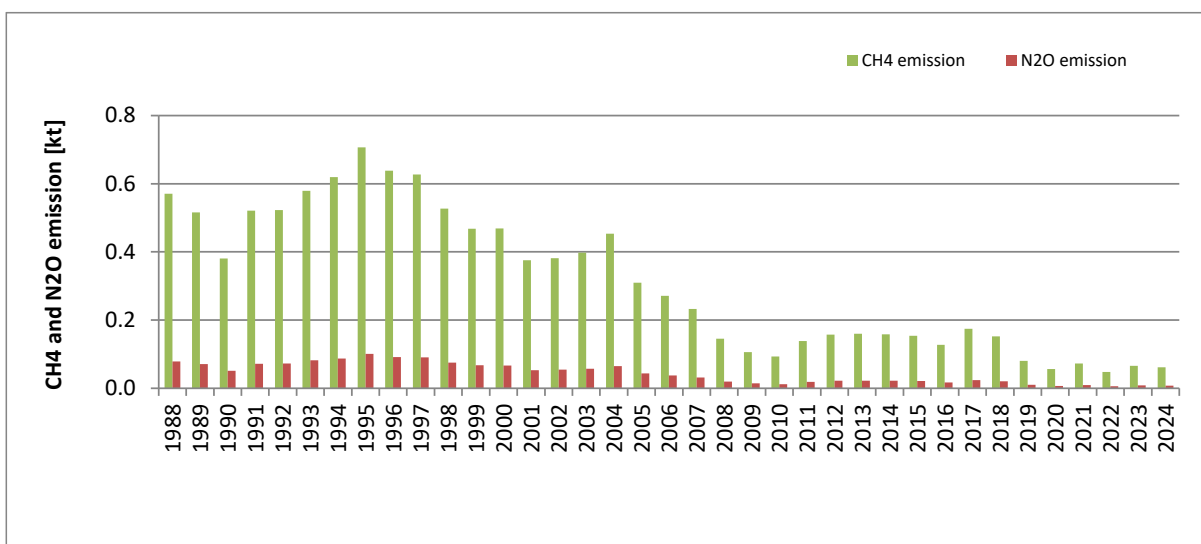
3.2.7.2.1. Iron and steel (CRT sector 1.A.2.a)

Table 3.2.7.1 shows the fuel use data in the sub-category 1.A.2.a *Iron and steel* for the period: 1988-2024. Detailed data on fuel consumptions in 1.A.2.a subcategory for the entire period 1988-2024 was presented in Annex 5.3 (table 4).

Table 3.2.7.1. Fuel consumption in 1988-2024 in 1.A.2.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	18.248	15.528	11.282	8.007	5.505	4.667	3.549	2.878
Gaseous Fuels	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239
Solid Fuels	95.323	82.955	75.403	72.311	72.764	84.180	95.514	117.353
Other Fuels	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005
TOTAL	190.236	165.159	143.615	121.048	111.334	118.697	128.320	147.416
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	1.916	6.031	1.961	2.209	1.843	1.008	0.366	0.318
Gaseous Fuels	25.898	28.278	23.993	21.440	22.024	18.329	15.463	14.827
Solid Fuels	111.979	112.482	98.551	79.891	88.616	75.051	72.276	76.592
Other Fuels	0.498	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.006	0.004	0.006	0.004	0.003	0.006	0.003	0.004
TOTAL	140.297	146.795	124.511	103.544	112.486	94.393	88.108	91.741
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	0.271	0.086	0.129	0.086	0.133	0.133	0.133	0.165
Gaseous Fuels	19.964	20.455	20.998	22.716	20.397	16.595	16.916	17.208
Solid Fuels	82.612	58.075	55.649	59.989	38.709	23.012	26.182	29.987
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.004	0.002	0.001	0.001	0.001	0.001	0.000	0.000
TOTAL	102.851	78.619	76.777	82.792	59.240	39.740	43.231	47.359
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	0.199	0.185	0.197	0.196	0.196	0.238	0.232	0.230
Gaseous Fuels	16.905	16.242	16.096	16.702	19.457	23.716	25.022	21.212
Solid Fuels	31.663	31.706	33.044	28.527	24.703	30.124	26.884	19.660
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001
TOTAL	48.768	48.134	49.338	45.426	44.357	54.079	52.139	41.103
	2020	2021	2022	2023	2024			
Liquid Fuels	0.179	0.196	0.187	0.214	0.195			
Gaseous Fuels	21.382	23.123	16.227	17.982	19.929			
Solid Fuels	14.812	17.825	13.903	14.961	14.459			
Other Fuels	0.000	0.000	0.000	0.000	0.000			
Biomass	0.000	0.008	0.009	0.006	0.006			
TOTAL	36.373	41.152	30.326	33.164	34.589			

Figure 3.2.7.2 shows CO₂ emissions in the 1988-2024 period. Emissions of CH₄ and N₂O in the same time period are shown in figure 3.2.7.3. Emission trends for all three gases follow closely the trends in fuel use.

Figure 3.2.7.2. CO₂ emission for 1.A.2.a category in 1988-2024Figure 3.2.7.3. CH₄ and N₂O emissions for 1.A.2.a category in 1988-2024

3.2.7.2.2. Non-ferrous metals (CRT sector 1.A.2.b)

The data on fuel type use in the sub-category 1.A.2.b *Non-ferrous metals* over the 1988-2024 period is presented in table 3.2.7.2. More detailed data concerning fuel consumptions was tabulated in Annex 5.3 (table 5).

Table 3.2.7.2. Fuel consumption in 1988-2024 in 1.A.2.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	0.683	0.803	0.811	0.851	0.937	0.854	0.937	0.899
Gaseous Fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447
Solid Fuels	12.001	10.832	6.601	5.703	3.186	4.618	7.831	10.099
Other Fuels	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
TOTAL	19.191	17.823	12.449	11.670	5.850	7.947	14.913	18.595
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	0.949	0.905	0.783	0.738	0.871	0.792	0.623	0.500

Gaseous Fuels	5.108	5.424	5.639	5.660	5.814	5.700	5.589	5.868
Solid Fuels	10.609	10.156	11.478	11.106	11.426	12.452	11.431	10.590
Other Fuels	2.411	2.361	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.149	0.042	0.026	0.010	0.011	0.005	0.001	0.000
TOTAL	19.226	18.888	17.925	17.514	18.122	18.949	17.644	16.958
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	0.664	0.623	0.623	0.381	0.381	0.379	0.383	0.339
Gaseous Fuels	6.402	6.464	6.880	6.740	6.537	5.846	6.039	6.670
Solid Fuels	8.675	6.678	6.904	7.816	7.701	7.164	6.882	7.241
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	15.741	13.765	14.407	14.937	14.619	13.389	13.305	14.250
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	0.293	0.293	0.253	0.249	0.412	0.675	0.474	0.533
Gaseous Fuels	6.890	6.703	6.950	7.225	7.226	7.555	7.958	7.958
Solid Fuels	7.329	7.367	7.806	7.974	6.841	6.209	6.738	7.096
Other Fuels	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	14.512	14.363	15.009	15.448	14.480	14.439	15.170	15.588
	2020	2021	2022	2023	2024			
Liquid Fuels	0.468	0.344	0.330	0.339	0.330			
Gaseous Fuels	7.663	7.982	7.320	7.071	7.171			
Solid Fuels	6.539	6.637	8.114	6.266	6.132			
Other Fuels	0.000	0.000	0.000	0.000	0.000			
Biomass	0.000	0.000	0.001	0.001	0.001			
TOTAL	14.671	14.963	15.765	13.677	13.633			

Emissions of the main greenhouse gases in 1.A.2.b between the base year and 2024 are shown in figures 3.2.7.4 and 3.2.7.5.

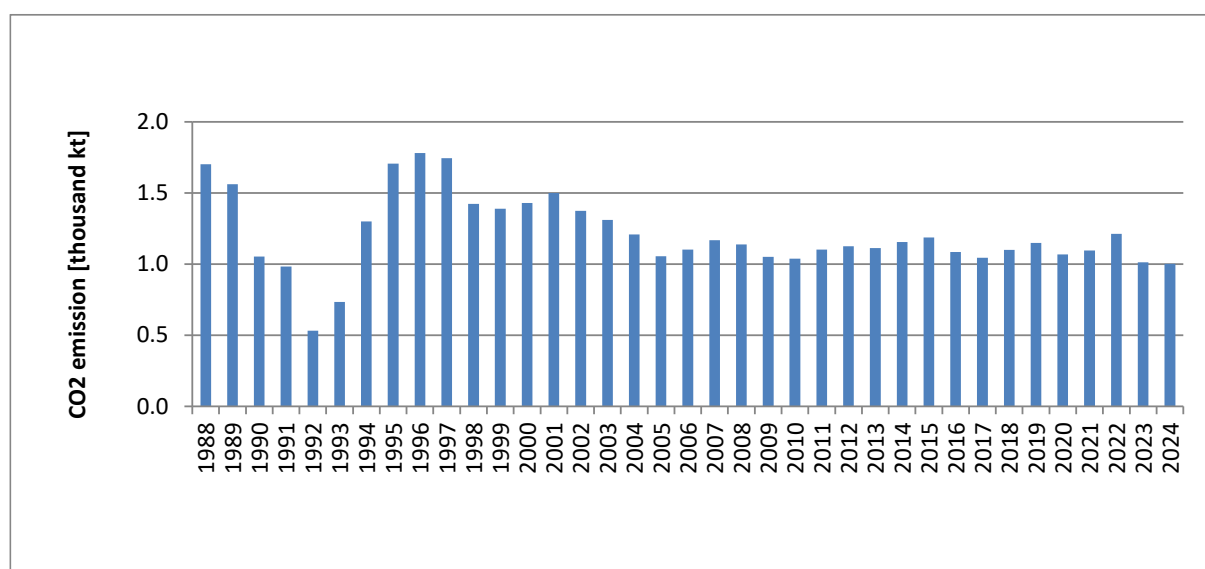
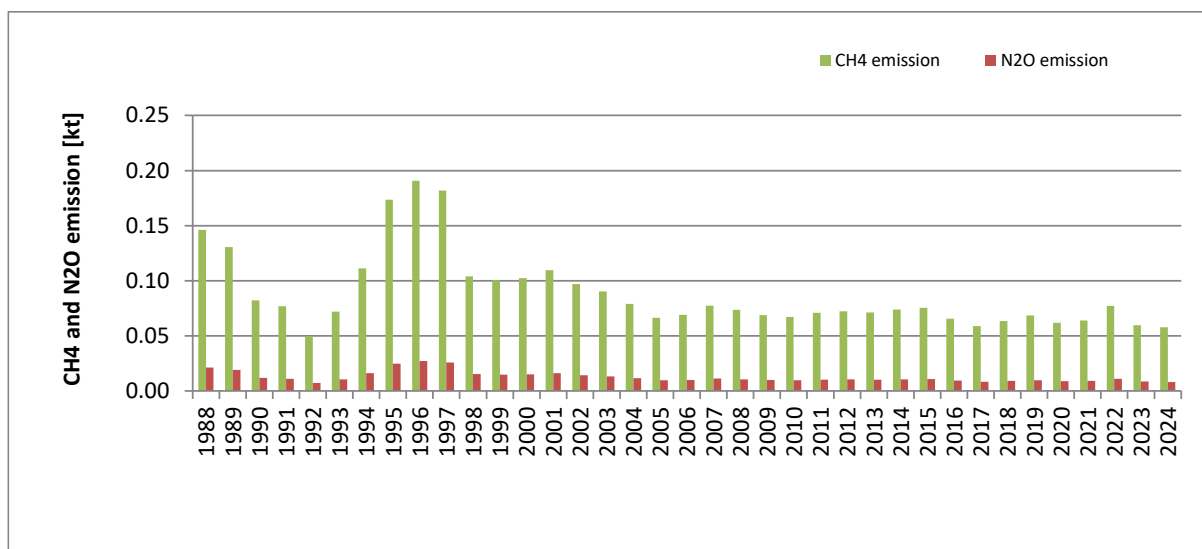


Figure 3.2.7.4. CO₂ emission for 1.A.2.b category in 1988-2024

Figure 3.2.7.5. CH₄ and N₂O emissions for 1.A.2.b category in 1988-2024

3.2.7.2.3. Chemicals (CRT sector 1.A.2.c)

Detailed data on fuel consumptions in 1.A.2.c subcategory for the entire period 1988-2024 was presented in Annex 5.3 (table 6). The data on fuel type use in the sub-category 1.A.2.c *Chemicals* over the 1988-2024 period is presented in the table 3.2.7.3.

Table 3.2.7.3. Fuel consumption in 1988-2024 in 1.A.2.c subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	14.825	13.968	4.132	6.224	9.007	7.782	4.565	11.034
Gaseous Fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356
Solid Fuels	12.407	14.986	10.759	9.252	6.903	16.648	10.206	74.727
Other Fuels	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007
TOTAL	46.241	50.503	37.011	38.440	37.390	52.511	41.905	113.670
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	20.035	23.251	41.212	39.348	38.484	33.275	33.039	33.565
Gaseous Fuels	6.191	11.024	9.408	9.041	9.464	8.481	7.199	6.457
Solid Fuels	75.325	65.835	57.054	52.352	51.675	50.217	47.431	30.119
Other Fuels	17.374	14.356	0.672	0.582	0.607	0.618	0.567	0.875
Biomass	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.153
TOTAL	118.925	114.465	108.347	101.324	100.230	92.591	88.238	71.168
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	33.689	26.009	29.338	29.810	23.501	26.741	22.115	16.816
Gaseous Fuels	7.494	8.061	9.009	8.754	7.950	9.707	11.807	13.886
Solid Fuels	29.110	29.427	28.861	29.366	45.594	43.347	48.722	49.579
Other Fuels	1.070	0.570	0.671	0.707	0.509	0.584	0.770	0.732
Biomass	0.094	0.153	0.000	0.121	0.000	0.058	0.058	0.053
TOTAL	71.458	64.220	67.879	68.758	77.554	80.437	83.473	81.067
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	13.779	16.675	13.302	10.318	10.200	13.099	12.732	18.412
Gaseous Fuels	13.568	14.696	14.500	14.861	12.068	13.021	15.171	14.969
Solid Fuels	50.452	50.892	50.088	46.363	48.295	51.209	51.499	51.002
Other Fuels	0.581	1.092	1.082	0.936	0.652	1.494	0.744	0.393
Biomass	0.131	0.050	0.111	0.094	0.144	0.104	0.146	0.371
TOTAL	78.511	83.404	79.083	72.571	71.358	78.927	80.293	85.147
	2020	2021	2022	2023	2024			
Liquid Fuels	19.634	20.586	14.497	11.268	14.722			
Gaseous Fuels	17.034	18.888	12.927	15.933	18.773			
Solid Fuels	46.825	48.552	43.599	35.930	31.029			

Other Fuels	0.330	0.408	0.239	0.057	0.051
Biomass	0.353	0.255	0.271	0.293	0.261
TOTAL	84.176	88.689	71.532	63.481	64.835

Figure 3.2.7.6 shows CO₂ emissions in the sub-category 1.A.2.c in the 1988-2024 period. Emissions of CH₄ and N₂O, in turn, are shown in figure 3.2.7.7.

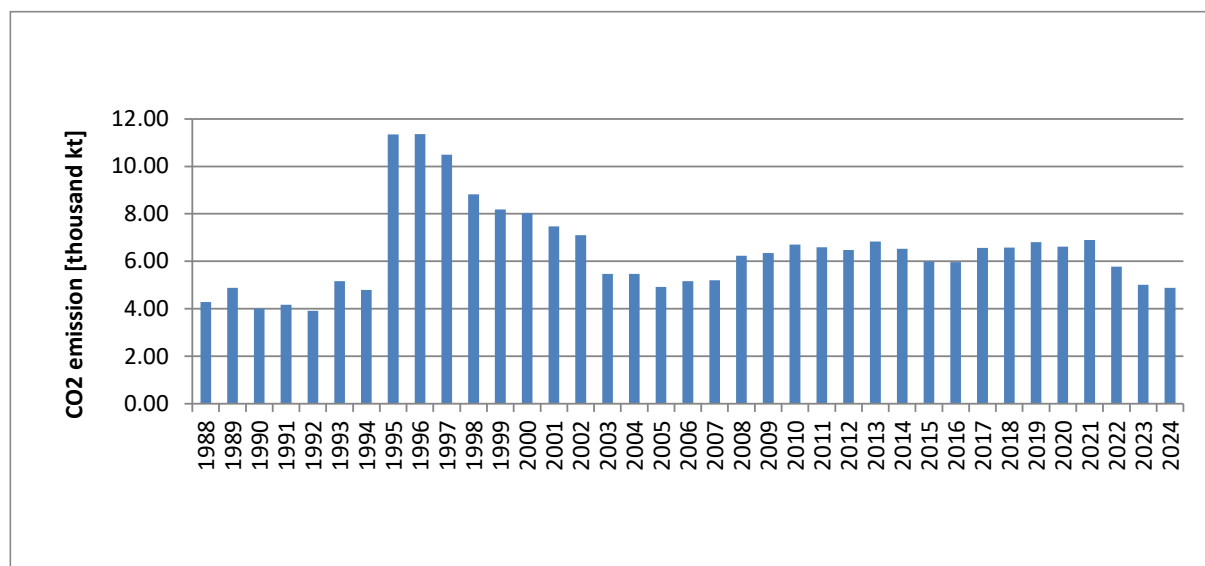


Figure 3.2.7.6. CO₂ emission for 1.A.2.c category in 1988-2024

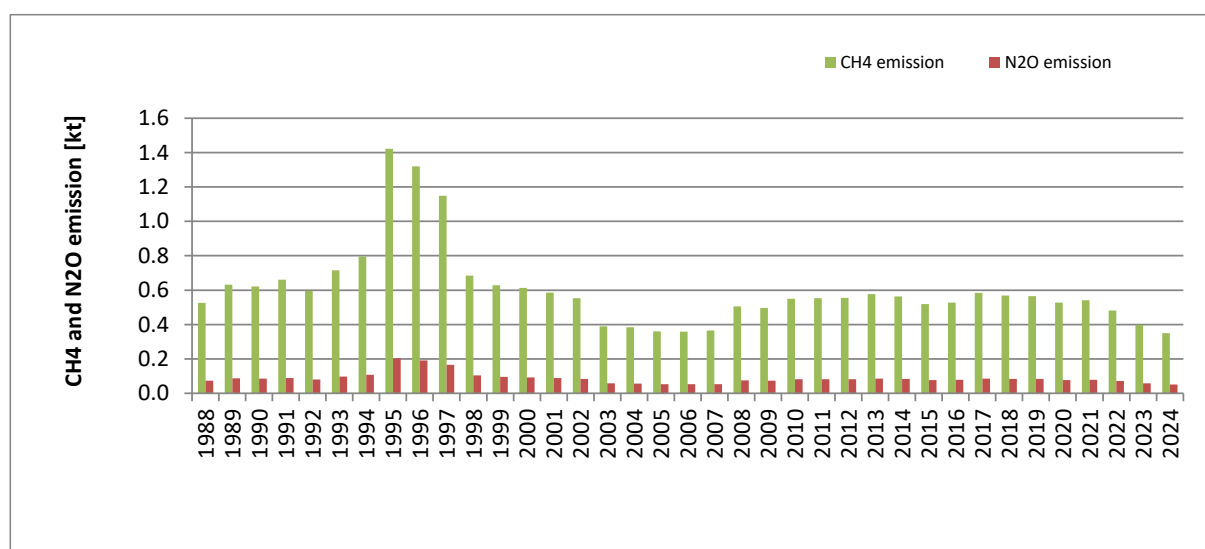


Figure 3.2.7.7. CH₄ and N₂O emissions for 1.A.2.c category in 1988-2024

Significant increase in fuel consumption between 1994 and 1995 in mentioned categories is the result of algorithm change in classification of fuel consumption for particular parts of national energy balance. For the years before 1995 all fuels consumed for energy and heat production in Autoproducer CHP Plants were included in *Transformation input in Autoproducer CHP Plants* and reported under 1.A.1.a subcategory. Starting from 1995 the fuel consumption for non-commercial heat production (heat not sold to third parties) was classified as part of final energy consumption in individual subsectors and reported in CRT in 1.A.2 category. This methodology change was described in *Energy Statistic of OECD Countries* (in Part I: *Methodology* as country notes for “Electricity and Heat”). Mentioned modification

in national energy statistic is noticeable also in Eurostat database. In terms of GHG emission inventory analysed change resulted in reallocation of part of emission from 1.A.1.a into 1.A.2 IPCC category.

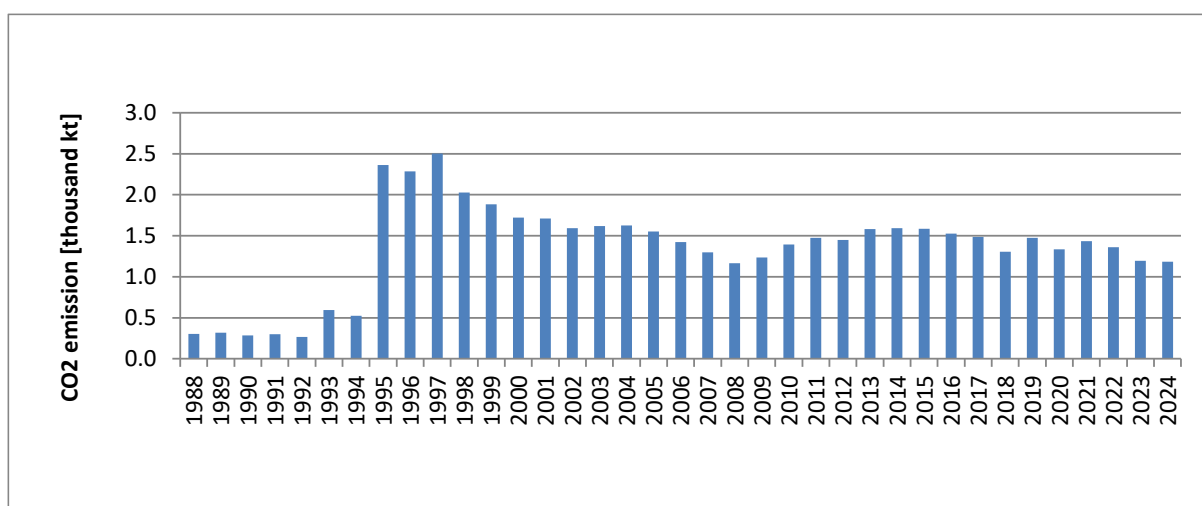
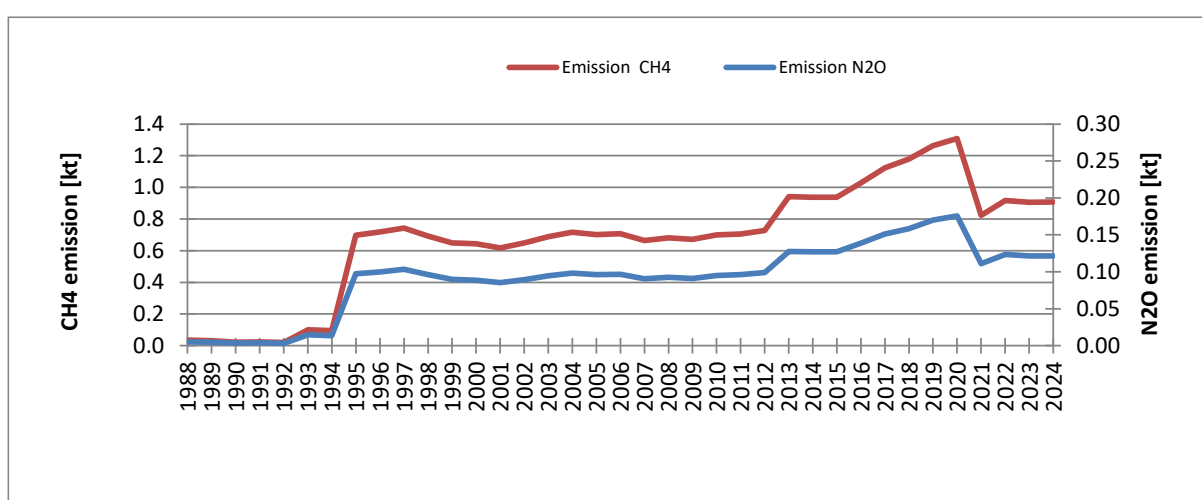
3.2.7.2.4. Pulp, paper and print (CRT sector 1.A.2.d)

The data on fuel type use in the sub-category 1.A.2.d *Pulp, paper and print* over the 1988-2024 period are presented in table 3.2.7.4. Characteristic for that sub-sector is relatively large share of biomass in the total fuel use. Detailed data on fuel consumptions in 1.A.2.d subcategory was presented in Annex 5.3 (table 7).

Table 3.2.7.4. Fuel consumption in 1988-2024 in 1.A.2.d subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	1.371	1.291	1.383	1.345	1.424	1.710	1.547	2.648
Gaseous Fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232
Solid Fuels	1.976	2.192	1.797	2.027	1.624	4.825	4.108	22.587
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437
TOTAL	3.803	3.850	3.282	3.434	3.074	8.181	7.515	40.903
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	1.700	2.134	2.640	2.245	2.205	2.062	2.053	2.225
Gaseous Fuels	0.455	1.096	0.563	1.007	1.211	1.445	1.461	2.094
Solid Fuels	22.482	24.114	19.017	17.528	15.723	15.591	14.345	14.105
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	16.243	16.472	16.476	15.545	15.938	15.138	16.622	17.950
TOTAL	40.881	43.816	38.697	36.325	35.076	34.236	34.480	36.374
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	2.264	2.048	2.138	2.356	2.005	1.995	1.992	1.989
Gaseous Fuels	2.657	2.288	2.976	4.087	4.822	4.973	5.135	4.587
Solid Fuels	13.824	13.457	11.620	9.480	7.879	8.515	10.113	11.301
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	18.957	18.611	19.379	18.644	19.729	19.189	19.630	19.475
TOTAL	37.703	36.403	36.113	34.567	34.435	34.671	36.870	37.351
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	1.785	1.872	1.545	1.830	1.885	1.752	1.539	1.725
Gaseous Fuels	5.535	6.271	6.994	7.166	7.991	8.709	8.513	9.935
Solid Fuels	10.643	11.460	11.291	10.922	9.628	8.744	7.024	7.751
Other Fuels	0.000	0.037	0.125	0.108	0.190	0.295	0.360	0.427
Biomass	20.441	27.243	27.092	27.156	30.526	33.881	36.234	38.730
TOTAL	38.404	46.883	47.047	47.182	50.220	53.381	53.671	58.568
	2020	2021	2022	2023	2024			
Liquid Fuels	1.514	1.998	2.137	1.497	1.341			
Gaseous Fuels	9.314	9.855	9.467	9.474	9.898			
Solid Fuels	6.637	7.194	6.184	4.560	4.370			
Other Fuels	0.531	0.406	0.608	0.840	0.798			
Biomass	40.512	24.300	27.534	27.619	27.812			
TOTAL	58.508	43.753	45.929	43.990	44.219			

Figures 3.2.7.8 and 3.2.7.9 show emissions of CO₂, CH₄ and N₂O, respectively in the sub-category 1.A.2.d in the period: 1988-2024.

Figure 3.2.7.8. CO₂ emission for 1.A.2.d category in 1988-2024Figure 3.2.7.9. CH₄ and N₂O emissions for 1.A.2.d category in 1988-2024

In 2021 noticeable decrease of CH₄ and N₂O emission is observed, which is connected with a drop of biomass consumption. That emission decrease is the result of relatively high value of default EFs for CH₄ and N₂O in case of solid biomass.

Considerable increase of fuel consumption and GHG emission between 1994 and 1995 results from the methodology change concerning fuel classification in energy balance, which is described in subchapter above (3.2.7.2.3. Chemicals).

3.2.7.2.5. Food processing, beverages and tobacco (CRT sector 1.A.2.e)

The data on fuel type use in the sub-category 1.A.2.e *Food Processing, Beverages and Tobacco* over the 1988-2024 period are presented in table 3.2.7.5. Detailed data on fuel consumption was tabulated in Annex 5.3 (table 8).

Table 3.2.7.5. Fuel consumption in 1988-2024 in 1.A.2.e subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	4.413	3.484	3.084	2.663	2.416	4.741	5.262	7.491
Gaseous Fuels	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839
Solid Fuels	29.280	35.542	35.298	38.886	35.366	59.370	56.721	75.762
Other Fuels	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000

	1988	1989	1990	1991	1992	1993	1994	1995
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082
TOTAL	35.775	41.043	40.443	43.627	40.224	67.436	69.222	87.175
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	8.655	7.941	9.956	10.302	10.741	10.957	11.425	11.458
Gaseous Fuels	15.051	12.927	10.694	9.255	10.494	11.363	12.490	15.075
Solid Fuels	92.241	81.162	66.942	48.201	45.134	41.444	43.486	40.497
Other Fuels	0.000	0.000	0.000	0.000	0.001	0.014	0.000	0.000
Biomass	0.094	0.075	0.104	0.089	0.112	0.104	0.097	0.386
TOTAL	116.041	102.104	87.696	67.847	66.481	63.883	67.498	67.416
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	11.113	10.120	8.738	7.863	7.620	5.612	5.014	4.524
Gaseous Fuels	16.164	17.456	18.623	20.614	20.725	20.950	21.610	22.127
Solid Fuels	37.409	36.898	31.779	32.072	27.427	26.446	26.503	26.123
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.447	0.282	0.311	0.248	0.459	0.301	0.542	0.679
TOTAL	65.133	64.756	59.451	60.796	56.231	53.309	53.670	53.452
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	4.994	3.900	3.482	2.856	3.326	3.405	3.333	2.920
Gaseous Fuels	23.705	24.474	25.093	26.009	27.589	29.944	36.319	35.407
Solid Fuels	26.478	25.085	24.877	22.635	23.201	23.701	23.936	23.864
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.635	0.866	1.097	1.479	1.790	1.494	1.618	1.326
TOTAL	55.812	54.325	54.549	52.979	55.906	58.545	65.207	63.518
	2020	2021	2022	2023	2024			
Liquid Fuels	2.498	2.459	5.246	4.562	3.555			
Gaseous Fuels	34.270	35.687	33.965	36.056	38.749			
Solid Fuels	22.103	21.022	21.008	19.865	20.270			
Other Fuels	0.000	0.000	0.000	0.000	0.000			
Biomass	1.251	0.912	1.587	1.640	1.684			
TOTAL	60.122	60.079	61.807	62.123	64.259			

Figures 3.2.7.10 and 3.2.7.11 show emissions of CO₂, CH₄ and N₂O, respectively in the sub-category 1.A.2.e in the period: 1988-2024.

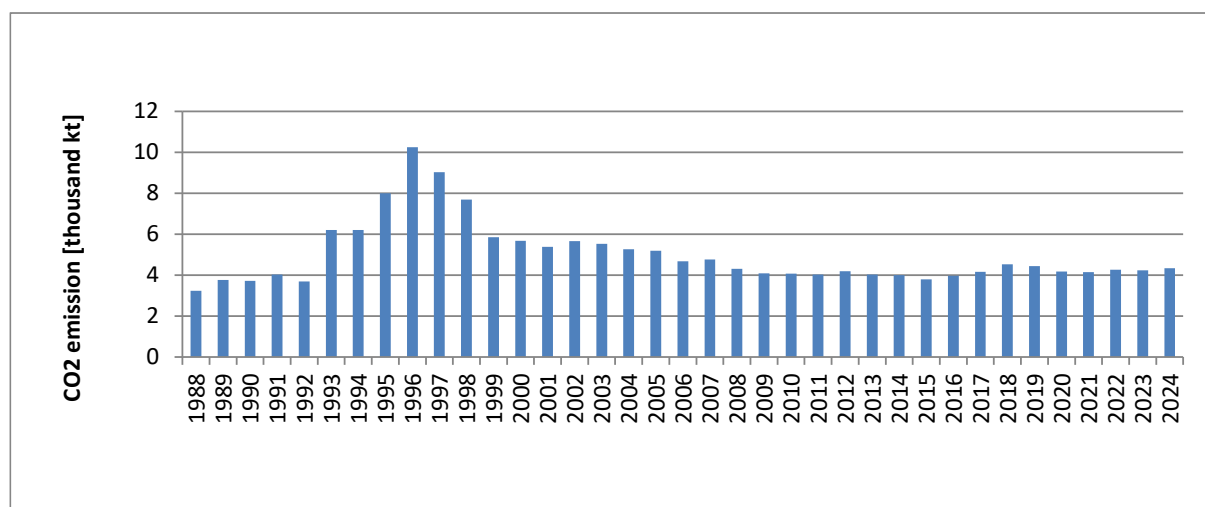
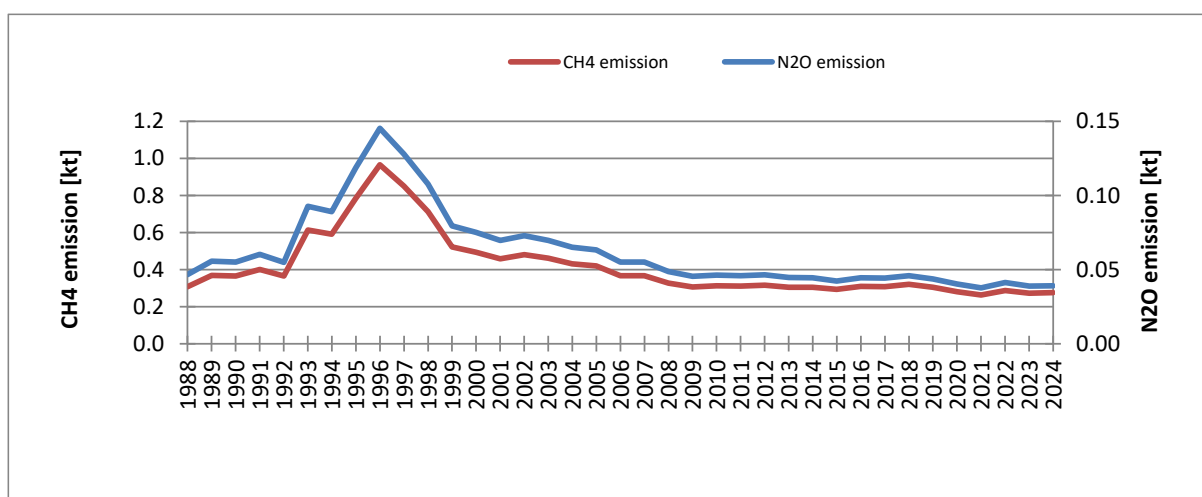


Figure 3.2.7.10. CO₂ emission for 1.A.2.e category in 1988-2024

Figure 3.2.7.11. CH₄ and N₂O emissions for 1.A.2.e category in 1988-2024

3.2.7.2.6. Non-metallic minerals (CRT sector 1.A.2.f)

The data on fuel type use in the sub-category 1.A.2.f *Non-metallic minerals* in the 1988-2024 period are presented in table 3.2.7.6. Detailed data concerning total fuel consumption in 1.A.2.f subcategory was tabulated in Annex 5.3 (table 9).

Table 3.2.7.6. Fuel consumption in 1988-2024 in 1.A.2.f subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	7.321	7.828	5.148	3.645	4.370	4.774	5.404	7.616
Gaseous Fuels	28.729	28.108	24.575	22.704	22.246	21.986	21.506	25.518
Solid Fuels	128.357	123.387	91.506	88.490	83.590	91.020	97.509	92.014
Other Fuels	0.382	0.446	0.068	0.023	0.267	0.250	0.145	0.197
Biomass	1.778	1.924	1.155	0.455	0.042	0.033	0.004	0.010
TOTAL	166.566	161.692	122.451	115.318	110.515	118.062	124.569	125.355
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	5.651	8.591	10.254	8.476	6.073	7.098	8.452	12.748
Gaseous Fuels	26.650	25.655	27.097	23.917	27.977	31.858	33.233	35.584
Solid Fuels	99.333	90.895	77.693	68.849	60.340	46.515	39.067	35.815
Other Fuels	0.144	0.047	0.207	0.529	0.472	0.524	0.508	1.474
Biomass	0.010	0.005	0.006	0.002	0.006	0.275	0.292	0.102
TOTAL	131.788	125.193	115.257	101.773	94.867	86.270	81.552	85.724
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	12.305	14.395	8.819	5.914	6.165	7.209	6.038	4.410
Gaseous Fuels	38.225	38.955	41.274	42.465	39.696	41.394	42.874	44.490
Solid Fuels	38.373	35.025	36.024	49.975	41.253	29.902	32.311	39.070
Other Fuels	1.831	3.418	6.663	7.737	7.778	12.134	14.966	16.746
Biomass	0.261	0.110	0.139	0.117	0.224	0.314	0.422	1.686
TOTAL	90.994	91.903	92.919	106.207	95.117	90.952	96.610	106.402
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	3.652	3.242	2.425	1.981	2.740	3.318	3.876	4.306
Gaseous Fuels	42.350	40.911	40.872	40.516	43.982	44.577	43.117	46.329
Solid Fuels	31.450	27.169	27.917	26.075	24.634	25.996	26.200	24.266
Other Fuels	16.083	16.515	19.231	19.079	25.428	28.126	32.375	33.271
Biomass	1.767	1.893	2.296	2.327	2.643	2.617	2.805	2.447
TOTAL	95.302	89.730	92.740	89.978	99.427	104.635	108.373	110.620
	2020	2021	2022	2023	2024			
Liquid Fuels	2.833	2.924	3.969	5.412	3.832			
Gaseous Fuels	44.359	51.813	45.555	40.718	42.602			
Solid Fuels	21.635	22.513	17.848	13.133	13.489			
Other Fuels	32.509	30.478	31.451	28.979	29.878			
Biomass	2.716	4.087	3.829	4.010	4.015			
TOTAL	104.052	111.814	102.652	92.253	93.816			

Figures 3.2.7.12 and 3.2.7.13 show emissions of CO₂, CH₄ and N₂O, respectively, in the sub-category 1.A.2.f in the period: 1988-2024.

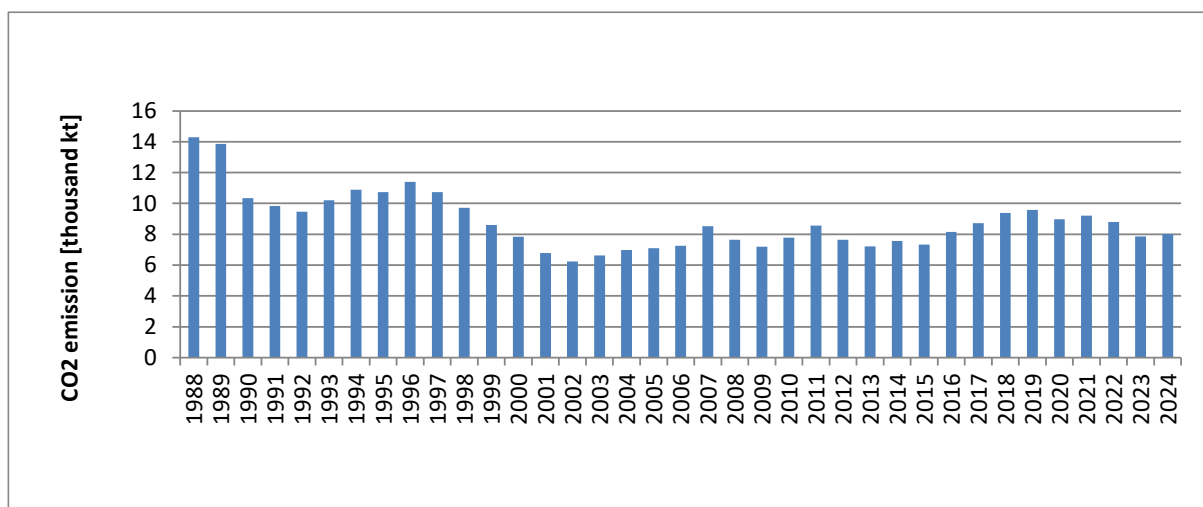


Figure 3.2.7.12. CO₂ emission from 1.A.2.f category in 1988-2024

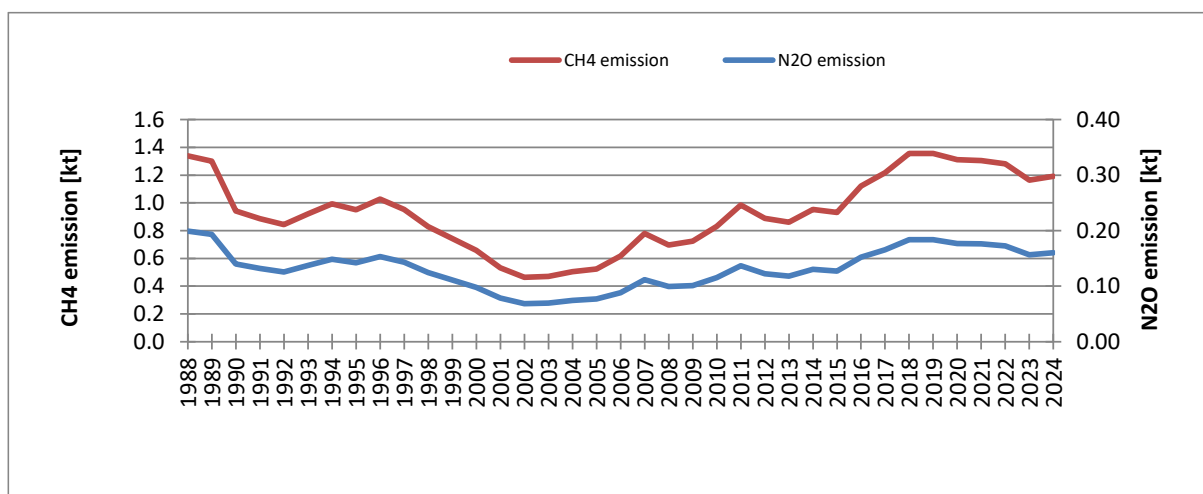


Figure 3.2.7.13. CH₄ and N₂O emissions from 1.A.2.f category in 1988-2024

3.2.7.2.7. Other (1.A.2.g)

The GHG emission was estimated for sub-categories as follows:

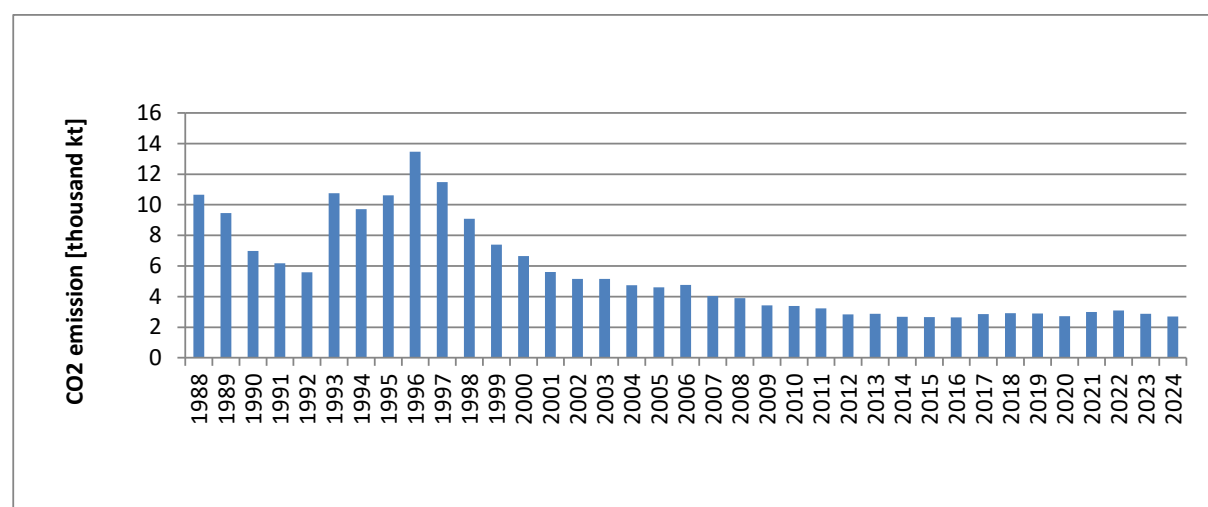
- *Manufacturing of machinery* - 1.A.2.g.i
- *Manufacturing of transport equipment* - 1.A.2.g.ii
- *Mining (excluding fuels) and quarrying* - 1.A.2.g.iii
- *Wood and wood products* - 1.A.2.g.iv
- *Construction* - 1.A.2.g.v
- *Textile and leather* - 1.A.2.g.vi
- *Other* - 1.A.2.g.vii

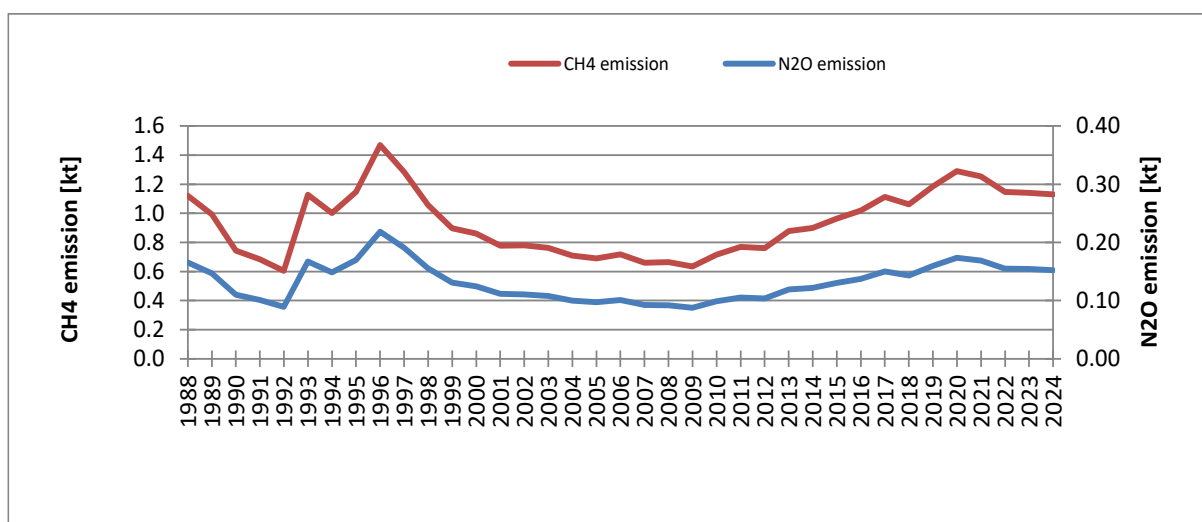
The data on fuel type use in stationary sources in the category 1.A.2.g *Other* over the 1988-2024 period are presented in table 3.2.7.7. Detailed data concerning total fuel consumption in 1.A.2.g subcategory was tabulated in Annex 5.3 (table 10).

Table 3.2.7.7. Fuel consumption in 1988-2024 in stationary sources of 1.A.2.g subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	19.848	18.040	13.880	12.097	10.890	12.337	11.787	15.025
Gaseous Fuels	24.039	22.347	15.645	11.756	13.811	17.922	17.337	15.177
Solid Fuels	82.038	72.062	53.343	48.237	41.225	91.821	79.959	86.995
Other Fuels	0.082	0.058	0.022	0.012	0.134	0.298	1.593	2.294
Biomass	8.335	7.545	5.826	5.518	5.035	4.995	3.410	4.970
TOTAL	134.342	120.051	88.715	77.619	71.095	127.373	114.085	124.461
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	22.954	22.267	19.010	16.773	16.626	14.485	14.109	14.561
Gaseous Fuels	14.210	16.061	17.640	16.352	18.545	18.320	19.273	21.156
Solid Fuels	111.176	92.291	67.499	52.974	43.040	34.317	28.834	26.923
Other Fuels	2.675	1.133	2.080	1.482	2.075	1.802	2.078	2.503
Biomass	6.520	8.195	8.233	8.604	10.105	10.716	12.300	11.897
TOTAL	157.534	139.948	114.462	96.185	90.391	79.640	76.594	77.040
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	14.254	15.158	15.512	12.955	11.878	11.546	11.693	11.647
Gaseous Fuels	22.582	23.324	23.290	23.540	26.264	22.861	24.965	23.874
Solid Fuels	23.460	20.769	18.945	17.440	14.873	11.715	11.889	10.918
Other Fuels	1.661	1.700	3.789	0.938	1.154	1.392	0.070	0.052
Biomass	12.184	12.193	11.626	13.240	14.044	14.007	17.901	20.051
TOTAL	74.141	73.144	73.162	68.112	68.214	61.521	66.518	66.542
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	10.234	8.765	9.613	8.396	8.478	8.857	9.216	9.789
Gaseous Fuels	23.020	26.035	23.394	22.751	24.488	26.750	27.581	27.911
Solid Fuels	8.149	7.961	7.010	7.901	6.959	7.581	7.394	6.696
Other Fuels	0.069	0.098	0.064	0.045	0.037	0.105	0.107	0.050
Biomass	20.854	24.842	25.929	27.981	30.076	32.873	31.115	35.469
TOTAL	62.326	67.702	66.011	67.075	70.038	76.166	75.412	79.914
	2020	2021	2022	2023	2024			
Liquid Fuels	8.802	9.440	10.799	11.564	10.212			
Gaseous Fuels	27.473	30.170	27.690	26.122	26.153			
Solid Fuels	5.850	6.649	7.804	5.628	4.926			
Other Fuels	0.043	0.117	0.122	0.144	0.131			
Biomass	39.353	37.724	33.719	34.227	34.142			
TOTAL	81.521	84.101	80.134	77.685	75.563			

Figures 3.2.7.14 and 3.2.7.15 show emissions of CO₂, CH₄ and N₂O, respectively in the 1.A.2.g category in the period: 1988-2024.

Figure 3.2.7.14. CO₂ emission from 1.A.2.g category in 1988-2024

Figure 3.2.7.15. CH₄ and N₂O emissions from 1.A.2.g category in 1988-2024

3.2.7.3. Uncertainties and time-series consistency

See chapter 3.2.6.3.

3.2.7.4. Source-specific QA/QC and verification

See chapter 3.2.6.4.

3.2.7.5. Source-specific recalculations

GHG emission was recalculated for 2023 as the result of correction in diesel oil consumption in energy balance in EUROSTAT database. The total decrease in diesel consumption after correction in category 1.A.2 in 2023 is approximately 10 PJ, with a decline of more than 7 PJ in subcategory 1.A.2.g.

Additional insignificant changes starting from 2010 are related to adjustments in natural gas consumption in updated statistical data as well in fuel oil use for 2023.

Table 3.2.7.8. Changes of GHG emission values in 1.A.2 subcategory as a result of recalculations

Changes	1988	1989	1990	1991	1992	1993	1994	1995	1996
CO ₂									
kt	0.00	0.00	0.00	3.21	12.84	22.47	12.84	77.05	48.16
%	0.00	0.00	0.00	0.01	0.04	0.05	0.03	0.12	0.07
CH ₄									
kt	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.003	0.002
%	0.00	0.00	0.00	0.00	0.02	0.02	0.01	0.05	0.03
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
%	0.00	0.00	0.00	0.01	0.02	0.03	0.02	0.07	0.04
Changes	1997	1998	1999	2000	2001	2002	2003	2004	2005
CO ₂									
kt	86.68	22.47	12.84	16.05	6.42	6.42	0.00	0.00	3.21
%	0.14	0.04	0.03	0.04	0.02	0.02	0.00	0.00	0.01
CH ₄									
kt	0.004	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
%	0.06	0.02	0.01	0.02	0.01	0.01	0.00	0.00	0.00

N ₂ O									
kt	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.08	0.03	0.02	0.02	0.01	0.01	0.00	0.00	0.01
Changes	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO ₂									
kt	0.00	0.00	0.00	0.00	0.196	-0.351	0.208	-0.082	-0.151
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂									
kt	0.311	-0.267	0.387	0.000	0.000	0.000	0.000	0.000	-753.367
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.88
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.031
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.76
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.006
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.10

3.2.7.6. Source-specific planned improvements

No improvements are planned at the moment.

3.2.8. Transport (CRT sector 1.A.3)

3.2.8.1. Source category description

Estimation of emissions in 1.A.3 *Transport* are carried out for each fuel in sub-categories listed below:

- a) *Civil Aviation* (1.A.3.a),
- b) *Road Transportation* (1.A.3.b),
- c) *Railways* (1.A.3.c),
- d) *Navigation* (1.A.3.d),
- e) *Other Transportation* (1.A.3.e).

The share of that sector in total GHG emission in 2024 amounts to 20.5%. Road transport is by far the largest contributor to transport emissions (see figure 3.2.8.1) – with the share of 99.2% in year 2024.

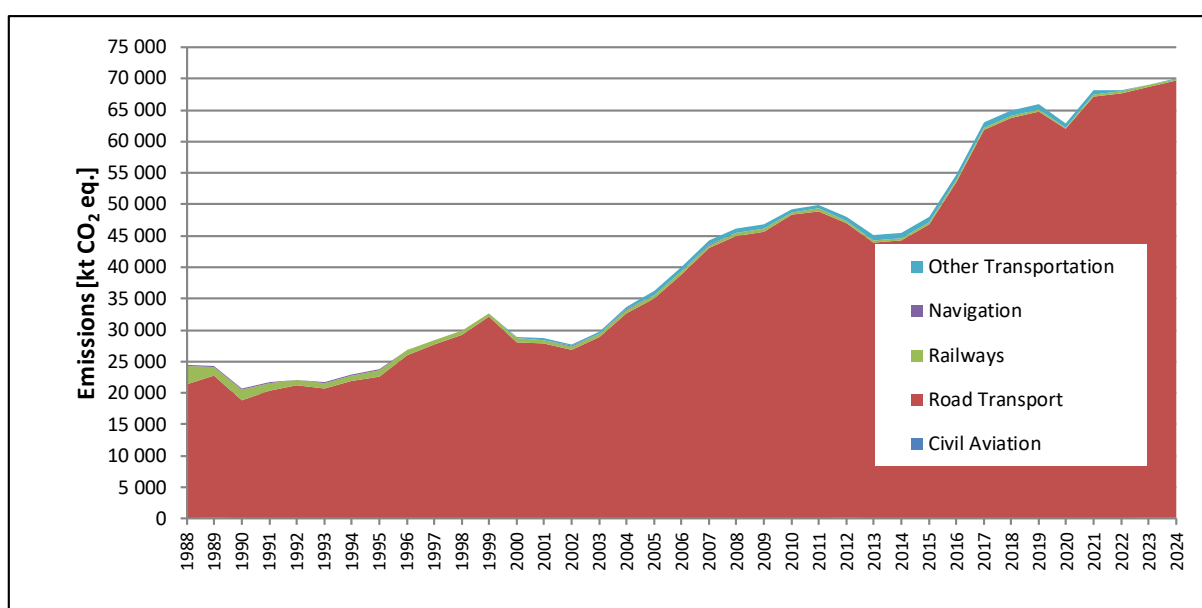


Figure 3.2.8.1. Emissions from transport in years 1988-2024

3.2.8.2. Methodological issues

The methodology used for estimation of GHG emissions in the national inventory for mobile non-road sources for the entire time series 1988-2024 is factor based – data on fuel used are multiplied by the corresponding emission factors. All emission factors for non-mobile sources were taken from IPCC 2006 guidelines and have constant values over the entire time series 1988-2024.

GHG emissions from sector 1.A.3.b *Road transport* have been calculated with the use of software COPERT 5, and all emission factors are default values from this model.

3.2.8.2.1. Civil Domestic Aviation (CRT sector 1.A.3.a)

This category includes emissions from passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.) and excludes use of fuel at airports for ground transport, fuel for stationary combustion at airports.

All military activities based on fuel used are incorporated in country energy balance underlying the national inventory in energy sector. No specific individual data related to military share is

available for confidential purposes.

For the years 1990-2024 data related to aviation gasoline and jet kerosene are those from the Eurostat database, while for the base year and 1989 – those of the IEA database.

Jet kerosene given in Polish statistics is reported as International aviation although it includes the whole amount of jet kerosene used for domestic and international purposes. To split jet kerosene, Eurocontrol data were used. Each year, under the contract with the European Commission's Directorate-General for Climate Action, EUROCONTROL calculates the mass of fuel burnt by civil aviation flights starting from and/or landing at airports in the Member States of the European Union (EU). This work is done in support of both the European Environment Agency (EEA) and the Member States of the EU. The calculation is made with the split on domestic and international aviation. The total amount of jet kerosene used in Poland, calculated by Eurocontrol is similar to this reported by Poland to Eurostat. To be consistent with Eurostat database (and Polish statistics) only the percentage ratio between domestic and international fuel use were used based on Eurocontrol data. Eurocontrol data of jet kerosene used in Poland and the share of domestic and international use of this fuel are given in the table below.

Table 3.2.8.1. Eurocontrol data of jet kerosene used in Poland and the share of domestic and international use for years 2005-2024

Eurocontrol		2005	2006	2007	2008	2009	2010	2011
Domestic	kt	21.86	24.78	26.94	26.16	24.30	28.61	31.43
International	kt	303.44	383.80	455.51	516.92	456.41	481.94	483.51
Total	kt	325.30	408.58	482.44	543.08	480.71	510.55	514.93
Eurostat	kt	311	415	432	519	470	495	485
Share								
Domestic	%	6.72	6.07	5.58	4.82	5.05	5.60	6.10
International	%	93.28	93.93	94.42	95.18	94.95	94.40	93.90
Total	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Eurocontrol		2012	2013	2014	2015	2016	2017	2018
Domestic	kt	45.75	34.21	38.84	34.36	34.21	36.89	35.78
International	kt	499.64	526.34	559.45	596.54	679.55	1266.92	1457.94
Total	kt	545.39	560.55	598.28	630.90	713.76	1303.81	1493.72
Eurostat	kt	537	524	590	646	685	852	1 008
Share								
Domestic	%	8.39	6.10	6.49	5.45	4.79	2.83	2.40
International	%	91.61	93.90	93.51	94.55	95.21	97.17	97.60
Total	%	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Eurocontrol		2019	2020	2021	2022	2023	2024	
Domestic	kt	35.34	17.65	18.98	34.65	41.67	40.51	
International	kt	1529.36	603.11	785.77	864.35	1063.44	1181.97	
Total	kt	1564.71	620.76	804.75	899.00	1105.11	1222.48	
Eurostat	kt	1 077	459	574	978	1 189	1 340	
Share								
Domestic	%	2.26	2.84	2.36	3.85	3.77	3.31	
International	%	97.74	97.16	97.64	96.15	96.23	96.69	
Total	%	100.00	100.00	100.00	100.00	100.00	100.00	

Due to the lack of Eurocontrol data for the years before 2005, the share of domestic use for years 1988-2004 was assumed as a 5-years average from Eurocontrol data for years 2005-2009. The 5-years average was evaluated as the most representative in consultations with experts in the area of transport and energy. The 5.65% share of domestic use was then accepted for the whole period before 2005. Such assumption seems to be reliable and not affecting accuracy of the inventory.

Emission factors for the estimation of GHG emissions from domestic aviation are default values from the IPCC 2006 guidelines (table 3.2.8.2).

Table 3.2.8.2. Emission factors for domestic aviation [kg/GJ]

EFs	CO ₂	CH ₄	N ₂ O
Aviation gasoline	70.00	0.0005	0.002
Jet kerosene	71.50	0.0005	0.002

Emissions from aviation come from the combustion of jet fuel and aviation gasoline. Data on fuel use in domestic aviation are shown in table 3.2.8.3 and figure 3.2.8.2. Figures 3.2.8.3 and 3.2.8.4 show emissions of CO₂, CH₄ and N₂O, respectively in the sub-category 1.A.3.a in the period 1988-2024.

Between 1988 and early 1990-ties dramatic decrease in fuel consumption and heavy industry production occurred triggered by significant economic changes related to political transformation from centralized to market economy. These changes affected all energy sectors and this is the main reason why Poland choose 1988 as a base year (as being more representative in trend than 1990 with collapsing industry).

Table 3.2.8.3. Fuel consumption and GHG emission in years 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Aviation gasoline	TJ	879.98	836.02	354.40	221.50	88.60	177.20	443.00	310.10	177.20	265.80
Jet kerosene	TJ	847.61	1 165.76	535.52	552.96	600.28	597.79	605.26	652.59	767.17	687.46
CO ₂ emission	kt	122.20	141.87	63.10	55.04	49.12	55.15	74.29	68.37	67.26	67.76
CH ₄ emission	kt	0.001	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
N ₂ O emission	kt	0.003	0.004	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Aviation gasoline	TJ	177.20	132.90	132.90	132.90	177.20	177.20	132.90	132.90	132.90	177.20
Jet kerosene	TJ	699.91	625.19	665.04	655.08	642.63	694.93	682.48	921.68	1 110.10	1 063.65
CO ₂ emission	kt	62.45	54.00	56.85	56.14	58.35	62.09	58.10	75.20	88.68	88.45
CH ₄ emission	kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
N ₂ O emission	kt	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aviation gasoline	TJ	132.90	176.00	176.00	220.00	220.00	176.00	220.00	176.00	176.00	146.87
Jet kerosene	TJ	1 102.45	1 021.55	1 192.72	1 272.73	1 936.91	1 375.08	1 646.86	1 512.94	1 411.78	1 036.05
CO ₂ emission	kt	88.13	85.36	97.60	106.40	153.89	110.64	133.15	120.49	113.26	84.36
CH ₄ emission	kt	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
N ₂ O emission	kt	0.002	0.002	0.003	0.003	0.004	0.003	0.004	0.003	0.003	0.002
		2018	2019	2020	2021	2022	2023	2024			
Aviation gasoline	TJ	175.91	175.91	158.40	167.20	171.95	91.87	249.08			
Jet kerosene	TJ	1 037.91	1 045.71	561.53	582.50	1 627.48	1 931.42	1 917.65			
CO ₂ emission	kt	86.52	87.08	51.24	53.35	128.40	144.53	154.55			
CH ₄ emission	kt	0.001	0.001	0.000	0.000	0.001	0.001	0.001			
N ₂ O emission	kt	0.002	0.002	0.001	0.001	0.004	0.004	0.004			

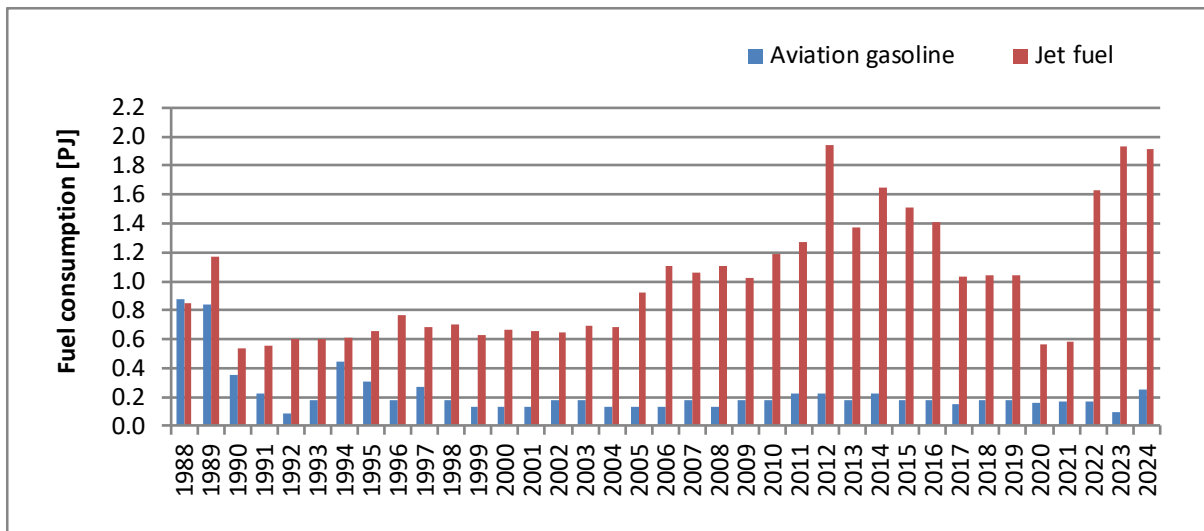
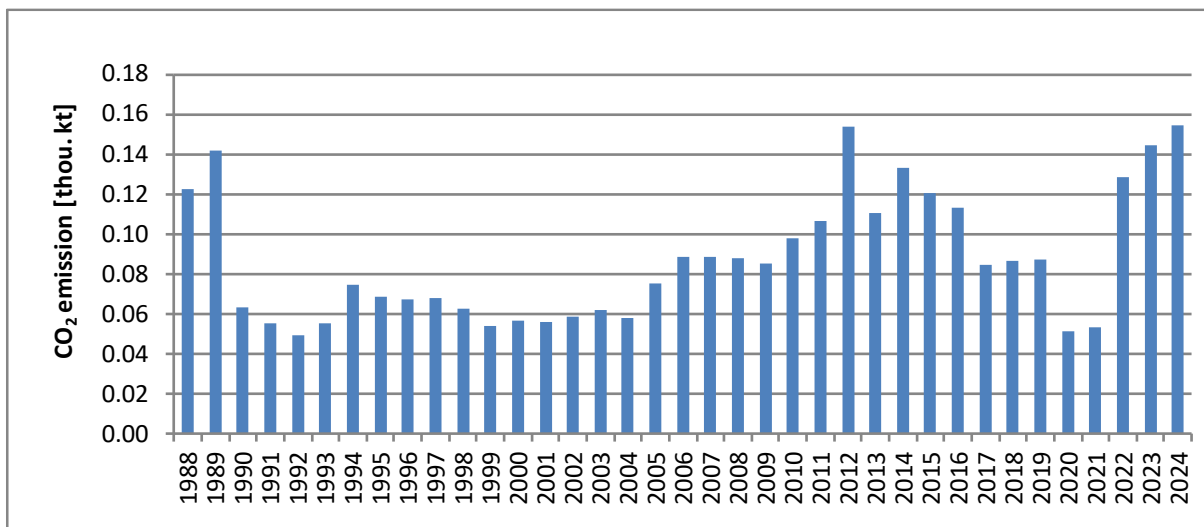
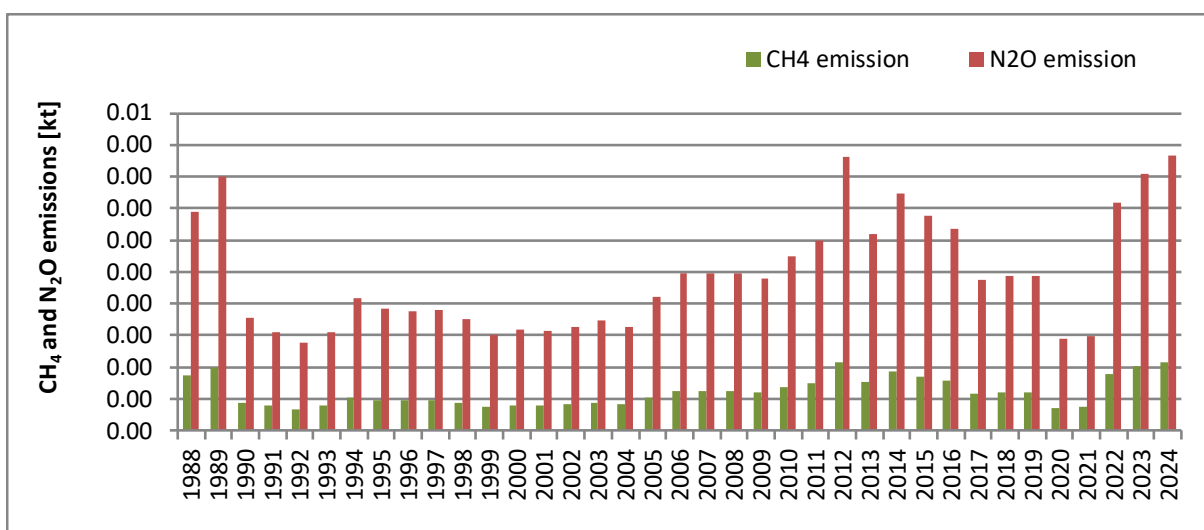


Figure 3.2.8.2. Fuel consumption in 1.A.3.a category for 1988-2024

Figure 3.2.8.3. CO₂ emission for 1.A.3.a category in 1988-2024Figure 3.2.8.4. CH₄ and N₂O emissions for 1.A.3.a category in 1988-2024

3.2.8.2.2. Road Transportation (CRT sector 1.A.3.b)

This category includes emissions from all types of motor vehicles such as: passenger cars, light

and heavy duty vehicles, buses, motorcycles and mopeds. Poland applied COPERT software to the official reporting of national road transport emissions. COPERT 5 is a complex modelling software aiming at the calculation of air pollutant emissions from road transport and using the methodology of the EMEP/EEA Air Pollutant Emission Inventory Guidebook. Application of the COPERT model allows to estimate emissions in accordance with the requirements of international and EU legislation.

Calculations for the years 1988-2024 was made by model COPERT 5 version 5.8.1. All emission factors are default values from COPERT 5.

Emission estimates from this category are based on:

- fuel consumption,
- number of vehicles per vehicle category, engine size or vehicle weight and emission control technology,
- the mileage per vehicle class,
- mileage share per road class (urban, rural and highways),
- the average speed per vehicle type and per road class,
- monthly temperature (min and max),
- fuel characteristics.

Data on fuel consumption for years 1990-2024 comes from Eurostat database, and for years 1988-1989 – from IEA. Consumption of each type of fuel (used in road transport) in statistics is given without distinguishing on individual vehicle type. Therefore, for the purpose of this report fuel consumption was disaggregated based on COPERT 5 calculations – mass of statistical and calculated fuel consumption is equal. Table 3.2.8.4 shows fuel consumption, implied emission factors and GHG emissions in 2024 by main vehicle categories.

Table 3.2.8.4. Fuel consumption, emission factors and GHG emissions in 2024 by vehicle categories

Vehicle category by fuel type	Fuel consumption TJ	Implied emission factors			Emissions		
		CO ₂ (t/TJ)	CH ₄ (kg/TJ)	N ₂ O (kg/TJ)	CO ₂ kt	CH ₄ kt	N ₂ O kt
Passenger cars	517 947.18				35 293.59	2.09	0.88
Gasoline	215 722.24	72.24	5.05	0.69	15 583.55	1.09	0.15
Diesel oil	190 879.02	74.24	0.48	2.86	14 169.97	0.09	0.55
Liquefied petroleum gases	84 180.00	64.93	9.44	1.57	5 466.03	0.79	0.13
Gaseous fuels (CNG)	547.21	57.15	9.80	0.57	31.27	0.01	0.00
Biomass	26 058.09	70.96	4.21	2.13	1 849.07	0.11	0.06
Other Fossil Fuels*	560.63	76.28	0.55	3.29	42.76	0.00	0.00
Light duty trucks	124 820.69				8 679.85	0.08	0.22
Gasoline	7 326.74	72.30	5.19	1.14	529.73	0.04	0.01
Diesel oil	109 457.22	74.24	0.30	1.79	8 125.60	0.03	0.20
Biomass	7 715.25	75.43	0.79	2.04	581.98	0.01	0.02
Other Fossil Fuels*	321.49	76.28	0.35	2.06	24.52	0.00	0.00
Heavy duty trucks and buses	352 362.30				24 514.70	0.51	1.30
Diesel oil	327 859.00	74.24	1.20	3.64	24 338.73	0.39	1.19
Gaseous fuels (CNG)	1 793.67	57.15	48.48	4.92	102.51	0.09	0.01
Biomass	21 746.68	76.01	1.38	4.19	1 652.93	0.03	0.09
Other Fossil Fuels*	962.95	76.28	1.38	4.19	73.45	0.00	0.00
Motorcycles and mopeds	3 858.86				258.68	0.22	0.01
Gasoline	3 633.22	71.20	54.95	1.28	258.68	0.20	0.00
Biomass	225.64	65.23	83.52	1.94	14.72	0.02	0.00

* fossil part of biodiesel

The number of vehicles per vehicle category, engine size or weight and emission control technology comes from Polish Central Vehicle and Driver Register system (CEPiK) and Statistics Poland [GUS]. The amount of vehicles according to categories and fuel type is shown in figure below.

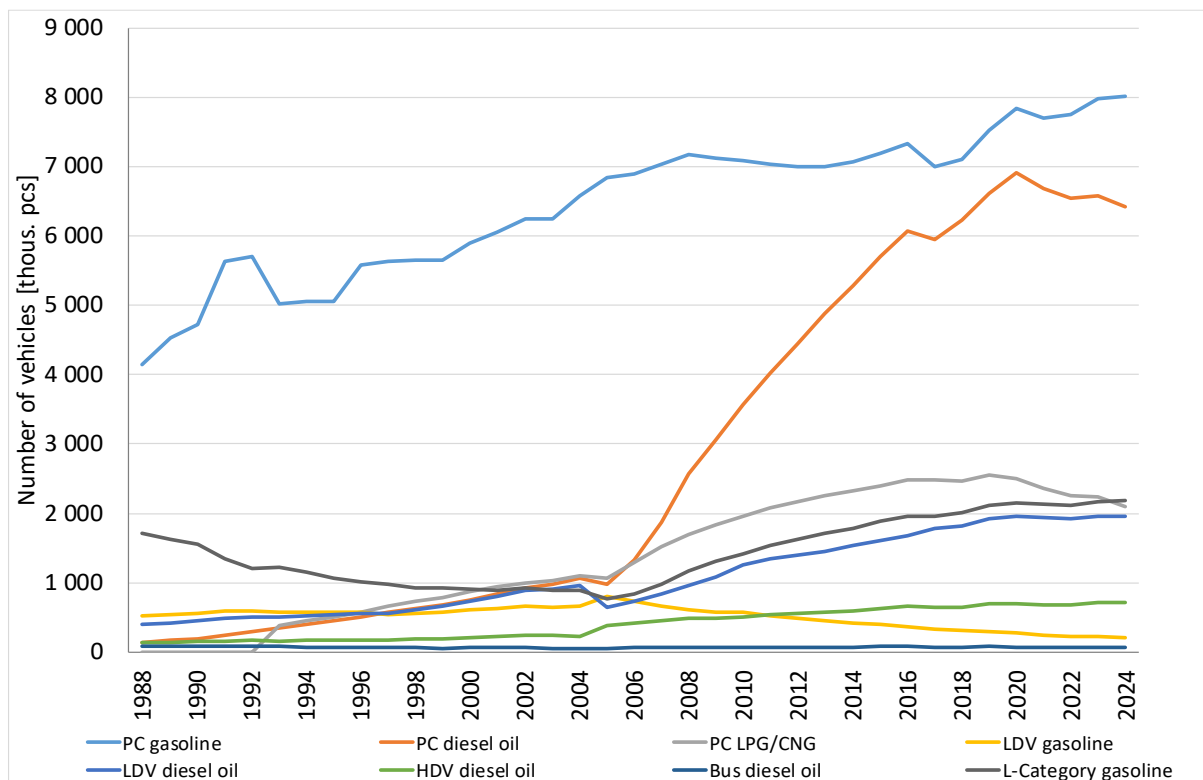


Figure 3.2.8.5. Number of vehicles in years 1988-2024

Average annual mileage for main vehicle categories in 2024 are presented in figure 3.2.8.6. Mileage share and speed per road class are shown in figures 3.2.8.7-8. The mileage comes from Polish Central Vehicle and Driver Register system (CEPiK).

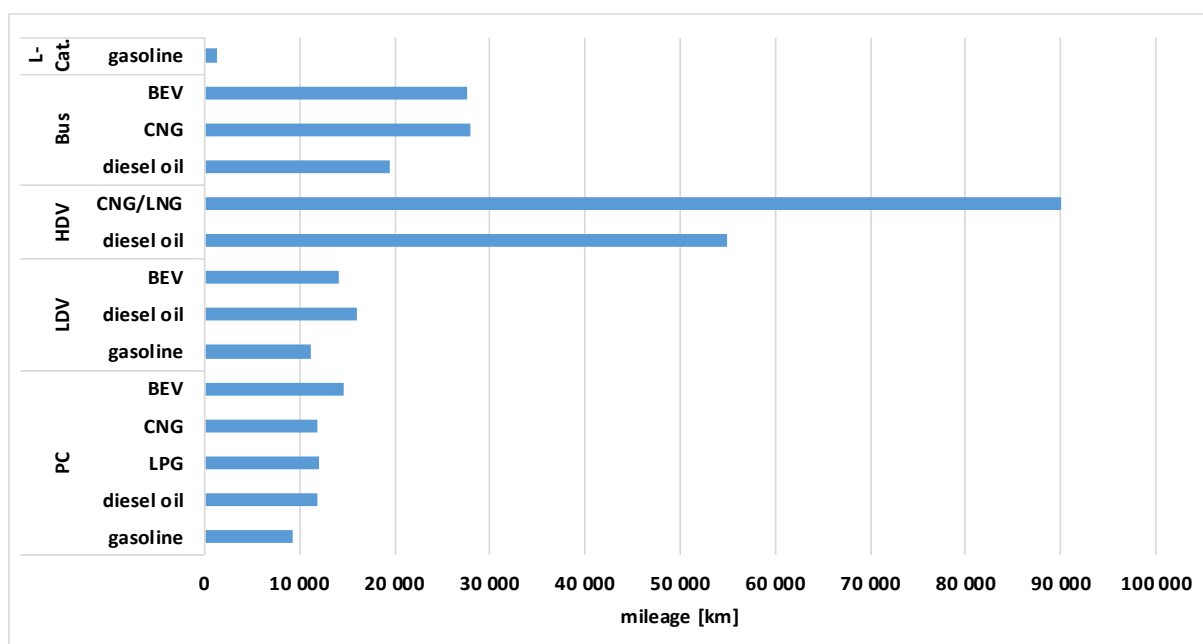


Figure 3.2.8.6. Average annual mileage driven by vehicles in 2024

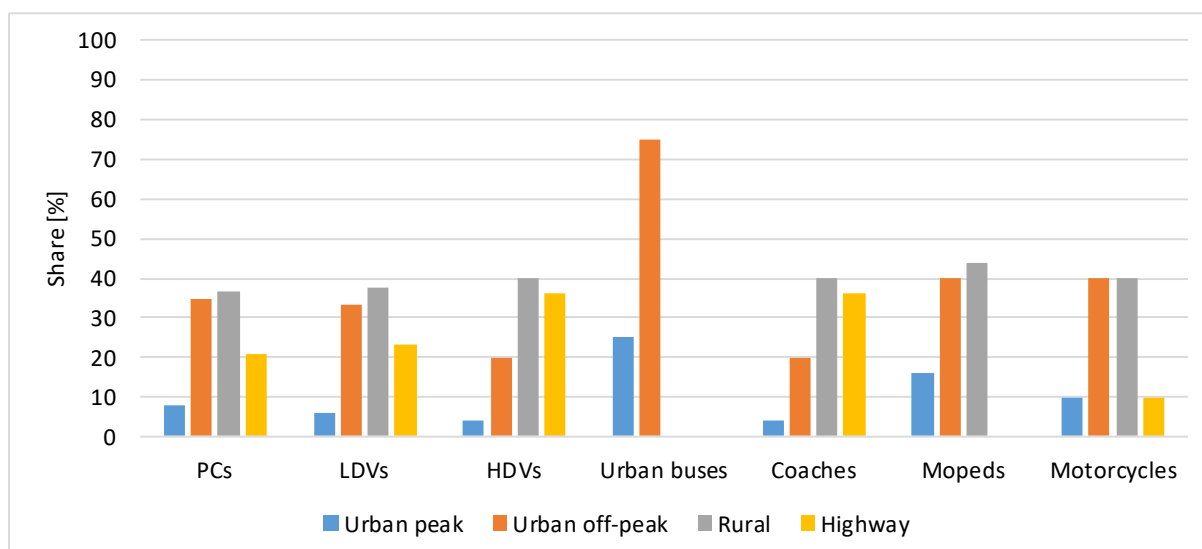


Figure 3.2.8.7. Mileage share per road class (Urban peak, Urban off-peak, Rural and Highways) in 2024

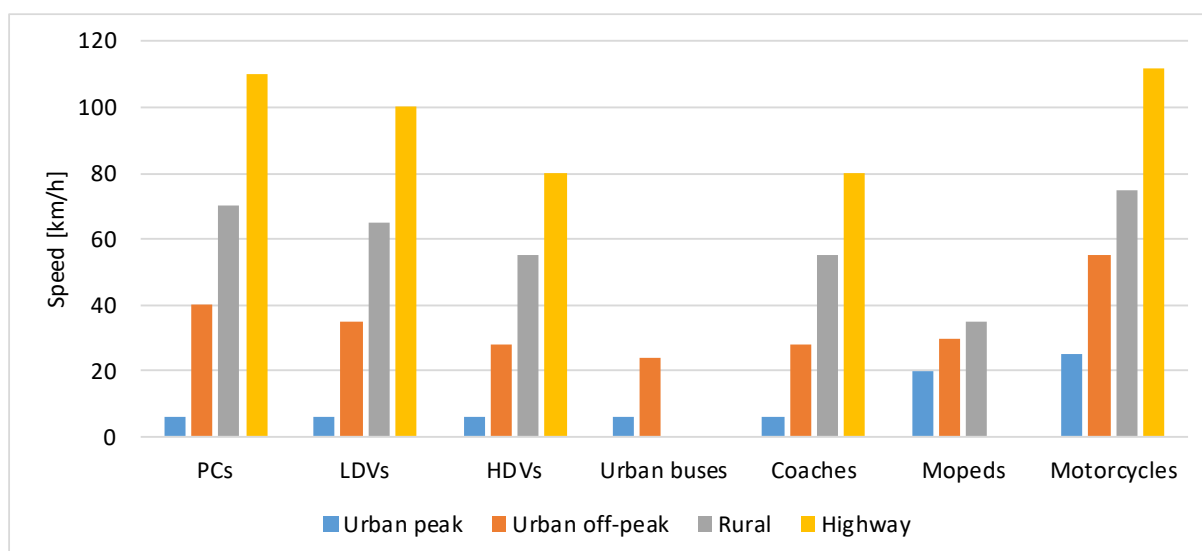


Figure 3.2.8.8. The average speed per road class (Urban peak, Urban off-peak, Rural and Highways) in 2024

Consumption of main fuels in road transport (gasoline, diesel oil and LPG) and GHG emissions in 1988-2024 period is shown in table 3.2.8.5.

Following the 2006 IPCC GLs (volume 2, chapter 3, section "CO₂ emissions from biofuels" on page 3.17) where recommendation is made to assess possible content of carbon in biofuels (and the associated CO₂ emissions) having a fossil origin, additional analysis was made to investigate and separate such fraction and results are presented in this submission.

Taking into account the "Act of the biocomponents and liquid biofuels", which has been in force since 2006, the following definitions of biomass and bio-components are given:

- biomass – biodegradable parts of products, waste or residues of biological origin from agriculture, including plant and animal substances, forestry and fishing, and related industries, including fish breeding and aquaculture, as well as the biodegradable fraction of industrial and municipal waste, including installations for biodegradable part of industrial and municipal waste, including waste from waste management

installations as well as water and sewage treatment facilities treatment;

- bio-components – bioethanol, biomethanol, biobutanol, ester, dimethyl bioether, pure vegetable oil, liquid bio-hydrocarbons, bio-propane-butane, bio propane, liquefied biomethane, compressed biomethane and biohydrogen, which are made of biomass for the production of liquid fuels, excluding other renewable biofuels.

In Poland, all fuels used in GHG emissions estimation in 1.A.3.b sector are those identified as liquid biofuels, which in the act are defined as following:

- gasoline containing more than 10.0% by volume of biocomponents or more than 22.0% by volume of ethers referred to: bioethanol (it is ethanol produced from biomass, including bioethanol contained in ethyl-tert-butyl vinegar or ethyl-tert-amyl ether; biomethane for the production of bioethanol is not considered to be ethyl alcohol containing more than 96% by volume of alcohol), excluding motor fuels containing liquid bio-hydrocarbons (according to the definition, liquid bio-hydrocarbons are liquid hydrocarbons or their mixtures produced from biomass in chemical and biochemical processes, including hydrated oils and synthetic hydrocarbons produced by the Fisher-Tropsch method),
- diesel fuel containing more than 7% by volume of biocomponents, excluding diesel fuel containing liquid bio-hydrocarbons,
- bioethanol, biomethanol, biobutanol, ester, dimethyl bioether, pure vegetable oil, liquid bio-hydrocarbons, bio-propane-butane, liquefied biomethane, compressed biomethane and biohydrogen – constituting spontaneous fuels.

Additionally COPERT model, which is used to calculate emissions from road transport in Poland, takes into account the identification and separation biogenic and fossil feedstock involved in the production process. According to the model information the biodiesel (FAME) produced from coal methanol and vegetable oil has a non-zero fossil fuel fraction, thus not entirely carbon neutral fuel. That's why depending on the production pathway, fossil fuel carbon content is about 5.5%.

Taking into account all information described above, the biofuels used in Poland the fossil part of biofuels occurs only in biodiesel. The regulation of the Minister of Economy *on the quality requirements for biocomponents, methods of testing the quality of biocomponents and the method of sampling biocomponents*, and also the biodiesel standard EN 14214 requires a minimum content of methyl esters of 96.5% (m/m) in FAME. Activity data and emissions related to fossil part of biodiesel are reported on CRT tables (as Other Fossil Fuels).

Table 3.2.8.5. Fuel consumption and GHG emission in years 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Motor gasoline	PJ	130.33	144.36	134.32	156.69	166.17	169.76	187.88	190.45	199.08	214.99
Diesel oil	PJ	155.40	161.03	118.12	117.05	118.42	108.10	101.65	105.14	136.78	139.58
LPG	PJ	0.00	0.00	0.00	0.00	0.00	1.14	3.36	8.32	11.97	15.89
Biodiesel	PJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bioetanol	PJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO₂ emission	kt	20 915	22 338	18 427	19 962	20 742	20 324	21 292	22 064	25 281	26 893
CH₄ emission	kt	5.70	6.13	5.53	6.19	6.55	6.55	6.93	6.87	7.06	7.29
N₂O emission	kt	0.59	0.63	0.52	0.56	0.65	0.74	0.98	1.25	1.61	1.86
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Motor gasoline	PJ	219.20	243.83	219.73	203.82	186.64	178.26	180.97	174.67	179.19	178.93
Diesel oil	PJ	155.70	162.45	135.11	140.91	135.15	164.56	201.46	230.35	269.40	323.96
LPG	PJ	16.56	22.09	20.10	27.72	39.21	50.61	63.43	73.27	80.41	82.78
Biodiesel	PJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	1.22	0.93
Bioetanol	PJ	0.00	0.00	0.00	0.00	0.00	1.19	0.57	1.43	2.32	3.02

CO ₂ emission	kt	28 441	31 079	27 175	26 966	26 040	28 357	32 126	34 455	38 144	42 331
CH ₄ emission	kt	7.09	7.55	6.52	5.47	4.99	4.90	5.08	5.13	5.38	5.41
N ₂ O emission	kt	2.17	2.72	2.61	2.63	2.50	1.24	1.34	1.37	1.48	1.59
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Motor gasoline	PJ	176.80	179.78	177.66	168.03	160.83	153.23	148.02	152.99	161.59	176.64
Diesel oil	PJ	353.37	365.97	402.82	421.92	401.95	369.44	379.22	407.38	484.27	578.10
LPG	PJ	81.31	76.04	76.36	73.97	73.88	73.28	73.83	74.98	79.40	84.25
CNG/LNG	PJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.61	0.47
Biodiesel	PJ	12.73	16.20	20.35	22.43	26.61	25.03	23.61	20.87	11.95	17.95
Bioethanol	PJ	5.35	7.05	7.10	6.73	5.79	6.03	5.56	6.43	7.02	7.38
CO ₂ emission	kt	44 305	45 126	47 747	48 317	46 323	43 317	43 691	46 248	52 836	61 220
CH ₄ emission	kt	5.38	5.01	4.60	4.32	4.00	3.62	4.03	3.79	3.62	3.86
N ₂ O emission	kt	1.60	1.38	1.47	1.50	1.45	1.37	1.42	1.49	1.69	1.95
		2018	2019	2020	2021	2022	2023	2024			
Motor gasoline	PJ	183.67	189.90	176.97	195.69	207.31	217.53	226.68			
Diesel oil	PJ	592.50	598.36	581.16	629.14	621.46	623.08	628.20			
LPG	PJ	85.39	89.01	79.81	83.49	86.48	86.94	84.18			
CNG/LNG	PJ	0.53	0.72	0.82	1.16	1.17	1.64	2.34			
Biodiesel	PJ	30.93	33.38	35.05	35.04	37.30	43.63	43.51			
Bioethanol	PJ	7.24	7.84	7.66	8.71	9.71	10.20	14.08			
CO ₂ emission	kt	62 914	64 054	61 256	66 435	66 907	67 844	68 747			
CH ₄ emission	kt	3.68	3.51	3.03	3.12	3.01	2.99	2.90			
N ₂ O emission	kt	2.09	2.15	2.10	2.28	2.30	2.36	2.41			

Generally the trend of consumption of biofuels in road transport is growing gradually – the share in 2024 accounted for 5.8%. The amounts of biofuels used in the years 1988-2024 are given in Table 3.2.8.5. Since the consumption of biofuels in item 1.A.3.b is not significant compared to the consumption of other fuels, it is not shown in the figure 3.2.8.9.

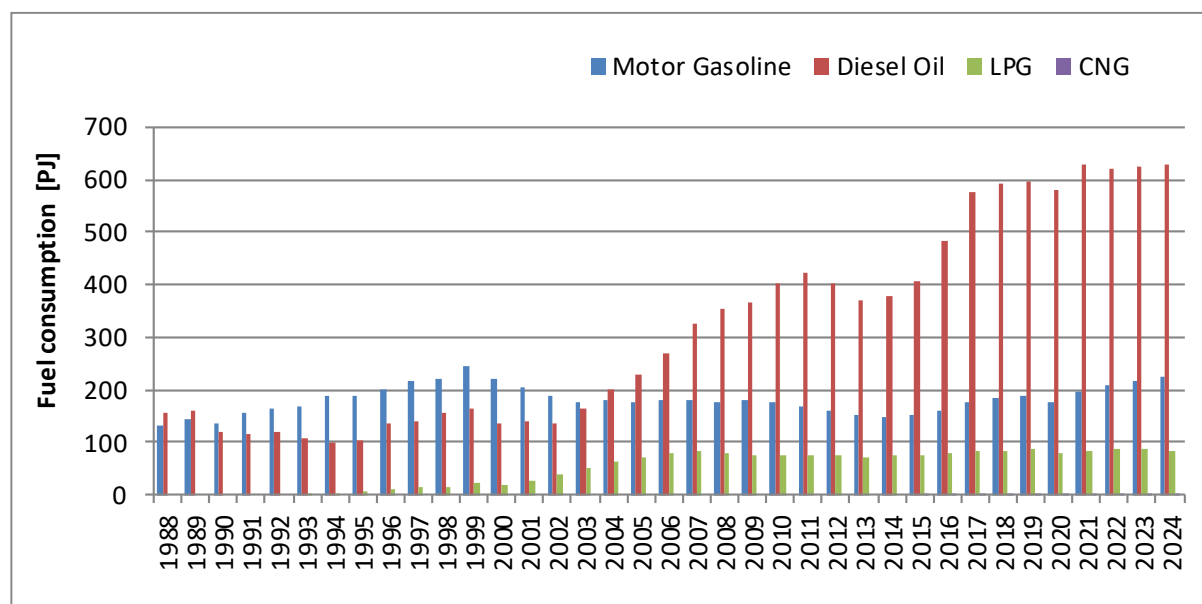
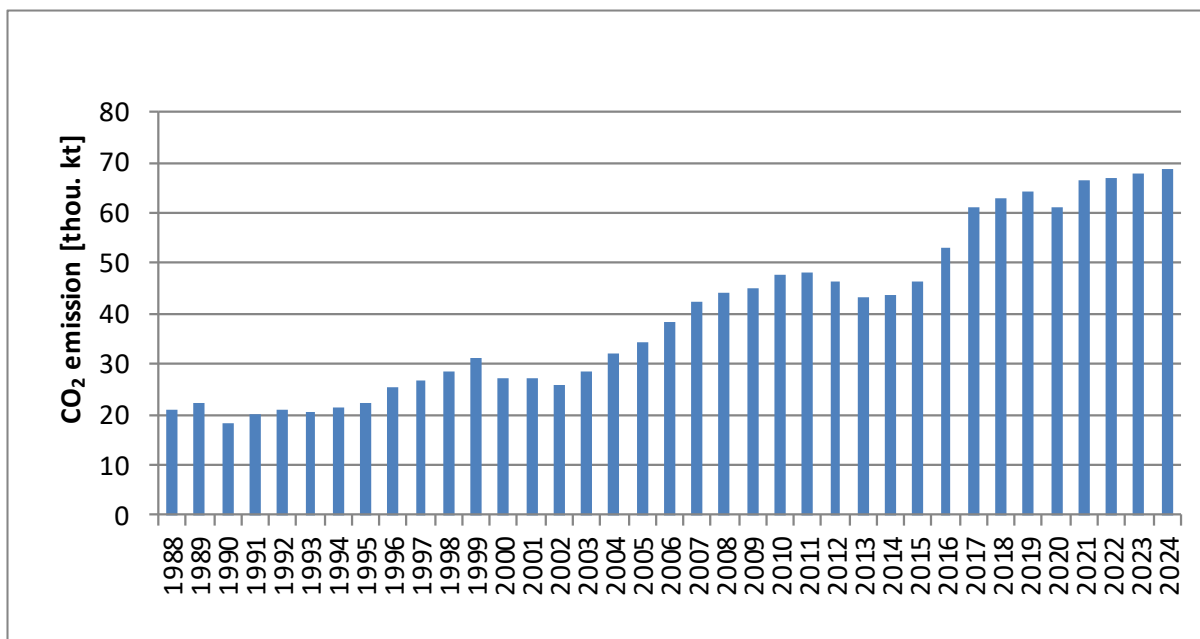
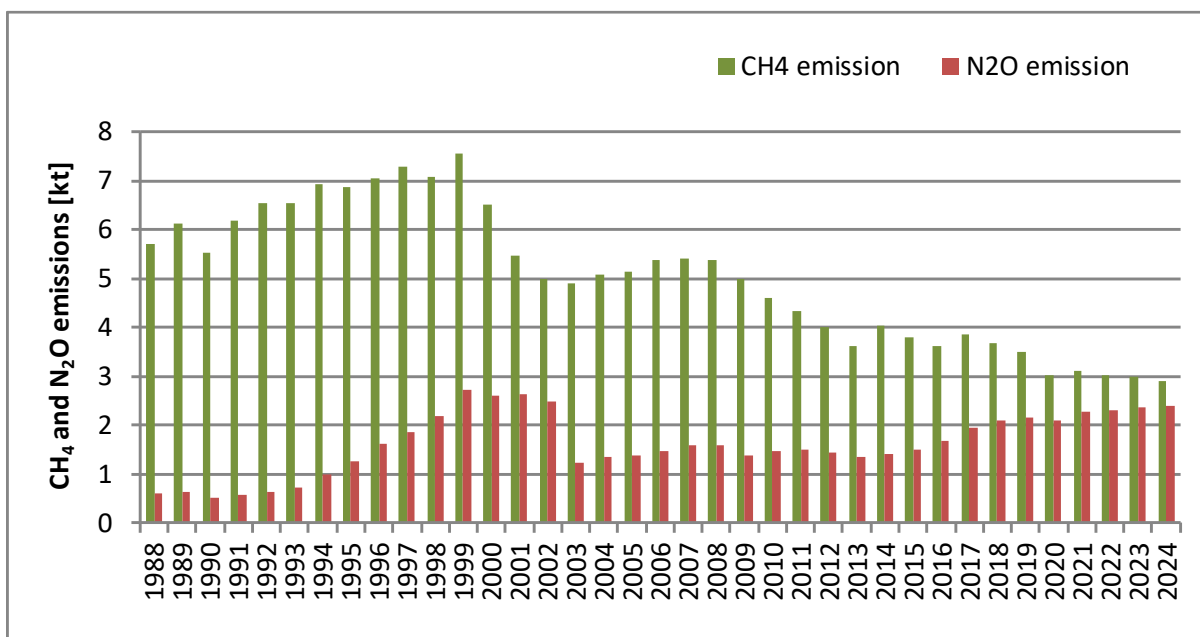


Figure 3.2.8.9. Fuel consumption in 1.A.3.b category for 1988-2024

Figure 3.2.8.10 shows CO₂ emissions in sub-category 1.A.3.b in period 1988-2024. Emissions of CH₄ and N₂O in the same sub-category are shown in figure 3.2.8.11.

Figure 3.2.8.10. CO₂ emission for 1.A.3.b category in 1988-2024Figure 3.2.8.11. CH₄ and N₂O emissions for 1.A.3.b category in 1988-2024

CO₂ emissions from urea based catalyst

For estimating CO₂ emissions from urea-based catalyst additives in catalytic converters model COPERT 5 was used. The model assumed that consumption of urea equals a certain fraction of fuel consumption. For diesel passenger cars Euro 6/VI the consumption of urea equals 2% of fuel consumption, the selective catalytic reduction (SCR) ratio being equal to 10%. For diesel heavy duty trucks and buses, the consumption of urea is assumed to be equal 6% of fuel consumption at Euro IV and V level (SCR ratio = 76.2%) and equal 3.5% at Euro VI level (SCR ratio = 100%). The purity (the mass fraction of urea in the urea-based additive), the default value of 32.5% has been used (IPCC 2006).

CO₂ emissions from combustion of lubricants

Lubricant oil is used in engines to reduce friction and to cool down specific components. Lubricant oil enters the combustion chamber and is oxidized during combustion, before it is exhausted to the atmosphere. The hydrocarbon composition of lube oil means that it unintentionally contributes to the CO₂ emissions without taking part to the energy consumption of road transport. The only exception is two-stroke engines where the lubricant oil is intentionally delivered to the cylinder and part of the lubricant oil could be used to deliver some energy to the engine (especially in older two-stroke engines). Emission factors of CO₂ due to lubricant oil consumption per vehicle technology are provided in this form, which are based on typical lubricant oil consumption factors for different vehicle types.

CO₂ emissions concerning non-energy use of lubricants, including those related to emissions from road transport, are estimated in 2.D.1.

As Poland uses the COPERT model to estimate CO₂ emissions in road transport, also this model is used to calculate CO₂ emissions from combustion of lubricants in 2-stroke engines (mainly L-category – motorcycles and mopeds). Those emissions are included in category 1A3b and account for less than 1% of total CO₂ emissions in category 1.A.3.b. (in 2024 it was 0.005%).

3.2.8.2.3. Railways (CRT sector 1.A.3.c)

This category includes emissions from railway transport for both freight and passenger traffic routes. Railway locomotives used in Poland are diesel and electric. Up to year 1998 coal was used in steam locomotives. Electric locomotives are powered by electricity generated at stationary power plants as well as other sources. The corresponding emissions are covered under the Stationary Combustion sector. Emission factors for the estimation of GHG emissions from railways are default values from the IPCC 2006 guidelines (table 3.2.8.6).

Table 3.2.8.6. Emission factors for railways [kg/GJ]

EFs	CO ₂	CH ₄	N ₂ O
Hard coal	96.10	0.002	0.0015
Diesel oil	74.10	0.004	0.0286

The amounts of fuels used in railway transport in the 1988-2024 period are shown table 3.2.8.7 and in figure 3.2.8.12.

Table 3.2.8.7. Fuel consumption and GHG emission in years 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Hard coal	TJ	10 972	5 785	3 169	1 686	350	293	156	132	192	181
Diesel oil	TJ	23 600	9 585	17 802	13 588	10 621	10 449	11 825	11 524	9 675	8 686
CO ₂ emission	kt	2 803	1 266	1 624	1 169	821	802	891	867	735	661
CH ₄ emission	kt	0.120	0.051	0.080	0.060	0.045	0.044	0.049	0.048	0.041	0.036
N ₂ O emission	kt	0.691	0.283	0.514	0.391	0.304	0.299	0.338	0.330	0.277	0.249
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hard coal	TJ	138	0	0	0	0	0	0	0	0	0
Diesel oil	TJ	8 170	7 740	7 095	6 923	6 579	6 923	6 923	6 794	6 235	6 149
CO ₂ emission	kt	619	574	526	513	488	513	513	503	462	456
CH ₄ emission	kt	0.034	0.032	0.029	0.029	0.027	0.029	0.029	0.028	0.026	0.026
N ₂ O emission	kt	0.234	0.221	0.203	0.198	0.188	0.198	0.198	0.194	0.178	0.176
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Hard coal	TJ	0	0	0	0	0	0	0	0	0	0
Diesel oil	TJ	5 375	5 196	4 806	4 980	4 633	4 287	3 854	3 526	3 526	3 615

CO ₂ emission	kt	398	385	356	369	343	318	286	261	261	268
CH ₄ emission	kt	0.022	0.022	0.020	0.021	0.019	0.018	0.016	0.015	0.015	0.015
N ₂ O emission	kt	0.154	0.149	0.137	0.142	0.133	0.123	0.110	0.101	0.101	0.103
		2018	2019	2020	2021	2022	2023	2024			
Hard coal	TJ	0	0	0	0	0	0	0			
Diesel oil	TJ	4 350	3 616	3 486	3 778	3 413	3 464	3 401			
CO ₂ emission	kt	322	268	258	280	253	257	252			
CH ₄ emission	kt	0.018	0.015	0.014	0.016	0.014	0.014	0.014			
N ₂ O emission	kt	0.124	0.103	0.100	0.108	0.098	0.099	0.097			

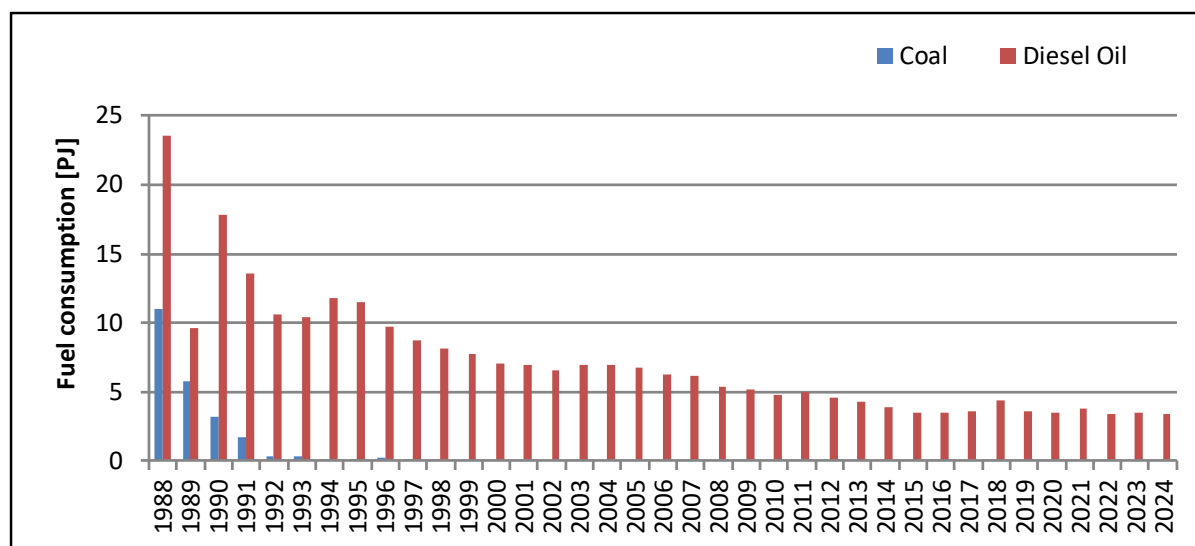
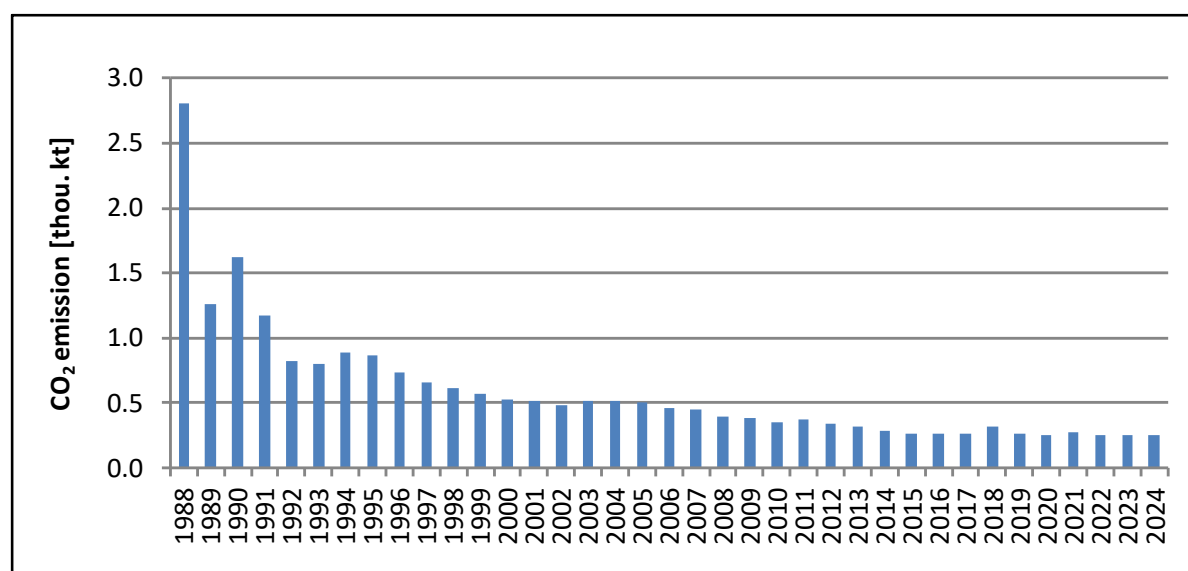


Figure 3.2.8.12. Fuel consumption in 1.A.3.c category for 1988-2024

Figures 3.2.8.13 and 3.2.8.14 show emissions of CO₂, CH₄ and N₂O, respectively in the sub-category 1.A.3.c for the entire time series beginning in the base year.

Figure 3.2.8.13. CO₂ emission for 1.A.3.c category in 1988-2024

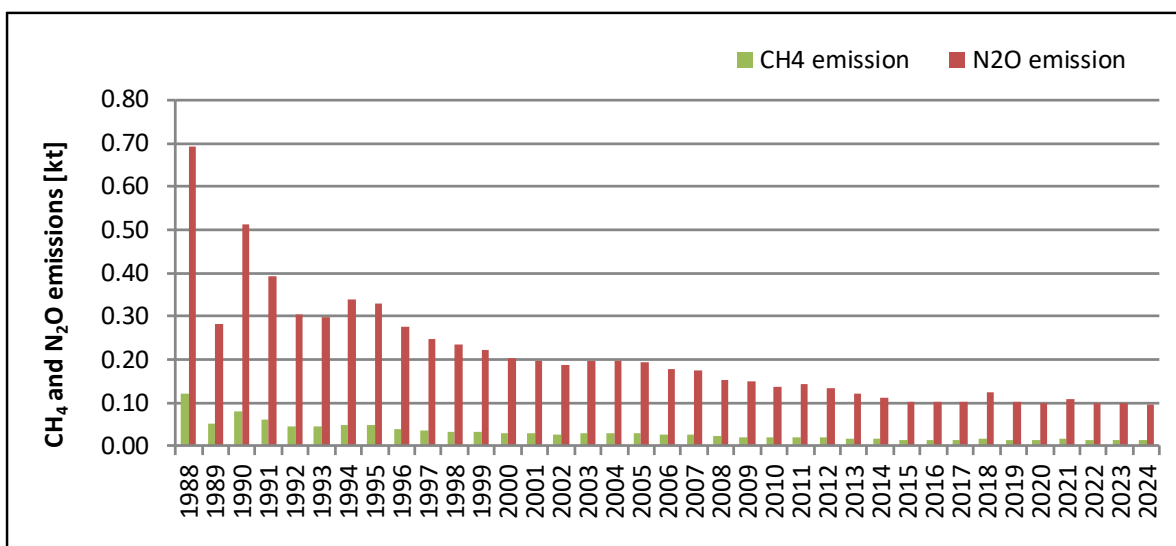


Figure 3.2.8.14. CH₄ and N₂O emissions for 1.A.3.c category in 1988-2024

3.2.8.2.4. Domestic Navigation (CRT sector 1.A.3.d)

This category relates to inland and marine domestic navigation and includes emissions from fuels used by vessels of all flags that depart and arrive in the same country. The category does not cover fishing, which should be reported under 1.A.4.c.iii.

Emission factors for the estimation of GHG emissions from domestic navigation are default values from the IPCC 2006 guidelines (table 3.2.8.8).

Table 3.2.8.8. Emission factors for domestic navigation [kg/GJ]

EF		CO ₂	CH ₄	N ₂ O
Inland navigation	Diesel oil	74.10	0.007	0.002
Maritime	Diesel oil	74.10	0.007	0.002
Maritime	Fuel oil	77.40	0.007	0.002

The structure of fuels used in Navigation has been recalculated based on G-03 questionnaires and statistical data on levels of international vs. domestic shipping activity (see table 3.2.8.9). The G-03 questionnaire it is selected data from energy statistic system published by GUS (Statistics Poland). Data connected with marine navigation activates were collected from questionnaire i.e. marine transport of goods and passengers, sea fish catches, goods loaded and unloaded in seaports. Then it was used to calculate fuel consumption in domestic navigation.

1990-2024 fuel use data for fuels classified to the international marine bunker were taken from the Eurostat database. For the years 1988-1989, the respective data were taken from the database of the International Energy Agency (IEA).

As there is no information about cargo activity in Eurostat, the structure of fuels used in domestic marine navigation has been recalculated based on G-03 questionnaires and statistical data on share of international vs domestic shipping activities. Marine Bunkers data are based on IEA and Eurostat energy statistics for Poland.

Table 3.2.8.9. Cargo traffic at Polish seaports in years 1990-2024

Cargo traffic		1990	1991	1992	1993	1994	1995	1996	1997	1998
International	kt	45 901	40 671	43 558	49 814	51 148	48 179	47 925	50 630	50 564
Domestic	kt	1 138	1 009	744	711	1 327	1 142	1 068	355	432
Share of domestic	%	2.4	2.4	1.7	1.4	2.5	2.3	2.2	0.7	0.8
		1999	2000	2001	2002	2003	2004	2005	2006	2007
International	kt	49 227	47 334	47 220	48 404	51 020	56 011	58 489	59 137	51 604
Domestic	kt	453	537	534	562	866	907	990	1 182	830
Share of domestic	%	0.9	1.1	1.1	1.1	1.7	1.6	1.7	2.0	1.6
		2008	2009	2010	2011	2012	2013	2014	2015	2016
International	kt	47 806	44 250	58 613	56 609	57 728	62 898	68 018	68 472	70 776
Domestic	kt	1 027	829	893	1 129	1 098	1 206	726	1 264	2 150
Share of domestic	%	2.1	1.8	1.5	2.0	1.9	1.9	1.1	1.8	2.9
		2017	2018	2019	2020	2021	2022	2023	2024	
International	kt	75 903	90 088	91 783	85 738	92 570	113 911	132 879	119 804	
Domestic	kt	2 173	1 710	2 081	2 782	4 093	5 062	3 536	4 436	
Share of domestic	%	2.8	1.9	2.2	3.1	4.2	4.3	2.6	3.6	

The amounts of fuels (diesel and fuel oil) used in both inland water and maritime navigation in the 1988-2024 period are shown in table 3.2.8.10 and figure 3.2.8.15.

Table 3.2.8.10. Fuel consumption and GHG emission in years 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Diesel oil-inland navigation	TJ	968.83	681.61	860.00	688.00	817.00	688.00	301.00	688.00	688.00	645.00
Marine diesel oil	TJ	239.59	236.54	232.96	183.59	119.30	82.08	97.98	93.40	72.68	27.93
Marine fuel oil	TJ	894.34	878.75	900.55	825.50	546.35	340.58	425.53	428.31	399.10	127.94
CO ₂ emission	Gg	158.77	136.05	150.69	128.48	111.67	83.42	62.50	91.05	87.26	59.77
CH ₄ emission	Gg	0.015	0.013	0.014	0.012	0.010	0.008	0.006	0.008	0.008	0.006
N ₂ O emission	Gg	0.004	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.002
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel oil-inland navigation	TJ	387.00	301.00	258.00	258.00	215.00	301.00	258.00	215.00	258.00	215.00
Marine diesel oil	TJ	27.25	25.20	24.52	19.76	19.60	31.67	22.84	30.42	31.48	24.15
Marine fuel oil	TJ	156.91	142.74	138.76	133.80	133.37	182.04	85.41	60.55	80.26	65.28
CO ₂ emission	Gg	42.84	35.22	31.67	30.94	27.71	38.74	27.42	22.87	27.66	22.77
CH ₄ emission	Gg	0.004	0.003	0.003	0.003	0.003	0.004	0.003	0.002	0.003	0.002
N ₂ O emission	Gg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Diesel oil-inland navigation	TJ	215.00	129.90	129.90	129.90	129.90	129.90	129.90	86.00	86.00	196.34
Marine diesel oil	TJ	26.70	16.49	9.22	10.46	10.14	13.39	7.18	68.63	207.72	94.89
Marine fuel oil	TJ	63.97	38.21	12.78	14.79	11.06	23.32	12.19	0.00	0.00	0.00
CO ₂ emission	Gg	22.86	13.80	11.30	11.54	11.23	12.42	11.10	11.46	21.76	21.58
CH ₄ emission	Gg	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
N ₂ O emission	Gg	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
		2018	2019	2020	2021	2022	2023	2024			
Diesel oil-inland navigation	TJ	84.84	78.69	43.30	46.91	42.39	43.04	35.39			
Marine diesel oil	TJ	69.77	52.51	163.71	334.32	339.33	215.08	306.49			
Marine fuel oil	TJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
CO ₂ emission	Gg	11.46	9.72	15.34	28.25	28.28	19.13	25.33			
CH ₄ emission	Gg	0.001	0.001	0.001	0.003	0.003	0.002	0.002			
N ₂ O emission	Gg	0.000	0.000	0.000	0.001	0.001	0.001	0.001			

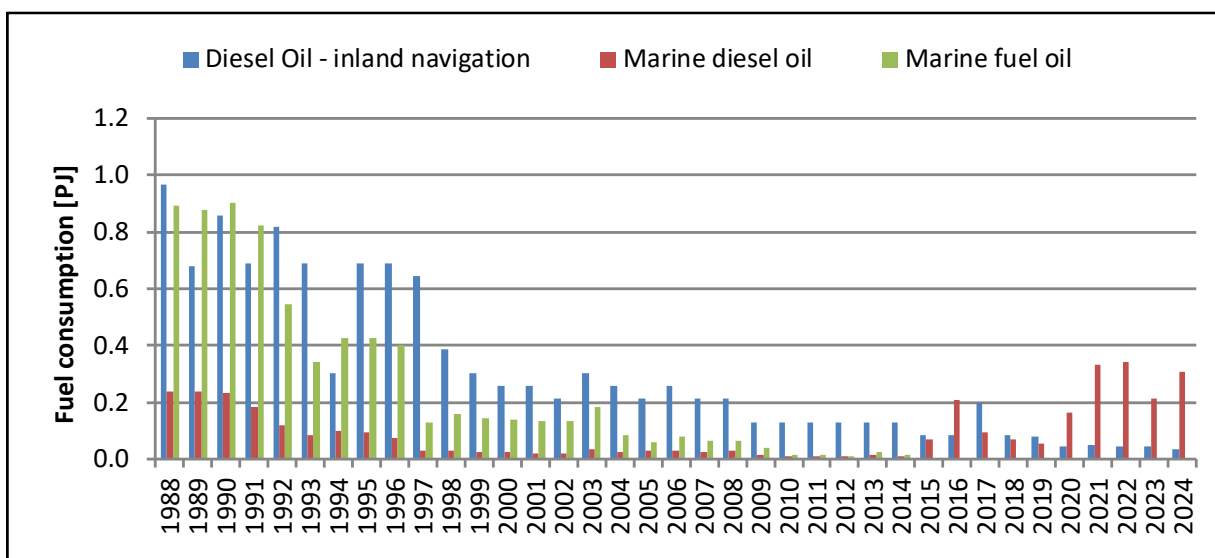


Figure 3.2.8.15. Fuel consumption in 1.A.3.d category for 1988-2024

Figures 3.2.8.16 and 3.2.8.17 show emissions of CO₂, CH₄ and N₂O in the sub-category 1.A.3.d for the entire time series 1988-2024.

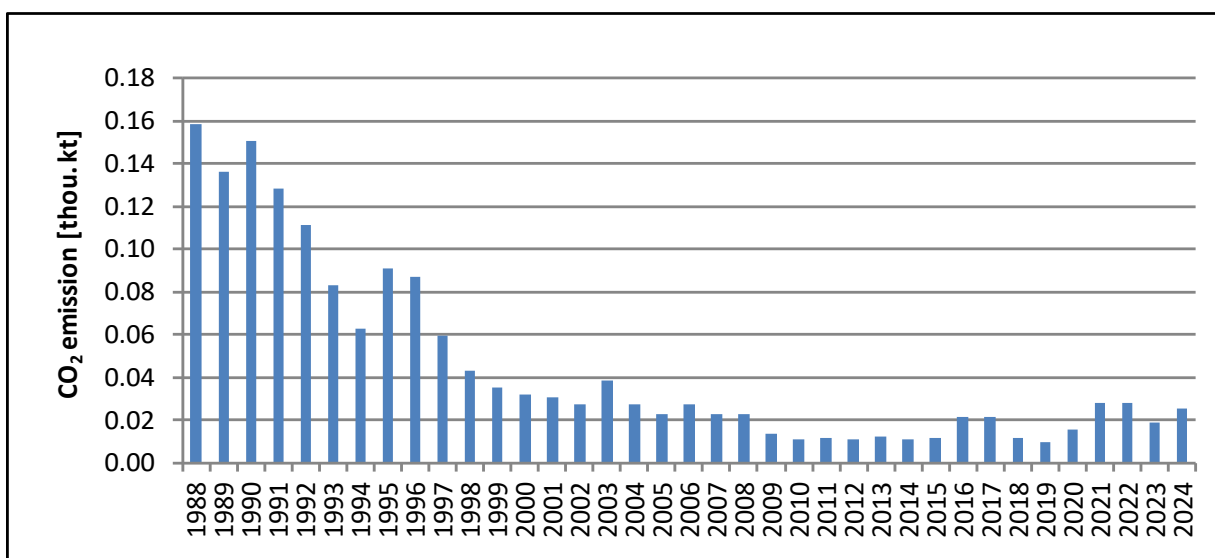
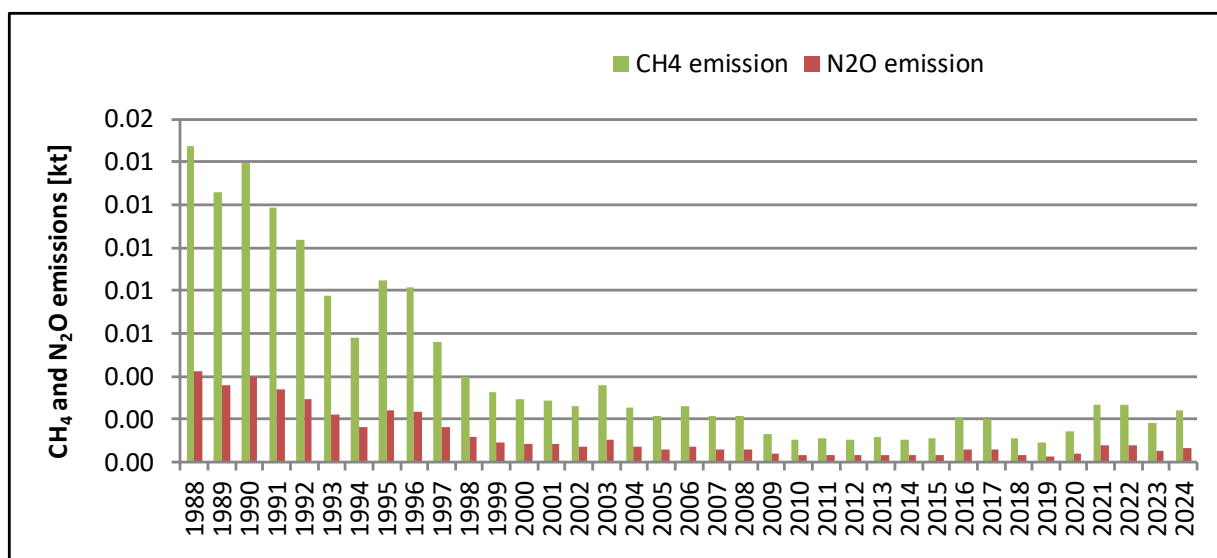


Figure 3.2.8.16. CO₂ emission for 1.A.3.d category in 1988-2024

Figure 3.2.8.17. CH₄ and N₂O emissions for 1.A.3.d category in 1988-2024

3.2.8.2.5. Other transportation (CRT sector 1.A.3.e)

Pipeline transport contains combustion related emissions from the operation of pump stations and maintenance of pipelines. From year 2000, when gas pipeline Jamal was completed, the amount of this fuel increased sharply from 21 TJ in 1999 to 2498 TJ in 2000. Significant decrease of natural gas consumption since 2022 was caused by the war outbreak in Ukraine in February 2022 and the related international political situation.

The amounts of fuels consumption in the sub-category 1.A.3.e.i *Pipelines transport* in the 1988-2024 period are shown in table 3.2.8.11. Natural gas consumption is shown on figure 3.2.8.18.

Table 3.2.8.11. Fuel consumption and GHG emission in years 1988-2024

		1988	1989	1990	1991	1992	1993	1994	1995	1996
Gasoline	TJ	0	0	0	0	0	0	0	0	0
Diesel oil	TJ	0	0	0	0	0	0	0	0	0
Natural gas	TJ	0	0	0	0	0	0	0.9	7.2	24.3
CO ₂ emission	kt	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.40	1.36
CH ₄ emission	kt	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000002
N ₂ O emission	kt	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
		1997	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline	TJ	0	0	0	0	44.3	44.3	44.3	44.3	44.3
Diesel oil	TJ	0	0	0	43	43	0	43	43	43
Natural gas	TJ	26.1	23.4	20.7	2498	3263	3502	5257	7381	9866
CO ₂ emission	kt	1.46	1.31	1.16	143.30	189.28	199.53	301.17	420.32	559.73
CH ₄ emission	kt	0.000003	0.000002	0.000002	0.00263	0.00352	0.00363	0.00552	0.00764	0.01013
N ₂ O emission	kt	0.000000	0.000000	0.000000	0.00028	0.00038	0.00038	0.00058	0.00079	0.00104
		2006	2007	2008	2009	2010	2011	2012	2013	2014
Gasoline	TJ	0	44.3	0	45	0	0	0	0	0
Diesel oil	TJ	43	43	43	43.3	43.3	43.3	43.3	43.3	43.3
Natural gas	TJ	12912	11828	13442	11084	9269	9298	10807	15421	15143
CO ₂ emission	kt	727.57	669.80	743.15	619.42	513.77	515.43	600.89	868.35	852.74
CH ₄ emission	kt	0.01304	0.01209	0.01357	0.01135	0.00940	0.00943	0.01094	0.01555	0.01527
N ₂ O emission	kt	0.00132	0.00124	0.00137	0.00116	0.00095	0.00096	0.00111	0.00157	0.00154
		2015	2016	2017	2018	2019	2020	2021	2022	2023
Gasoline	TJ	0	0	0	0	0	0	0	0	0
Diesel oil	TJ	43	43	42	0	4	1	1	0	1
Natural gas	TJ	14379	15409	14859	15764	14019	11586	10563	919	1543
CO ₂ emission	kt	805.82	854.58	823.93	871.12	774.01	640.56	585.39	51.51	86.58
CH ₄ emission	kt	0.01451	0.01554	0.01498	0.01576	0.01403	0.01159	0.01057	0.00092	0.00154
N ₂ O emission	kt	0.00146	0.00157	0.00151	0.00158	0.00140	0.00116	0.00106	0.00009	0.00015
		2024								

Gasoline	TJ	0
Diesel oil	TJ	2
Natural gas	TJ	1496
CO ₂ emission	kt	84.04
CH ₄ emission	kt	0.00150
N ₂ O emission	kt	0.00015

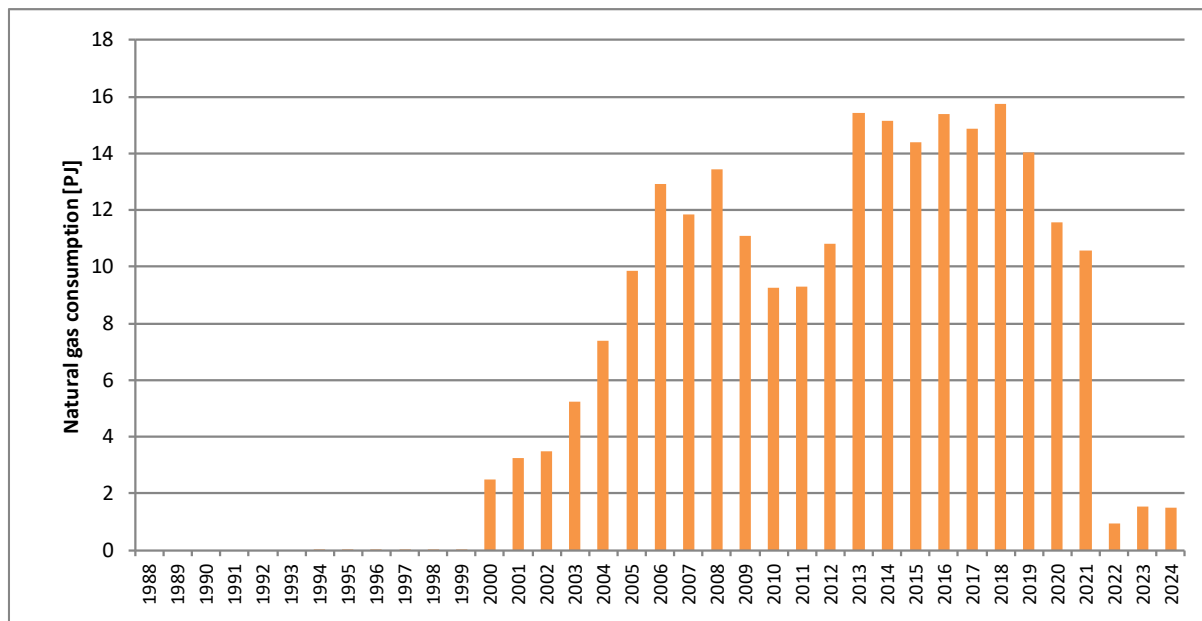


Figure 3.2.8.18. Natural gas consumption in 1.A.3.e.i category for 1988-2024

Figures 3.2.8.19 and 3.2.8.20 show emissions of CO₂, CH₄ and N₂O, in the sub-category 1.A.3.e from *Pipelines transport* for the entire time series 1988-2024.

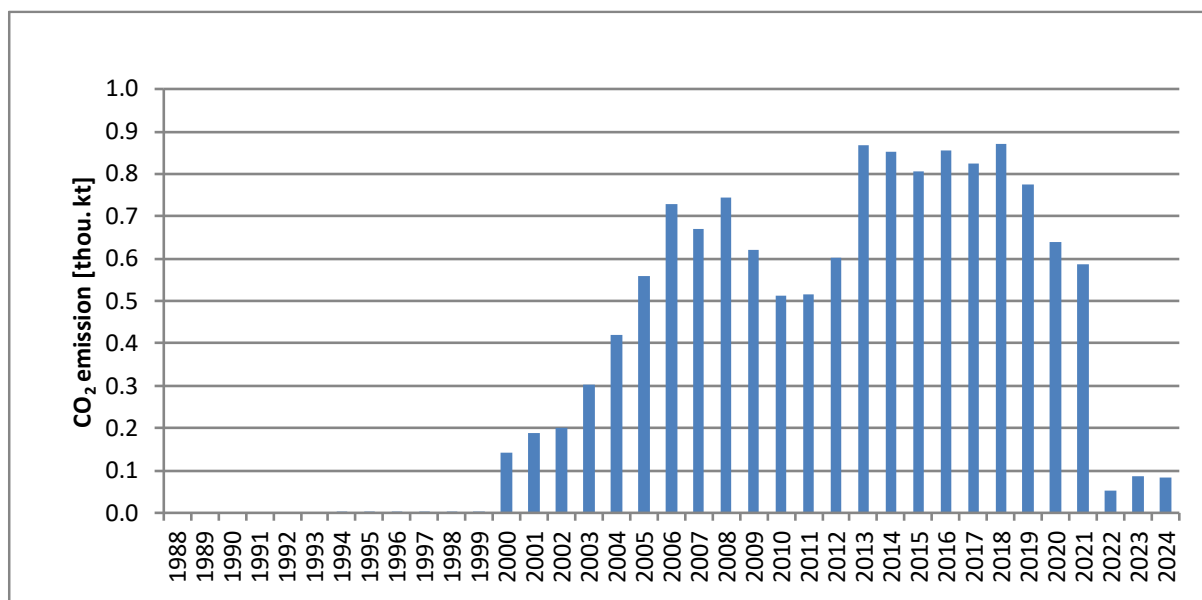


Figure 3.2.8.19. CO₂ emission from 1.A.3.e.i category in 1988-2024

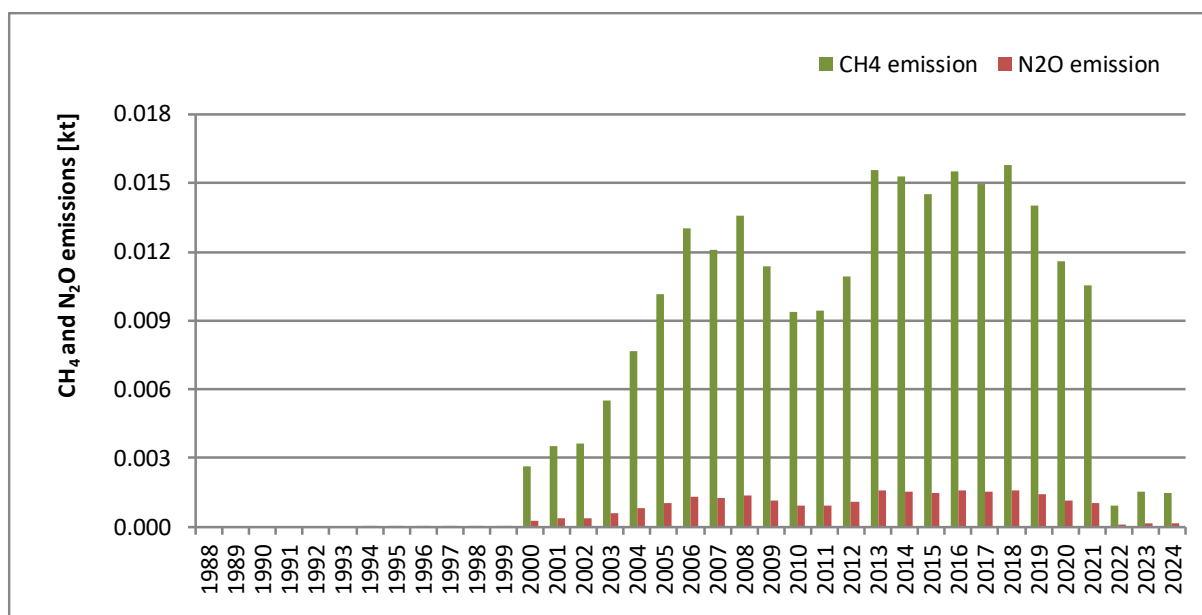


Figure 3.2.8.20. CH₄ and N₂O emissions from 1.A.3.e.i category in 1988-2024

3.2.8.2.6. Other mobile sources outside of the source category 1.A.3

Other mobile sources included in the national inventory in sub-categories other than 1.A.3 include:

- machinery and off-road transport in agriculture (sub-category 1.A.4.c.ii) – classified in 1.A.4,
- fishery (sub-category 1.A.4.c.iii) – classified in source category 1.A.4.

The amounts of fuels used in the above listed sub-categories in the 1988-2024 period are presented in table 3.2.8.12 and figure 3.2.8.21. The amounts of corresponding emissions of CO₂, CH₄ and N₂O are shown in tables 3.2.8.13–3.2.8.14 and figures 3.2.8.22 and 3.2.8.23.

Table 3.2.8.12. Fuel consumption in 1988-2024 in mobile sources in subcategories other than 1.A.3

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Diesel oil - 1.A.4.c.ii	PJ	49.42	47.82	50.64	48.80	57.34	72.33	78.33	82.47	92.02	107.05
Diesel oil - 1.A.4.c.iii	PJ	4.55	4.15	3.45	3.32	3.46	2.84	3.24	3.19	2.58	2.68
Fuel oil - 1.A.4.c.iii	PJ	7.54	6.87	5.67	5.46	5.69	4.67	5.33	5.24	4.24	4.41
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel oil - 1.A.4.c.ii	PJ	97.39	99.75	110.51	103.02	102.71	103.92	105.85	108.28	80.41	73.91
Diesel oil - 1.A.4.c.iii	PJ	1.94	1.94	1.72	1.81	1.78	1.43	1.61	1.37	1.29	1.34
Fuel oil - 1.A.4.c.iii	PJ	3.18	3.19	2.83	2.98	2.93	2.36	2.65	2.25	2.13	2.20
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Diesel oil - 1.A.4.c.ii	PJ	73.96	71.69	71.91	72.49	73.04	71.40	68.96	68.15	72.16	86.27
Diesel oil - 1.A.4.c.iii	PJ	1.29	1.92	1.57	1.64	1.66	1.78	1.62	1.68	1.80	1.88
Fuel oil - 1.A.4.c.iii	PJ	2.11	3.11	2.53	2.65	2.68	2.88	2.62	2.73	2.94	3.06
		2018	2019	2020	2021	2022	2023	2024			
Diesel oil - 1.A.4.c.ii	PJ	91.04	94.64	95.60	96.06	100.24	100.96	87.24			
Diesel oil - 1.A.4.c.iii	PJ	1.84	1.89	1.84	1.78	1.56	1.59	1.37			
Fuel oil - 1.A.4.c.iii	PJ	3.06	3.15	3.06	2.92	2.59	2.63	2.25			

Table 3.2.8.13. GHG emission in 1988-2024 in subcategory 1.A.4.c.ii

1.A.4.c.ii		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
CO ₂ emission	kt	3 662	3 544	3 753	3 616	4 249	5 359	5 804	6 111	6 819	7 933
CH ₄ emission	kt	0.205	0.198	0.210	0.203	0.238	0.300	0.325	0.342	0.382	0.444
N ₂ O emission	kt	1.413	1.368	1.448	1.396	1.640	2.069	2.240	2.359	2.632	3.062
1.A.4.c.ii		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO ₂ emission	kt	7 217	7 392	8 189	7 634	7 611	7 700	7 843	8 023	5 958	5 477
CH ₄ emission	kt	0.404	0.414	0.459	0.428	0.426	0.431	0.439	0.449	0.334	0.307
N ₂ O emission	kt	2.785	2.853	3.161	2.946	2.938	2.972	3.027	3.097	2.300	2.114
1.A.4.c.ii		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CO ₂ emission	kt	5 481	5 312	5 329	5 372	5 412	5 291	5 110	5 050	5 347	6 393
CH ₄ emission	kt	0.307	0.297	0.298	0.301	0.303	0.296	0.286	0.283	0.299	0.358
N ₂ O emission	kt	2.115	2.050	2.057	2.073	2.089	2.042	1.972	1.949	2.064	2.467
1.A.4.c.ii		2018	2019	2020	2021	2022	2023	2024			
CO ₂ emission	kt	6 746	7 013	7 084	7 118	7 428	7 481	6 464			
CH ₄ emission	kt	0.378	0.393	0.397	0.399	0.416	0.419	0.362			
N ₂ O emission	kt	2.604	2.707	2.734	2.747	2.867	2.887	2.495			

Table 3.2.8.14. GHG emission in 1988-2024 in subcategory 1.A.4.c.iii

1.A.4.c.iii		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
CO ₂ emission	kt	921	839	695	669	697	571	653	641	520	541
CH ₄ emission	kt	0.085	0.077	0.064	0.061	0.064	0.053	0.060	0.059	0.048	0.050
N ₂ O emission	kt	0.024	0.022	0.018	0.018	0.018	0.015	0.017	0.017	0.014	0.014
1.A.4.c.iii		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO ₂ emission	kt	390	391	346	365	358	288	324	276	260	269
CH ₄ emission	kt	0.036	0.036	0.032	0.034	0.033	0.027	0.030	0.025	0.024	0.025
N ₂ O emission	kt	0.010	0.010	0.009	0.010	0.009	0.008	0.009	0.007	0.007	0.007
1.A.4.c.iii		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CO ₂ emission	kt	259	383	312	326	330	354	322	336	361	376
CH ₄ emission	kt	0.024	0.035	0.029	0.030	0.030	0.033	0.030	0.031	0.033	0.035
N ₂ O emission	kt	0.007	0.010	0.008	0.009	0.009	0.009	0.008	0.009	0.009	0.010
1.A.4.c.iii		2018	2019	2020	2021	2022	2023	2024			
CO ₂ emission	kt	373	384	373	358	317	321	275			
CH ₄ emission	kt	0.034	0.035	0.034	0.033	0.029	0.030	0.025			
N ₂ O emission	kt	0.010	0.010	0.010	0.009	0.008	0.008	0.007			

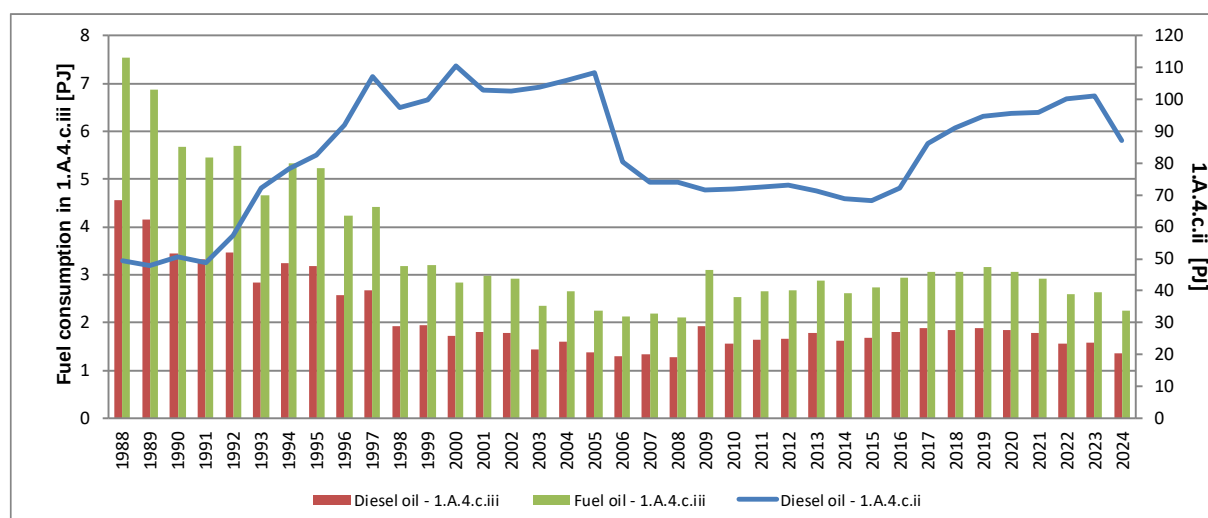


Figure 3.2.8.21. Fuel consumption in 1988-2024 in mobile sources in subcategories other than 1.A.3

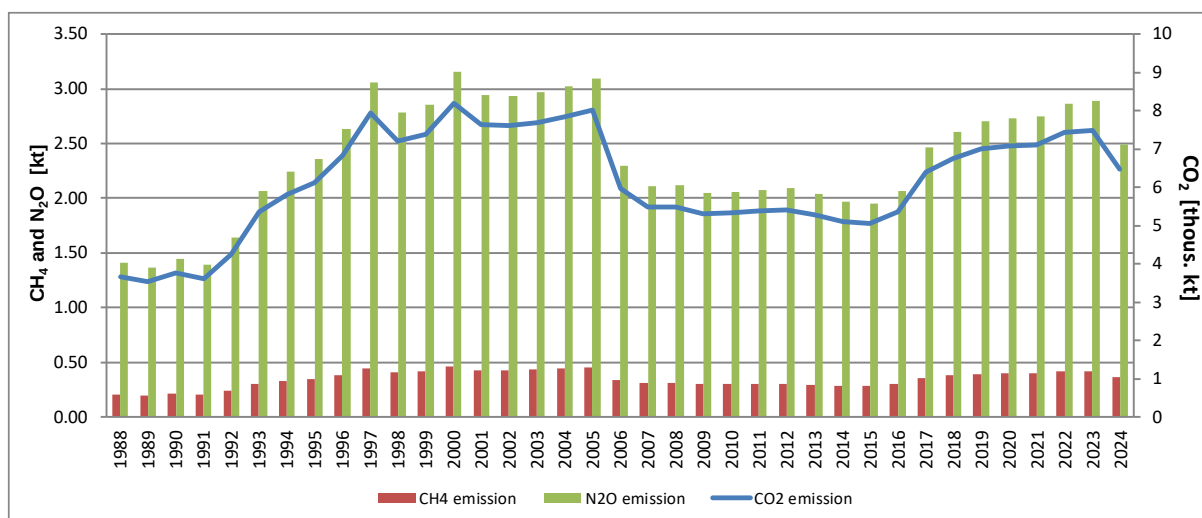


Figure 3.2.8.22. GHG emission in 1988-2024 in subcategory 1.A.4.c.ii

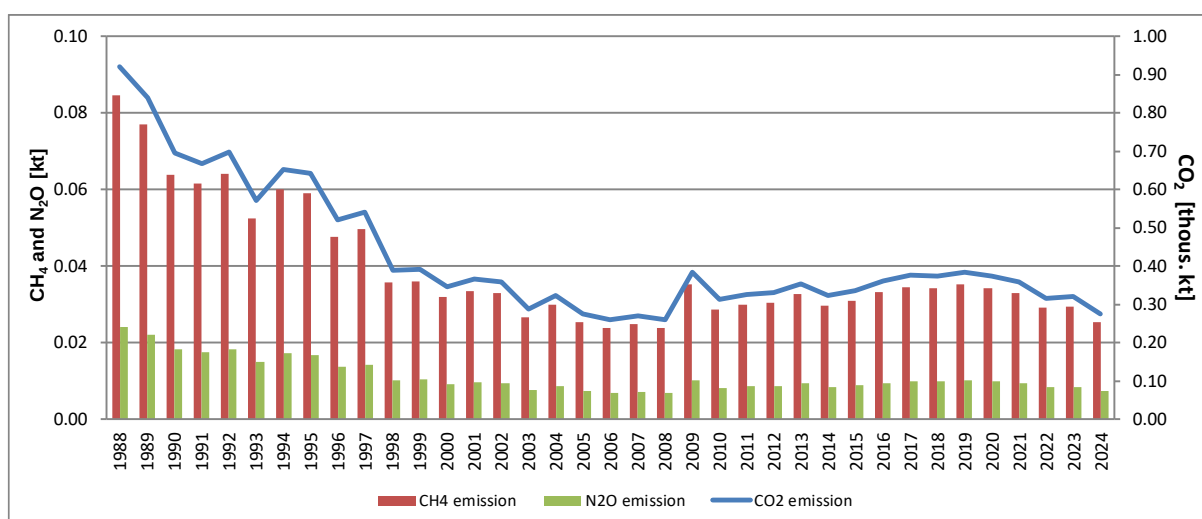


Figure 3.2.8.23. GHG emission in 1988-2024 in subcategory 1.A.4.c.iii

3.2.8.3. Uncertainties and time-series consistency

See chapter 3.2.6.3.

3.2.8.4. Source-specific QA/QC and verification

See chapter 3.2.6.4.

3.2.8.5. Source-specific recalculations

The following recalculations have been implemented:

- fuel consumption was corrected based on updated Eurostat database – changes occurred in road transport, national navigation, pipelines transport and aviation;
- the update of number of vehicles and vehicles mileages in road transport based on new and updated data from Polish Central Vehicle and Driver Register database;
- the update of meteorological data on average minimum and maximum ambient temperatures and update and supplement of average humidity according to Institute of Meteorology and Water Management – National Research Institute.

Changes in GHG emissions in road transport, national navigation, pipelines transport and

aviation resulting from recalculations are shown in tables 3.2.8.15-18.

Table 3.2.8.15. Changes in GHG emission in subsector 1.A.3.a *Civil aviation* resulting from recalculations

Difference	1988	1989	1990	1991	1992	1993	1994	1995	1996
kt CO ₂ eq.	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
Difference	1997	1998	1999	2000	2001	2002	2003	2004	2005
kt CO ₂ eq.	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
Difference	2006	2007	2008	2009	2010	2011	2012	2013	2014
kt CO ₂ eq.	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
Difference	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.2.8.16. Changes in GHG emission in subsector 1.A.3.d *Domestic navigation* resulting from recalculations

Difference	1988	1989	1990	1991	1992	1993	1994	1995	1996
kt CO ₂ eq.	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
Difference	1997	1998	1999	2000	2001	2002	2003	2004	2005
kt CO ₂ eq.	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
Difference	2006	2007	2008	2009	2010	2011	2012	2013	2014
kt CO ₂ eq.	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
Difference	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.34	-0.29
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01

Table 3.2.8.17. Changes in GHG emission in subsector 1.A.3.e.i *Pipelines transport* resulting from recalculations

Difference	1988	1989	1990	1991	1992	1993	1994	1995	1996
kt CO ₂ eq.	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
Difference	1997	1998	1999	2000	2001	2002	2003	2004	2005
kt CO ₂ eq.	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
Difference	2006	2007	2008	2009	2010	2011	2012	2013	2014
kt CO ₂ eq.	0.00	0.00	0.00	0.00	0.01	-0.02	0.02	-0.01	-0.02
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Difference	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	0.03	-0.03	-38.70	-76.66	-85.10	-125.86	-69.61	-128.78	0.00
%	0.00	0.00	-0.04	-0.08	-0.10	-0.16	-0.11	-0.71	0.00

Table 3.2.8.18. Changes in GHG emission in subsector 1.A.3.b *Road transport* resulting from recalculations

Difference	1988	1989	1990	1991	1992	1993	1994	1995	1996
kt CO ₂ eq.	-39.70	-49.04	-47.73	-50.28	-44.92	-9.14	33.72	98.03	172.46
%	-0.19%	-0.22%	-0.25%	-0.25%	-0.21%	-0.04%	0.16%	0.44%	0.67%
Difference	1997	1998	1999	2000	2001	2002	2003	2004	2005
kt CO ₂ eq.	226.29	297.26	409.08	407.40	436.58	405.50	55.46	54.26	40.24
%	0.83%	1.03%	1.29%	1.47%	1.59%	1.53%	0.19%	0.17%	0.12%
Difference	2006	2007	2008	2009	2010	2011	2012	2013	2014
kt CO ₂ eq.	39.27	41.46	40.99	-23.32	-19.37	-21.78	-21.11	-19.99	4.40

%	0.10%	0.10%	0.09%	-0.05%	-0.04%	-0.04%	-0.05%	-0.05%	0.01%
Difference	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	-2.99	-6.78	-7.30	-2.89	-0.05	1.76	-13.39	-993.92	743.29
%	-0.01%	-0.01%	-0.01%	0.00%	0.00%	0.00%	-0.02%	-1.45%	1.10%

Recalculation for mobile sources in subcategories other than 1.A.3, i.e.: *Off-road vehicles and other machinery* in agriculture (1.A.4.c.ii) and *Fishing* (1.A.4.c.iii) included:

- correction of diesel oil consumption based on updated Eurostat database;
- amendments related to fish catch volumes published in the GUS yearbook, which affected fuel consumption in the fishing.

Changes in GHG emissions are presented in table 3.2.8.19.

Table 3.2.8.19. Changes in GHG emission in subcategories 1.A.4.c.ii and 1.A.4.c.iii resulting from recalculations

1.A.4.cii									
Difference	1988	1989	1990	1991	1992	1993	1994	1995	1996
kt CO ₂ eq.	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%
Difference	1997	1998	1999	2000	2001	2002	2003	2004	2005
kt CO ₂ eq.	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%
Difference	2006	2007	2008	2009	2010	2011	2012	2013	2014
kt CO ₂ eq.	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%
Difference	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	0.59	0.00	0.00	0.00	0.00	-0.06	0.00	1055.16	0.12
%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	14.77%	0.00%
1.A.4.ciii									
Difference	1988	1989	1990	1991	1992	1993	1994	1995	1996
kt CO ₂ eq.	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%
Difference	1997	1998	1999	2000	2001	2002	2003	2004	2005
kt CO ₂ eq.	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%
Difference	2006	2007	2008	2009	2010	2011	2012	2013	2014
kt CO ₂ eq.	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%
Difference	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	-1.45	0.00	0.00	0.00	0.00	0.15	0.00	0.00	1.58
%	-0.43%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.49%

3.2.8.6. Source-specific planned improvements

Poland intends to investigate the correlation between cargo activity and shipping emissions and on cross-checks between emissions estimated on the basis of cargo activity and emissions estimated on the basis of Eurostat data.

3.2.9. Other sectors (CRT sector 1.A.4)

3.2.9.1. Source category description

Emissions in 1.A.4 *Other Sectors* are estimated for each fuel in detailed sub-categories given below:

- a) *Commercial/institutional* (1.A.4.a),
- b) *Residential* (1.A.4.b),
- c) *Agriculture/forestry/fishing* (1.A.4.c):
 - Stationary - 1.A.4.c.i,
 - Off-road vehicles and other machinery - 1.A.4.c.ii,
 - Fishing - 1.A.4.c.iii.

Subsector 1.A.4.b *Residential* is by far the largest contributor to emissions from this category (see figure 3.2.9.1) – about 66.0% in 2024.

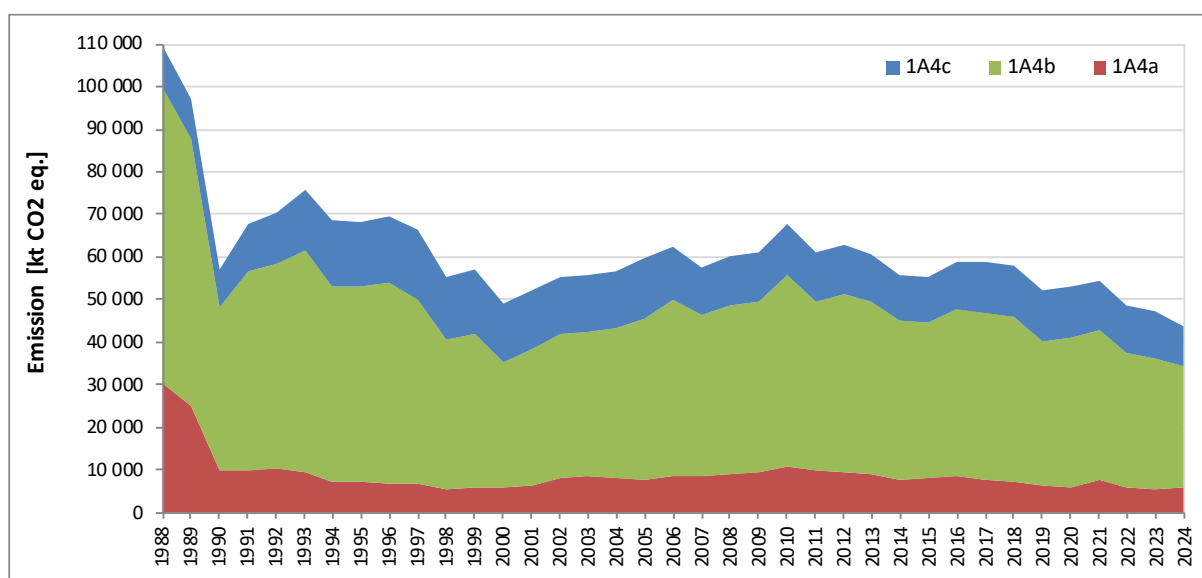


Figure 3.2.9.1. GHG emissions from 1.A.4 *Other sectors* in years 1988-2024 according to subcategories

3.2.9.2. Methodological issues

Methodology of emission estimation in 1.A.4 subcategory corresponds with methodology described for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for subsectors included in 1.A.4 subcategory are presented in Annex 5.3.

3.2.9.2.1. Other sectors – Commercial/Institutional (1.A.4.a)

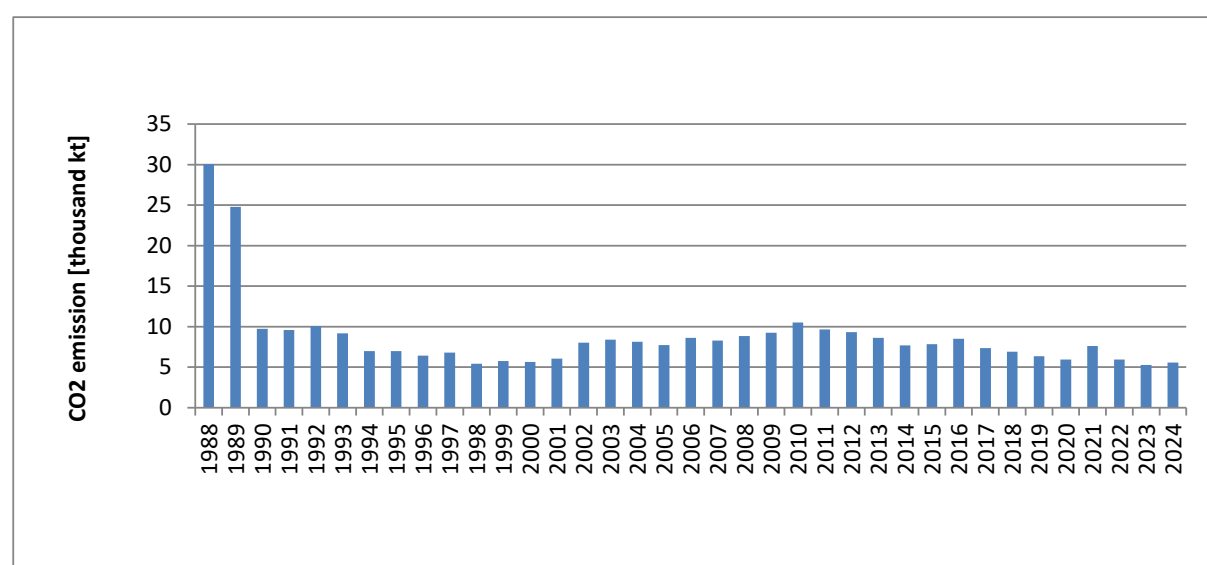
The data on fuel type use in the sub-category 1.A.4.a *Other Sectors – Commercial/Institutional* over the 1988-2024 period are presented in table 3.5.9.1. Detailed data concerning fuel consumption in 1.A.4.a subcategory was tabulated in Annex 5.3 (table 11).

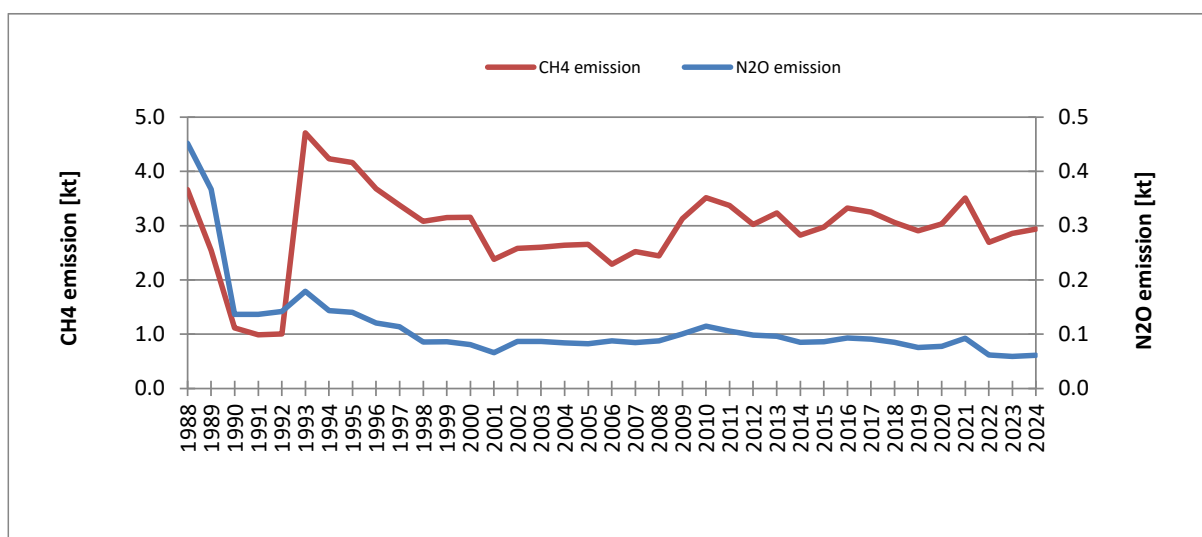
The fuel consumption related to mobile sources (category 1.A.4.a.ii) is included in category 1.A.3.b. The reasons are difficulties in separating the consumption of this fuel, due to its purchase at gas stations and reporting in the fuel balance together with fuels in transport.

Table 3.2.9.1. Fuel consumption in 1988-2024 in 1.A.4.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	0.000	0.000	0.000	0.000	0.000	0.000	1.372	1.286
Gaseous Fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260
Solid Fuels	297.025	244.614	90.171	91.760	95.301	85.366	63.396	61.568
Other Fuels	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000
Biomass	0.084	0.123	0.379	0.187	0.206	12.374	11.968	11.983
TOTAL	312.322	257.481	104.842	103.005	106.708	109.640	86.398	88.097
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	2.363	7.974	9.946	12.353	18.418	22.080	23.344	24.480
Gaseous Fuels	18.771	24.256	32.769	37.697	38.567	49.971	61.001	67.057
Solid Fuels	51.525	47.725	28.968	27.821	21.956	17.265	29.795	29.740
Other Fuels	0.124	0.000	0.003	0.004	0.024	0.091	0.101	0.071
Biomass	10.625	9.627	9.085	9.216	9.211	6.596	6.440	6.466
TOTAL	83.408	89.581	80.770	87.090	88.176	96.003	120.681	127.815
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	21.485	17.974	28.698	27.980	27.551	25.768	30.996	29.029
Gaseous Fuels	69.564	68.410	63.517	65.489	71.250	75.746	83.435	78.275
Solid Fuels	28.299	28.032	32.148	27.840	30.808	33.484	38.065	33.598
Other Fuels	0.002	0.022	0.000	0.000	0.037	0.123	0.026	0.046
Biomass	7.366	7.803	6.190	6.949	6.823	8.779	9.859	9.781
TOTAL	126.716	122.241	130.553	128.257	136.470	143.900	162.381	150.728
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	22.494	18.093	17.755	17.567	17.754	18.404	18.735	17.106
Gaseous Fuels	80.890	76.500	67.428	71.826	80.969	60.809	56.324	56.462
Solid Fuels	34.126	31.703	28.036	27.080	28.394	27.963	25.502	20.567
Other Fuels	0.037	0.421	0.231	0.195	0.355	0.250	0.219	0.195
Biomass	9.113	9.556	8.674	9.404	10.546	10.544	10.143	10.106
TOTAL	146.660	136.273	122.123	126.071	138.018	117.970	110.924	104.436
	2020	2021	2022	2023	2024			
Liquid Fuels	16.182	17.662	15.320	11.092	16.943			
Gaseous Fuels	47.900	67.306	64.525	59.169	58.048			
Solid Fuels	21.852	26.794	12.848	10.723	9.379			
Other Fuels	0.589	0.731	0.219	1.007	1.456			
Biomass	10.204	10.911	9.669	9.735	9.725			
TOTAL	96.727	123.405	102.580	91.725	95.551			

Figures 3.2.9.2 and 3.2.9.3 show emissions of CO₂, CH₄ and N₂O, respectively in the subcategory 1.A.4.a in the period 1988-2024.

Figure 3.2.9.2. CO₂ emission for 1.A.4.a category in 1988-2024

Figure 3.2.9.3. CH₄ and N₂O emissions for 1.A.4.a category in 1988-2024

3.2.9.2.2. Other sectors – Residential (CRT sector 1.A.4.b)

The data on fuel type use in stationary sources in the sub-category 1.A.4.b *Residential* over the 1988-2024 period are presented in table 3.2.9.2 detailed information on fuel consumption for 1.A.4.b subcategory is presented in Annex 5.3 (table 12).

The fuel consumption related to mobile sources (category 1.A.4.b.ii) is included in category 1.A.3.b. The reasons are difficulties in separating the consumption of this fuel, due to its purchase at gas stations and reporting in the fuel balance together with fuels in transport subcategory.

Table 3.2.9.2. Fuel consumption in 1988-2024 in 1.A.4.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	6.762	7.452	1.750	1.041	1.892	6.244	9.224	13.197
Gaseous Fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559
Solid Fuels	617.874	546.675	307.009	385.556	390.063	412.793	345.629	338.768
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	33.615	32.351	38.875	30.944	34.552	106.000	104.715	105.000
TOTAL	760.831	694.097	469.838	551.214	567.718	666.627	611.238	616.524
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	18.705	25.370	27.520	29.670	38.012	42.785	45.000	49.020
Gaseous Fuels	143.057	150.022	138.268	135.995	127.611	133.737	127.093	127.629
Solid Fuels	357.959	307.233	234.197	243.307	179.010	198.167	219.913	217.515
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	101.000	100.000	100.700	95.000	95.000	104.500	104.500	103.075
TOTAL	620.721	582.625	500.685	503.972	439.633	479.189	496.505	497.239
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	46.096	43.000	43.000	40.076	36.679	33.265	29.387	27.763
Gaseous Fuels	126.376	135.111	138.686	132.622	131.450	134.857	148.431	135.464
Solid Fuels	228.651	255.027	290.111	260.834	279.820	287.843	330.255	284.965
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	103.360	100.700	104.500	102.000	102.500	102.500	112.746	115.000
TOTAL	504.483	533.838	576.297	535.532	550.449	558.465	620.819	563.192
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	26.767	25.084	24.421	24.572	24.630	25.090	26.440	27.175
Gaseous Fuels	141.401	143.186	131.595	132.207	145.144	151.979	149.111	152.348
Solid Fuels	300.920	289.756	265.455	260.056	275.731	274.404	257.671	208.452

Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	116.850	116.850	105.450	108.395	111.435	109.725	237.671	219.724
TOTAL	585.938	574.876	526.922	525.230	556.939	561.198	670.893	607.699
	2020	2021	2022	2023	2024			
Liquid Fuels	25.838	26.064	24.953	23.247	22.154			
Gaseous Fuels	160.833	191.171	181.655	176.065	177.272			
Solid Fuels	217.719	203.368	172.464	171.672	151.426			
Other Fuels	0.000	0.000	0.000	0.000	0.000			
Biomass	203.228	207.136	196.917	183.250	184.775			
TOTAL	607.618	627.739	575.989	554.234	535.627			

Figure 3.2.9.4 show emissions of CO₂ in 1.A.4.b in the 1988-2024 period while CH₄ and N₂O, emissions in the same sub-category are shown in figure 3.2.9.5.

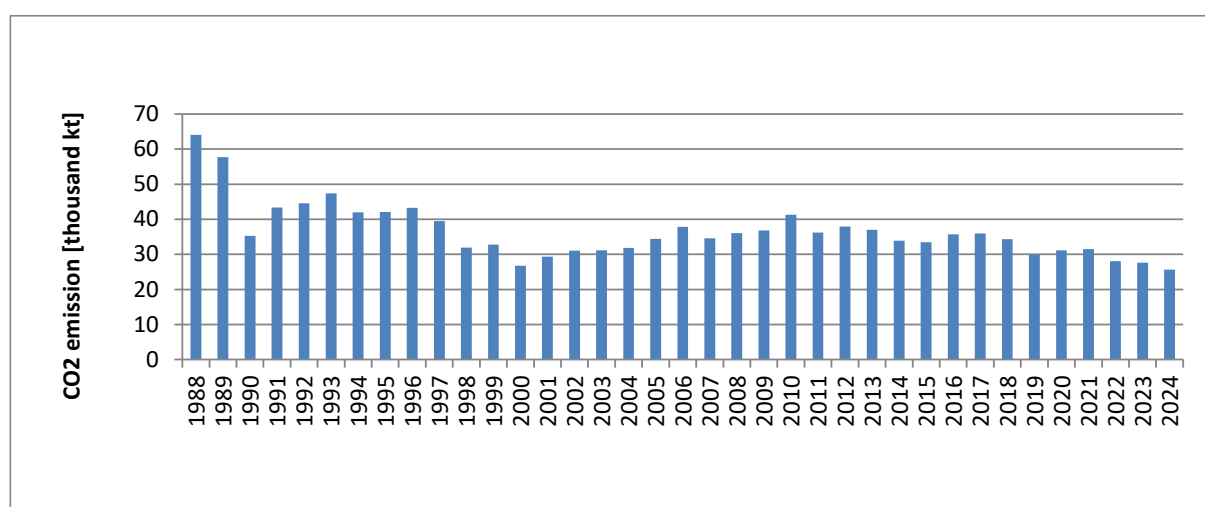


Figure 3.2.9.4. CO₂ emission for 1.A.4.b category in 1988-2024

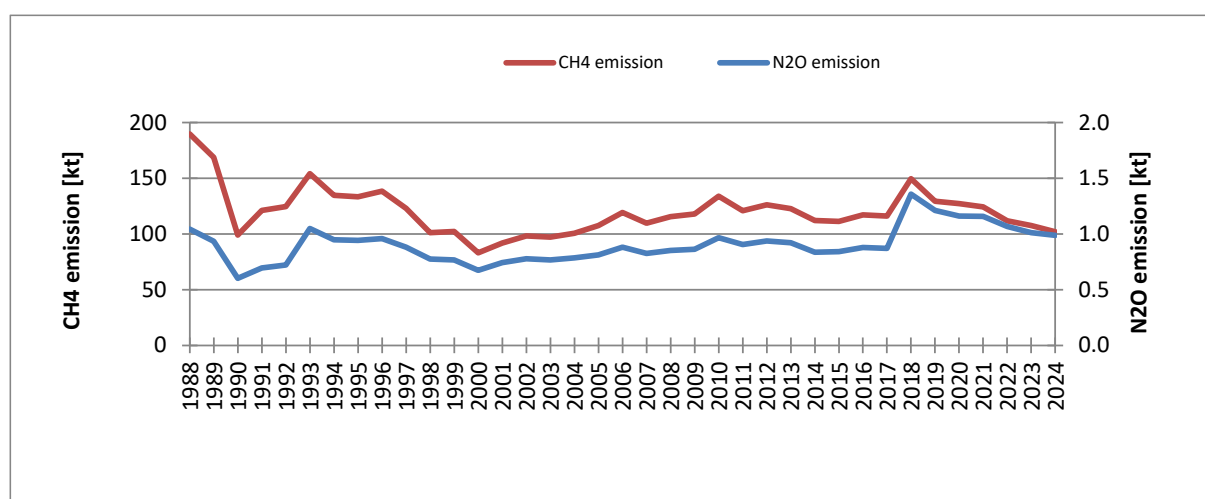


Figure 3.2.9.5. CH₄ and N₂O emissions for 1.A.4.b category in 1988-2024

3.2.9.2.3. Other sectors – Agriculture/forestry/fishing – Stationary (CRT sector 1.A.4.c.i)

The data on fuel type use in sub-category 1.A.4.c.i *Agriculture/forestry/fishing – Stationary* over the 1988-2024 period are presented in table 3.2.9.3. Detailed data concerning total fuel consumption in 1.A.4.c subcategory (including fuel consumption related to off-road vehicles and other machinery in agriculture and fuel use in fishing) was tabulated in Annex 5.3 (table 13).

Table 3.2.9.3. Fuel consumption in 1.A.4.c.i subcategory for years 1988-2024 [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	2.720	2.600	3.596	2.747	1.454	14.199	18.468	10.624
Gaseous Fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243
Solid Fuels	42.691	42.026	39.285	59.666	64.630	63.925	66.182	64.198
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.039	0.113	0.000	0.000	0.000	20.057	18.367	18.500
TOTAL	45.956	45.185	43.328	62.689	66.139	98.313	103.229	93.566
	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	6.330	9.241	8.263	8.519	8.921	8.588	7.023	9.520
Gaseous Fuels	0.428	0.571	0.869	0.476	0.536	0.777	0.914	1.197
Solid Fuels	67.920	58.853	52.806	55.390	37.586	41.898	35.057	34.078
Other Fuels	0.000	0.000	0.000	0.006	0.012	0.011	0.000	0.000
Biomass	17.567	17.000	17.100	17.106	17.113	19.053	19.010	19.017
TOTAL	92.245	85.664	79.038	81.497	64.168	70.327	62.004	63.811
	2004	2005	2006	2007	2008	2009	2010	2011
Liquid Fuels	9.552	10.849	4.412	3.799	4.007	3.495	3.265	3.671
Gaseous Fuels	1.182	1.084	1.492	1.841	1.900	1.577	1.486	1.531
Solid Fuels	35.787	38.979	45.996	40.708	45.296	44.910	49.905	43.833
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	19.878	19.047	19.978	19.062	19.118	19.127	21.127	24.154
TOTAL	66.398	69.958	71.879	65.409	70.322	69.109	75.783	73.189
	2012	2013	2014	2015	2016	2017	2018	2019
Liquid Fuels	3.705	2.905	2.962	3.065	3.363	3.490	3.305	3.447
Gaseous Fuels	1.796	1.501	1.438	1.144	1.305	1.519	1.267	1.558
Solid Fuels	45.502	44.474	42.312	38.431	40.873	40.583	38.087	30.776
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	21.200	21.223	19.638	20.641	21.831	21.672	21.093	19.977
TOTAL	72.203	70.103	66.350	63.281	67.372	67.264	63.751	55.758
	2020	2021	2022	2023	2024			
Liquid Fuels	3.307	2.974	0.949	2.170	1.943			
Gaseous Fuels	1.806	2.176	1.528	1.668	1.845			
Solid Fuels	31.579	25.901	20.404	18.450	13.419			
Other Fuels	0.000	0.000	0.000	0.000	0.000			
Biomass	20.438	24.237	19.802	18.302	16.928			
TOTAL	57.129	55.288	42.683	40.590	34.135			

Figures 3.2.9.6 and 3.2.9.7 show emissions of CO₂ and CH₄ and N₂O, respectively in the sub-category 1.A.4.c.i in the period: 1988-2024.

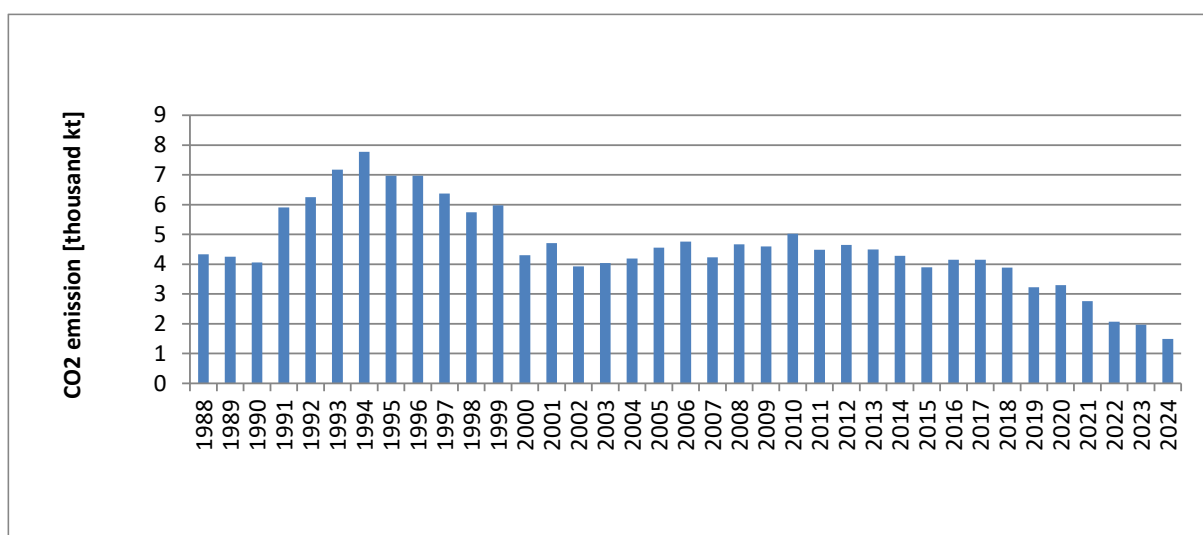


Figure 3.2.9.6. CO₂ emission in 1.A.4.c.i category in 1988-2024

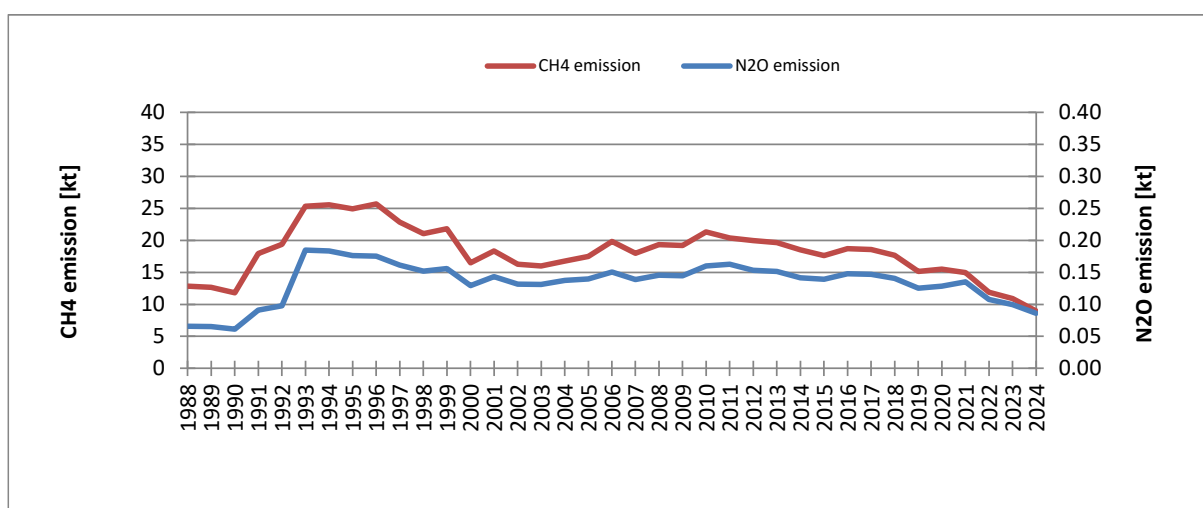


Figure 3.2.9.7. CH₄ and N₂O emissions in 1.A.4.c.i category in 1988-2024

The mobile sources classified in the sub-category 1.A.4.c (i.e. 1.A.4.c.ii *Off-road vehicles and other machinery* and 1.A.4.c.iii *Fishing*) are described in chapter 3.2.8.2.6.

3.2.9.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.2.9.4. Source-specific QA/QC and verification

See chapter 3.2.6.4

3.2.9.5. Source-specific recalculations

GHG emission recalculations are mainly the result of the following statistical data updates:

- correction of solid biomass consumption in households for 2021 and 2022,
- braun coal briquettes consumption update for 2021 in 1.A4.c subcategory,
- natural gas consumption adjustments in 1.A.4.a and 1.A.4.b subcategories, starting from 2010.

Table 3.2.9.4. Changes of GHG emission values in 1.A.4 subcategory as a result of recalculations

Changes	1988	1989	1990	1991	1992	1993	1994	1995	1996
CO ₂									
kt	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
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	1997	1998	1999	2000	2001	2002	2003	2004	2005
CO ₂									
kt	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
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO ₂									
kt	0.00	0.00	0.00	0.00	0.35	-0.57	0.35	-0.13	-0.23
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Changes	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂									
kt	0.47	-0.42	0.54	0.00	0.00	0.00	6.15	0.00	-8.40
%	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.02
CH ₄									
kt	0.000	0.000	0.000	0.000	0.000	0.000	-0.167	-2.474	-0.001
%	0.00	0.00	0.00	0.00	0.00	0.00	-0.12	-1.91	0.00
N ₂ O									
kt	0.000	0.000	0.000	0.000	0.000	0.000	-0.002	-0.033	0.002
%	0.00	0.00	0.00	0.00	0.00	0.00	-0.06	-0.87	0.05

3.2.9.6. Source-specific planned improvements

No improvements are planned at the moment.

3.3. Fugitive emissions (CRF sector 1.B)

3.3.1. Fugitive emission from solid fuels (CRF sector 1.B.1)

3.3.1.1. Source category description

Fugitive emission from solid fuels involves emission from coal mining and handling (CH_4) and emission from coke oven gas subsystem (CO_2 and CH_4).

The biggest share of emission in 1.B category comes from coal mining and handling. The hard coal and lignite extraction are presented at the graph below (Figure 3.3.1). The main reason for the decreasing coal extraction since late 1980s was the declining demand for coal and lignite in the economy.

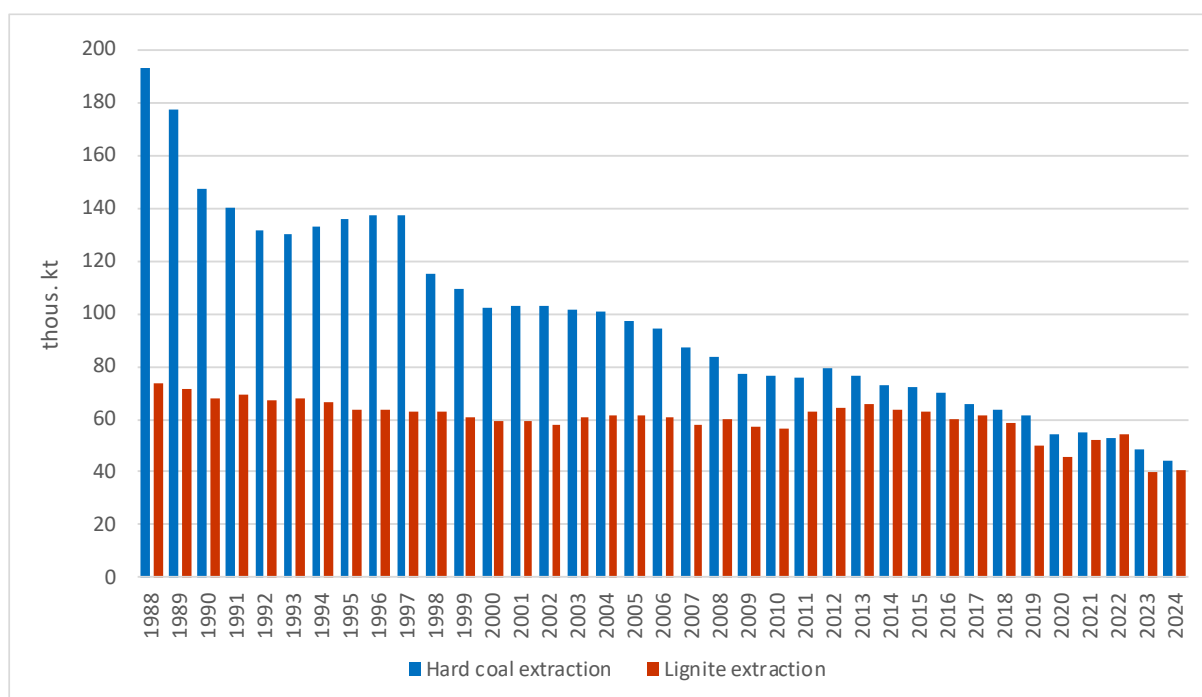


Figure 3.3.1. Hard coal and lignite extraction in 1988-2024

3.3.1.2. Methodological issues

3.3.1.2.1 Fugitive emissions from fuels – coal mining (CRF sector 1.B.1.a.)

Coal Mining and Handling – underground mines (1.B.1.a.i.)

The case study has been developed for estimating methane emission from coal mining – “The national methodology for estimating methane emissions from coal mining for reporting to the national inventory of greenhouse gases emissions and removals” (National Centre for Emission Management 2016, in Polish).

Data published by Eurostat, are used to calculate the amount of methane emitted during coal mining in each year. For 2024, data published in the report "Evaluation of work safety, mine rescue and public safety related with the activities of mining and geology in 2024" (https://www.wug.gov.pl/bhp/stan_bhp_w_gornictwie), on methane emission intensity and use (table 11, page 24) were applied to calculate the actual total emissions of methane from coal mines. Poland has reached out to the Higher Mining Office – the supervising body for mining facilities in Poland – requesting information regarding methane burning on flares. Poland has received information stating that methane burning on flares accompanying the extraction of hard coal and brown coal does not occur in Poland.

Table 3.3.1. shows data on methane emissions and accompanying data related to coal mining, including the CH₄ implied emission factors for each year, in relation to hard coal extraction, for comparison purposes.

Table 3.3.1. Activity data used to calculate the CH₄ emissions from coal mining in 1988-2024

Year	Methane content [mln m ³]	Methane use for energy production [mln m ³]	CH ₄ emission from underground mining as published by State Mining Authority [kt]	Underground coal production [Mg]	Implied CH ₄ emission factor [kg/t]	Implied CH ₄ emission factor [m ³ /t]
	a	b	a-b			
1988	1037.20	207.90	555.63	193 015 000	2.88	4.30
1989	1045.73	208.43	560.99	177 633 000	3.16	4.71
1990	988.92	188.53	536.26	147 493 000	3.64	5.43
1991	829.24	185.10	431.57	140 027 000	3.08	4.60
1992	848.09	174.06	451.60	131 313 000	3.44	5.13
1993	779.96	167.60	410.28	130 047 000	3.15	4.71
1994	764.53	136.30	420.91	133 127 000	3.16	4.72
1995	745.31	137.10	407.50	136 190 000	2.99	4.47
1996	748.40	147.50	402.60	137 048 000	2.94	4.38
1997	748.40	134.40	411.38	137 129 000	3.00	4.48
1998	763.30	152.70	409.10	115 145 000	3.55	5.30
1999	744.50	136.90	407.09	109 322 000	3.72	5.56
2000	746.90	124.00	417.34	102 219 000	4.08	6.09
2001	743.70	131.50	410.17	103 280 000	3.97	5.93
2002	752.60	122.40	422.23	102 723 000	4.11	6.13
2003	798.10	127.80	449.10	101 659 000	4.42	6.59
2004	825.90	144.20	456.74	100 517 000	4.54	6.78
2005	851.10	144.80	473.22	97 110 000	4.87	7.27
2006	870.30	158.30	477.04	94 407 000	5.05	7.54
2007	878.90	165.70	477.84	87 406 000	5.47	8.16
2008	880.90	156.50	485.35	83 661 000	5.80	8.66
2009	855.70	159.50	466.45	77 478 000	6.02	8.99
2010	836.40	161.10	452.45	76 172 000	5.94	8.87
2011	828.80	166.30	443.88	75 668 000	5.87	8.76
2012	828.20	178.60	435.23	79 234 000	5.49	8.20
2013	847.80	187.70	442.27	76 466 000	5.78	8.63
2014	891.10	211.40	455.40	72 540 000	6.28	9.37
2015	933.00	197.10	493.05	72 176 000	6.83	10.20
2016	933.80	195.00	495.00	70 385 000	7.03	10.50
2017	948.50	212.00	493.46	65 479 946	7.54	11.25
2018	916.10	203.10	477.71	63 384 045	7.54	11.25
2019	803.80	189.40	411.65	61 623 387	6.68	9.97
2020	819.62	187.90	423.25	54 385 927	7.78	11.62
2021	815.30	214.20	402.74	55 006 381	7.32	10.93
2022	778.90	206.10	383.78	52 829 352	7.26	10.84
2023	752.10	200.90	369.30	48 352 644	7.64	11.40
2024	722.10	191.51	355.50	43 945 270	8.09	12.07

It should be stressed that the data on emissions are collected and analyzed in a systematic way and they are published according to the law. These data therefore meet the requirements of data quality (QA/QC) arising from IPCC Guidelines in terms of durability and consistency of methodology.

This methodology is in line with Tier 3 approach (Tier 3 approach) of the IPCC Guidelines (2006) as it is based on direct measurements and calculations of fugitive emissions from coal mines. The annual CH₄ implied emission factor increased due to mining occurring at deeper levels, in highly methaniferous seams.

Fugitive emission of CH₄ from post-mining was estimated based on the activity data concerning hard coal extraction amount from Eurostat and emission factors presented in table 3.3.2. have been taken from IPCC 2006.

Table 3.3.2. CH₄ Emission factor for calculation post-mining emission from coal mines

CH ₄ emission factor	
Post - Mining	2.50 [m ³ CH ₄ /t; IPCC 2006, page 4.12]

Tier 1 method was used for calculation of fugitive emissions from abandoned underground mines (1.B.1.iii.) [IPCC 2006. page 4.21 equation 4.1.9.] Fugitive emissions of CH₄ from mine closure was estimated based on number of abandoned underground mines provided by State Mining Authority [WUG] and emission factors from IPCC 2006 – table 4.1.5., 4.1.6. and 4.1.7.

Table 3.3.3 shows data on number of closed coal mines, emission factor used and total emission from abandoned underground mines in 1988-2024.

Table 3.3.3. Activity data on number of closed coal mines. emission factors and total emission from abandoned underground mines

Inventory year	Number of closed mines per time brand 1976-2000	Emission factor - for interval of mine closure [mln m ³ /mine]	Number of closed mines per time brand 2001-present	Emission factor - for interval of mine closure [mln m ³ /mine]	Fraction of gassy mines	Conversion factor [kg/m ³]	Total emission from closed mines [Gg CH ₄]
1988	0	1.561	0	NA	1.00	0.67	0
1989	0	1.561	0	NA	1.00	0.67	0
1990	0	1.561	0	NA	1.00	0.67	0
1991	0	1.334	0	NA	1.00	0.67	0
1992	0	1.83	0	NA	1.00	0.67	0
1993	0	1.072	0	NA	1.00	0.67	0
1994	0	0.988	0	NA	1.00	0.67	0
1995	1	0.921	0	NA	1.00	0.67	0.62
1996	2	0.865	0	NA	1.00	0.67	1.16
1997	3	0.818	0	NA	1.00	0.67	1.64
1998	4	0.778	0	NA	1.00	0.67	2.09
1999	4	0.743	0	NA	1.00	0.67	1.99
2000	10	0.713	0	NA	1.00	0.67	4.78
2001	10	0.686	7	5.735	1.00	0.67	31.49
2002	10	0.661	12	2.397	1.00	0.67	23.70
2003	10	0.639	12	1.762	1.00	0.67	18.45
2004	10	0.620	13	1.454	1.00	0.67	16.82
2005	10	0.601	13	1.265	1.00	0.67	15.04
2006	10	0.585	13	1.133	1.00	0.67	13.79
2007	10	0.569	13	1.035	1.00	0.67	12.83
2008	10	0.555	13	0.959	1.00	0.67	12.07
2009	10	0.542	13	0.896	1.00	0.67	11.44
2010	10	0.529	13	0.845	1.00	0.67	10.90
2011	10	0.518	13	0.801	1.00	0.67	10.45
2012	10	0.507	13	0.763	1.00	0.67	10.04
2013	10	0.496	13	0.730	1.00	0.67	9.68
2014	10	0.487	13	0.701	1.00	0.67	9.37
2015	10	0.478	18	0.675	1.00	0.67	11.34
2016	10	0.469	22	0.652	1.00	0.67	12.75
2017	10	0.439	24	0.625	1.00	0.67	12.99
2018	10	0.432	29	0.604	1.00	0.67	14.63
2019	10	0.425	29	0.586	1.00	0.67	14.23
2020	10	0.419	29	0.569	1.00	0.67	13.86
2021	10	0.413	29	0.555	1.00	0.67	13.55
2022	10	0.408	30	0.542	1.00	0.67	13.63
2023	10	0.402	33	0.529	1.00	0.67	14.39
2024	10	0.397	33	0.518	1.00	0.67	14.11

Coal Mining and Handling – surface mines (1.B.1.a.ii.)

Tier 1 method was used for calculation of fugitive emissions from surface mining and post-mining [IPCC 2006, page 4.18-4.19]. Fugitive emission of CH₄ from surface mining and post-mining was estimated based on the activity data concerning lignite extraction amount from Eurostat database and emission factors from IPCC 2006 (table 3.3.4).

Table 3.3.4. CH₄ Emission factor for calculation mining and post-mining emission from surface coal mining

CH ₄ emission factor	
Mining	1.20 [m ³ CH ₄ /t; IPCC 2006, page 4.18]
Post - Mining	0.1 [m ³ CH ₄ /t; IPCC 2006, page 4.19]

The conversion factor applied for recalculation of emitted methane volume to mass is 0.67 kg/m³ taking into account gas density at 20°C and 1 atmosphere pressure.

In table 3.3.5 data is shown on lignite extraction and total methane emissions from lignite mines in 1988-2024.

Table 3.3.5. Lignite extraction and total methane emissions from lignite mines in 1988-2024

Year	Lignite extraction amount [kt]	CH ₄ emission [kt]
1988	73489.00	64.01
1989	71816.00	62.55
1990	67584.00	58.87
1991	69406.00	60.45
1992	66852.00	58.23
1993	68105.00	59.32
1994	66770.00	58.16
1995	63547.00	55.35
1996	63845.00	55.61
1997	63169.00	55.02
1998	62820.00	54.72
1999	60839.00	52.99
2000	59484.00	51.81
2001	59552.00	51.87
2002	58210.00	50.70
2003	60920.00	53.06
2004	61198.00	53.30
2005	61636.00	53.68
2006	60844.00	53.00
2007	57538.00	50.12
2008	59668.00	51.97
2009	57108.00	49.74
2010	56510.00	49.22
2011	62841.00	54.73
2012	64280.00	55.99
2013	65849.00	57.35
2014	63877.00	55.64
2015	63128.00	54.98
2016	60246.00	52.47
2017	61160.66	53.27
2018	58570.90	51.02
2019	50328.58	43.84
2020	45983.41	40.05

Year	Lignite extraction amount [kt]	CH ₄ emission [kt]
2021	52355.51	45.60
2022	54621.41	47.58
2023	40100.59	34.93
2024	40974.99	35.69

3.3.1.2.2. Fugitive emission from solid fuel transformation (1.B.1.b)

Processing emission of CO₂ from coking plants in the period 1990-2024 was estimated based on carbon budgets in the coking plants (tab. 3.3.6). Data concerning input and output are based on Eurostat and Statistics Poland. Coke production for 1990-2024 were applied according to data in Eurostat [Eurostat].

The Eurostat database does not cover energy balances for Poland for the years before 1990, therefore data on input and output in coking plants (i.e. coke output) applied for C balance in coke production process for the years 1988-1989 were taken from IEA database [IEA].

The amounts of carbon in the input and output components used in C balances for entire period were calculated based on IPCC factors [IPCC 1997, IPCC 2006].

Fuels given as the input in C balance for coke production process (tab. 3.3.6) did not include the fuels for energy purpose of the process. Emission from coke production given in 1.A.1.c subcategory was related to the fuel consumption for energy purpose of the coke plants, so double counting should not be the case in GHG inventory.

CH₄ emission in the period 1990-2024 was estimated based on coke production volume from [Eurostat] while for 1988 and 1989 from [IEA]. For the entire period emission factor 0.1 g CH₄/Mg coke produced [IPCC 2006 chapter 4, table 4.2. page 4.26] was applied.

Table 3.3.6. Carbon balance for coke production in years 1988-2024

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
INPUT [TJ]														
Coking coal	656 592	637 742	535 538	448 105	437 665	405 168	436 596	451 761	403 902	423 800	377 787	338 208	366 814	362 343
High Methane Natural Gas	0.00	1 238.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke			962	548	1 788	1 679	2 473	2 353	1 836	1 640	1 975	1 429	1 896	982
Blast furnace gas	0.00	151.98	0	0	0	0	0	0	0	0	0	0	0	0
Tar	0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Industrial waste	6.99	0.00	0	0	0	0	0	0	0	0	0	0	0	0
NCV [MJ/kg]														
Coking coal	29.41	29.41	29.41	29.41	29.41	29.41	28.49	29.36	29.36	29.45	29.54	29.48	29.62	29.53
INPUT – Material-specific carbon content [kg C/GJ]														
Coking coal	26.02	26.02	26.02	26.02	26.02	26.02	26.06	26.03	26.03	26.02	26.02	26.02	26.02	26.02
High Methane Natural Gas	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30
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
Blast furnace gas	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80
Tar	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Industrial waste	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00
INPUT – Carbon contents in charge components [kt]														
Coking coal	17 087.58	16 597.00	13 937.16	11 661.75	11 390.05	10 544.33	11 378.08	11 757.78	10 512.08	11 028.54	9 829.87	8 800.85	9 543.24	9 428.21
High Methane Natural Gas	0.00	18.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke	0.00	0.00	28.10	16.00	52.22	49.04	72.20	68.70	53.60	47.88	57.66	41.72	55.37	28.68
Blast furnace gas	0.00	10.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tar	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
Industrial waste	0.27	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
Carbon contents in charge – SUM [kt]	17 087.85	16 626.71	13 965.26	11 677.75	11 442.26	10 593.36	11 450.28	11 826.48	10 565.68	11 076.42	9 887.52	8 842.57	9 598.61	9 456.90
OUTPUT [TJ]														
Coke	471 501.80	455 831.82	376 934.21	319 455.64	311 718.15	288 275.40	320 980.56	322 354.68	288 272.00	298 024.62	266 036.56	228 421.30	254 374.14	252 286.15
Coke-Oven Gas	118 914.58	117 040.40	96 831.90	84 743.10	82 306.80	75 753.00	84 002.40	84 766.50	76 035.60	79 286.40	73 457.10	62 989.20	68 849.10	69 008.40
Tar	27 580.00	27 429.30	22 885.30	20 268.20	20 648.10	19 071.40	21 146.60	21 265.00	19 831.90	19 600.40	17 949.60	16 264.80	17 003.00	17 232.60
Benzol	7 701.50	7 230.90	6 166.90	5 150.70	5 646.20	5 159.10	6 010.60	6 056.50	5 446.70	5 428.60	4 856.90	4 524.70	2 498.50	4 788.60
OUTPUT – Material-specific carbon content [kg C/GJ]														
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
Coke-Oven Gas	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10
Tar	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Benzol	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
OUTPUT – Carbon content in products [kt]														
Coke	13 767.85	13 310.29	11 006.48	9 328.10	9 102.17	8 417.64	9 372.63	9 412.76	8 417.54	8 702.32	7 768.27	6 669.90	7 427.73	7 366.76
Coke-Oven Gas	1 438.87	1 416.19	1 171.67	1 025.39	995.91	916.61	1 016.43	1 025.67	920.03	959.37	888.83	762.17	833.07	835.00
Tar	606.76	603.44	503.48	445.90	454.26	419.57	465.23	467.83	436.30	431.21	394.89	357.83	374.07	379.12
Benzol	177.13	166.31	141.84	118.47	129.86	118.66	138.24	139.30	125.27	124.86	111.71	104.07	57.47	110.14
Carbon content in products – SUM [kt]	15 990.61	15 496.23	12 823.46	10 917.86	10 682.20	9 872.48	10 992.53	11 045.56	9 899.15	10 217.75	9 163.70	7 893.96	8 692.33	8 691.01
C process emission[kt]	1 097.23	1 130.48	1 141.80	759.89	760.06	720.88	457.75	780.92	666.53	858.67	723.83	948.60	906.28	765.88
CO₂ process emission[kt]	4 023.19	4 145.10	4 186.60	2 786.25	2 786.88	2 643.23	1 678.42	2 863.36	2 443.93	3 148.45	2 654.03	3 478.21	3 323.04	2 808.24
Coke output [kt]	17 007.00	16 499.00	13 516.00	11 356.00	11 066.00	10 275.00	11 455.00	11 578.00	10 339.00	10 535.00	9 746.00	8 368.00	8 972.00	8 946.00
EF [kg CO₂/Mg of coke]	237	251	310	245	252	257	147	247	236	299	272	416	370	314

Table 3.3.6. (cont.) Carbon balance for coke production in years 1988-2024

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
INPUT [TJ]														
Coking coal	353 752	410 854	400 604	332 566	380 135	402 391	389 792	274 662	381 938	364 348	350 150	371 333	375 885	382 750
High Methane Natural Gas	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
Coke	1 642	1 435	1 505	1 926	2 076	2 278	2 735	1 681	2 625	2 570	1 976	1 403	1 677	2 319
Blast furnace gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tar	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industrial waste	0	0	6	14	0	0	0	0	4	0	0	0	0	0
NCV [MJ/kg]														
Coking coal	29.53	29.56	29.55	29.51	29.59	29.50	29.57	29.56	29.49	29.52	29.60	29.59	29.55	29.54
INPUT – Material-specific carbon content [kg C/GJ]														
Coking coal	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02
High Methane Natural Gas	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30
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
Blast furnace gas	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80
Tar	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Industrial waste	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00
INPUT – Carbon contents in charge components [kt]														
Coking coal	9 204.60	10 689.96	10 423.35	8 653.64	9 890.18	10 470.63	10 141.78	7 146.40	9 938.58	9 480.46	9 109.96	9 661.19	9 780.18	9 959.00
High Methane Natural Gas	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
Coke	47.95	41.91	43.96	56.24	60.63	66.51	79.85	49.07	76.64	75.06	57.71	40.96	48.98	67.71
Blast furnace gas	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
Tar	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
Industrial waste	0.00	0.00	0.22	0.53	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00
Carbon contents in charge – SUM [kt]	9 252.55	10 731.86	10 467.53	8 710.41	9 950.81	10 537.14	10 221.63	7 195.48	10 015.36	9 555.51	9 167.67	9 702.15	9 829.16	10 026.71
OUTPUT [TJ]														
Coke	246 206.68	285 906.69	285 926.85	237 152.48	270 125.30	287 632.38	281 354.45	196 753.98	273 830.55	261 046.30	249 973.34	261 200.16	265 751.20	274 176.00
Coke-Oven Gas	65 570.40	75 090.60	72 946.80	61 947.00	71 712.00	76 950.00	73 935.00	53 376.30	73 008.00	69 440.40	65 321.10	68 843.70	69 753.60	71 336.70
Tar	16 462.60	18 188.10	17 796.24	14 907.24	16 219.60	17 351.20	15 729.24	11 844.08	16 483.64	15 276.60	14 182.72	14 861.68	14 484.48	14 258.16
Benzol	4 474.80	5 253.30	5 358.28	4 403.18	3 803.70	5 315.63	4 711.94	3 373.43	4 892.60	4 518.80	4 125.10	4 465.40	4 455.90	4 548.20
OUTPUT – Material-specific carbon content [kg C/GJ]														
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
Coke-Oven Gas	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10
Tar	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Benzol	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
OUTPUT – Carbon content in products [kt]														
Coke	7 189.23	8 348.48	8 349.06	6 924.85	7 887.66	8 398.87	8 215.55	5 745.22	7 995.85	7 622.55	7 299.22	7 627.04	7 759.94	8 005.94
Coke-Oven Gas	793.40	908.60	882.66	749.56	867.72	931.10	894.61	645.85	883.40	840.23	790.39	833.01	844.02	863.17
Tar	362.18	400.14	391.52	327.96	356.83	381.73	346.04	260.57	362.64	336.09	312.02	326.96	318.66	313.68
Benzol	102.92	120.83	123.24	101.27	87.49	122.26	108.37	77.59	112.53	103.93	94.88	102.70	102.49	104.61
Carbon content in products – SUM [kt]	8 447.73	9 778.04	9 746.48	8 103.64	9 199.69	9 833.95	9 564.58	6 729.23	9 354.42	8 902.80	8 496.50	8 889.71	9 025.10	9 287.40
C process emission[kt]	804.82	953.83	721.05	606.77	751.12	703.20	657.05	466.25	660.94	652.72	671.16	812.44	804.06	739.30
CO₂ process emission[kt]	2 950.99	3 497.37	2 643.85	2 224.83	2 754.11	2 578.38	2 409.19	1 709.58	2 423.44	2 393.29	2 460.93	2 978.93	2 948.23	2 710.78
Coke output [kt]	8 723.00	10 112.00	10 097.00	8 404.00	9 613.00	10 168.00	10 075.00	7 091.00	9 844.00	9 377.00	8 893.00	9 360.00	9 568.00	9 792.00
EF [kg CO₂/Mg of coke]	338	346	262	265	286	254	239	241	246	255	277	318	308	277

Table 3.3.6. (cont.) Carbon balance for coke production in years 1988-2024

	2016	2017	2018	2019	2020	2021	2022	2023	2024
INPUT [TJ]									
Coking coal	378 556	369 738	374 507	351 579	307 415	362 235	329 504	311 524	295 538
High Methane Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke	2 066	2 287	2 413	2 132	2 013	2 949	2 835	2 236	2 114
Blast furnace gas	0	0	0	0	0	0	0	0	0
Tar	0	0	0	0	0	0	0	0	0
Industrial waste	0	0	0	0	0	0	0	0	0
NCV [MJ/kg]									
Coking coal	29.55	29.54	29.23	29.43	29.44	29.59	29.60	29.60	29.52
INPUT – Material-specific carbon content [kg C/GJ]									
Coking coal	26.02	26.02	26.03	26.02	26.02	26.02	26.02	26.02	26.02
High Methane Natural Gas	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30	15.30
Coke	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20
Blast furnace gas	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80	70.80
Tar	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Industrial waste	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00
INPUT – Carbon contents in charge components [kt]									
Coking coal	9 849.78	9 620.43	9 748.95	9 149.40	7 999.99	9 424.57	8 572.81	8 105.01	7690.04
High Methane Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coke	60.32	66.79	70.46	62.26	58.77	86.12	82.77	65.29	61.73
Blast furnace gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carbon contents in charge – SUM [kt]	9 910.09	9 687.23	9 819.40	9 211.66	8 058.76	9 510.69	8 655.58	8 170.30	7751.77
OUTPUT [TJ]									
Coke	272 104.00	263 706.60	265 237.53	249 651.05	217 927.30	259 946.30	237 510.00	224 093.55	212994.22
Coke-Oven Gas	70 472.70	69 167.16	70 428.16	67 301.19	58 877.35	70 230.15	63 083.21	60 619.82	57615.09
Tar	14 446.76	14 030.29	14 184.71	13 605.41	11 815.35	13 736.10	12 673.52	12 415.50	11950.78
Benzol	4 334.20	4 076.50	4 271.50	3 984.80	3 687.90	4 379.30	3 977.87	3 810.48	3610.92
OUTPUT – Material-specific carbon content [kg C/GJ]									
Coke	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20	29.20
Coke-Oven Gas	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10
Tar	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Benzol	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
OUTPUT – Carbon content in products [kt]									
Coke	7 945.44	7 700.23	7 744.94	7 289.81	6 363.48	7 590.43	6 935.29	6 543.53	6219.43
Coke-Oven Gas	852.72	836.92	852.18	814.34	712.42	849.78	763.31	733.50	697.14
Tar	317.83	308.67	312.06	299.32	259.94	302.19	278.82	273.14	262.92
Benzol	99.69	93.76	98.24	91.65	84.82	100.72	91.49	87.64	83.05
Carbon content in products – SUM [kt]	9 215.67	8 939.58	9 007.42	8 495.12	7 420.65	8 843.13	8 068.91	7 637.81	7262.54
C process emission[kt]	694.42	747.65	817.81	716.09	638.10	667.55	586.68	532.48	489.23
CO ₂ process emission[kt]	2 546.22	2 741.37	2 998.64	2 625.66	2 339.72	2 447.70	2 151.15	1 952.44	1793.83
Coke output [kt]	9 718	9 418.09	9 472.77	8 916.11	7 783.12	9 283.70	8 482.50	8 003.34	7606.94
EF [kg CO ₂ /Mg of coke]	262	291	317	294	301	264	254	244	236

3.3.1.2.3. Fugitive emissions from fuels – coke oven gas (CRF sector 1.B.1.c)

Tier 1 method has been used for calculation of fugitive emissions from coke oven gas system [IPCC 2006] while emission factors presented in table 3.3.7. have been taken from domestic case study [Steczko 1994]. Activity data for 1990-2024 come from [EUROSTAT]. For years: 1988-1989 the activity data come from [IEA] database.

Table 3.3.7. Emission factors for CO₂ and CH₄ from coke oven gas system (country specific EF)

Gas system emission factor [kt/PJ]	CO ₂	CH ₄
Gas processing	0.000194	0.000546
Gas transmission	0.020629	0.057977
Gas distribution	0.038056	0.106954

For coke-oven gas subsystem there is no possibility to add activity data in PJ in the CRF Reporter database, but only in kt. This conversion into kt was done only for reporting purposes under CRF Reporter (emission is estimated on the PJ activity data basis), the mentioned change has no impact on emissions.

3.3.1.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.3.1.4. Source-specific QA/QC and verification

QA/QC and verification are integral parts of the inventory and has been elaborated in line with the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006)*.

Activity data used in the GHG inventory concerning sector 1.B come from:

- Eurostat database which is provided data by the Statistics Poland (GUS),
- State Mining Authority (WUG "Evaluation of work safety, mine rescue and public safety in connection with the activities of mining and geology in 2025" (https://www.wug.gov.pl/bhp/stan_bhp_w_gornictwie),
- and from the study published by Polish Geological Institute [PIG 2025].

GUS, PIG and WUG are responsible for QA/QC of collected and published data. Activity data applied in GHG inventory are regularly checked and updated if necessary according to adjustments made in Eurostat database.

Generally QC procedures follow QA/QC plan presented in Annex 7.

3.3.1.5. Source-specific recalculations

Recalculation is result of correction of amounts of abandoned hard coal mines after year 2001 and IPCC 2019 methane emission factors for abandoned hard coal mines since 2016.

Emission changes for subcategory 1.B.1. are presented in table below.

Table 3.3.8. Emission recalculations for subcategory 1.B.1 *Fugitive emission from solid fuels*

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
kt CO ₂ eq.	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%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
kt CO ₂ eq.	0.00	-2023.08	-775.35	-541.23	-429.23	-361.88	-315.36	-281.59	-255.70	-234.50	-217.80	-203.36
%	0%	-9%	-3%	-2%	-2%	-2%	-1%	-1%	-1%	-1%	-1%	-1%

Change	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	-191.16	-180.85	-171.65	-163.59	-156.65	-174.43	-189.70	-200.81	-211.18	-219.92	-230.00	-245.36
%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-2%

3.3.1.6. Source-specific planned improvements

Analysis for possibility of updating the emission factors for the systems of coke-oven gas.

3.3.2. Fugitive emissions from oil and natural gas (CRF sector 1.B.2)

3.3.2.1. Source category description

Fugitive emission from oil and natural gas include fugitive emissions from extraction, transport and refining of oil, from production, processing, transmission, distribution and underground storage of gas as well as from venting and flaring of gas and oil.

3.3.2.2. Methodological issues

3.3.2.2.1 Fugitive emissions from fuels – oil (CRF sector 1.B.2.a)

Tier 1 method has been used for calculation of fugitive emissions from oil system [IPCC 2006]. For years: 1988-1989 the activity data come from [IEA] database, for 1990-2024 come from Eurostat (table 3.3.9).

Table 3.3.9. Activity data for emission from oil system in years 1988-2024

Year	Oil extraction [kt]		Import	Transport	Input to oil refineries
	off shore	on shore	[kt]	[kt]	[kt]
1988	0.00	155.51	14 625.88	14 781.39	14 625.88
1989	0.00	153.19	14 367.84	14 521.03	14 856.69
1990	0.00	160.00	13 126.00	13 286.00	12 846.00
1991	0.00	158.00	11 454.00	11 612.00	11 726.00
1992	0.00	200.00	13 052.00	13 252.00	13 146.00
1993	0.00	235.00	13 674.00	13 909.00	13 366.00
1994	0.00	284.00	12 721.00	13 005.00	13 448.00
1995	0.00	292.00	12 957.00	13 249.00	13 443.00
1996	0.00	317.00	14 026.00	14 343.00	14 597.00
1997	0.00	289.00	14 713.00	15 002.00	14 884.00
1998	0.00	360.00	15 367.00	15 727.00	16 023.00
1999	0.00	434.00	16 022.00	16 456.00	16 719.00
2000	0.00	653.00	18 002.00	18 655.00	18 274.00
2001	0.00	767.00	17 558.00	18 325.00	17 962.00
2002	0.00	728.00	17 942.00	18 670.00	17 785.00
2003	271.60	493.40	17 448.00	18 213.00	17 457.00
2004	259.85	626.15	17 316.00	18 202.00	18 118.00
2005	242.37	605.63	17 912.00	18 760.00	18 165.00
2006	270.05	525.95	19 813.00	20 609.00	20 045.00
2007	196.62	524.38	20 885.00	21 606.00	20 113.00
2008	263.34	491.66	20 787.00	21 542.00	20 804.00
2009	182.73	504.27	20 098.00	20 785.00	20 304.00
2010	192.30	494.70	22 688.00	23 375.00	22 843.00
2011	153.06	463.94	23 792.00	24 409.00	24 001.00
2012	192.72	488.28	24 633.00	25 314.00	25 153.00
2013	151.19	810.81	23 347.00	24 309.00	24 302.00
2014	165.74	785.26	23 713.00	24 664.00	24 196.00
2015	167.66	760.34	26 492.00	27 420.00	26 140.00
2016	248.48	752.52	24 573.00	25 574.00	25 790.00
2017	221.63	774.42	24 647.77	25 643.82	25 139.29
2018	207.17	803.16	26 846.87	27 857.20	26 899.16
2019	203.96	768.61	26 622.01	27 594.57	27 181.30
2020	234.41	703.05	24 905.81	25 843.27	25 757.17
2021	252.50	635.58	23 619.55	24 507.63	24 755.16
2022	258.92	595.13	26 290.81	27 144.85	26 644.55
2023	269.64	556.24	24 493.09	25 318.97	24 978.82
2024	288.60	514.35	25 522.76	26 325.70	26 000.00

CO₂ and CH₄ factors used for estimation of emissions from oil exploration and production have

been sourced from IPCC 2006.

Table 3.3.10. Emission factors for CO₂ and CH₄ from oil exploration

Oil system	Emission factors	Source
CO₂		
Exploration – well drilling [kt/10 ³ m ³]	0.0001	IPCC 2006 page 4.48 table 4.2.4.
Exploration – well testing [kt/10 ³ m ³]	0.009	IPCC 2006 page 4.48 table 4.2.4.
Exploration – well servicing [kt/10 ³ m ³]	0.0000019	IPCC 2006 page 4.48 table 4.2.4.
CH₄		
Exploration – well drilling [kt/10 ³ m ³]	0.000033	IPCC 2006 page 4.48 table 4.2.4.
Exploration – well testing [kt/10 ³ m ³]	0.000051	IPCC 2006 page 4.48 table 4.2.4.
Exploration – well servicing [kt/10 ³ m ³]	0.00011	IPCC 2006 page 4.48 table 4.2.4.

Table 3.3.11. Emission factors for CO₂ and CH₄ from oil production

Oil system	Emission factors	Source
CO₂		
Oil production - offshore [kt/10 ³ m ³]	0.000043	IPCC 2006 page 4.50 table 4.2.4.
Oil production - onshore [kt/10 ³ m ³]	0.26	IPCC 2006 page 4.50 table 4.2.4.
Oil transmission [kt/10 ³ m ³]	0.00049	IPCC 2006 page 4.52 table 4.2.4.
CH₄		
Oil production - offshore [kt/10 ³ m ³]	0.00059	IPCC 2006 page 4.50 table 4.2.4.
Oil production - onshore [kt/10 ³ m ³]	3.6	IPCC 2006 page 4.50 table 4.2.4.
Oil transmission [kt/10 ³ m ³]	0.0054	IPCC 2006 page 4.52 table 4.2.4.
Refining [kt/10 ³ m ³]	0.0410	IPCC 2006 page 4.53 table 4.2.4.

3.3.2.2.2 Fugitive emissions from fuels – natural gas (CRF sector 1.B.2.b)

Estimation of CO₂ and CH₄ emissions from natural gas was performed based on *Tier 1* method [IPCC 2006]. Activity data for 1990-2024 come from [EUROSTAT]. Data on final consumption (utility sales of natural gas) consist of data from industry sector and other sectors. For years 1988-1989 activity data come from [IEA] database. Activity data are given in table 3.3.12.

Table 3.3.12. Activities for natural gas system

Year	Production [PJ]	Final consumption (utility sales) [PJ]
1988	156.6	256.6
1989	145.0	248.2
1990	99.6	241.5
1991	111.3	224.4
1992	107.2	223.1
1993	136.9	233.8
1994	129.8	243.0
1995	132.7	253.9
1996	131.5	255.8
1997	134.2	275.3
1998	136.0	266.9
1999	129.9	260.8
2000	138.7	262.2
2001	146.2	280.0
2002	149.4	283.7
2003	151.2	296.9
2004	164.4	310.6
2005	162.6	321.6
2006	162.5	326.7
2007	163.1	328.9
2008	154.5	331.0
2009	154.0	334.5

Year	Production [PJ]	Final consumption (utility sales) [PJ]
2010	154.6	362.7
2011	161.2	348.1
2012	163.6	356.1
2013	160.1	356.5
2014	156.0	334.4
2015	154.2	340.4
2016	148.7	370.2
2017	147.0	368.6
2018	145.2	370.4
2019	143.7	374.1
2020	142.2	372.0
2021	139.8	438.2
2022	137.0	400.9
2023	132.2	390.3
2024	129.0	400.4

Emission factors gas system for exploration, production, processing, transmission and distribution was taken from IPCC 2006. Emission factor listed in table 3.3.13.

Table 3.3.13. Emission factors for CO₂ and CH₄ from natural gas system [IPCC 2006, table 4.2.4]

Oil system	Emission factors	Source
CO₂		
Gas production - offshore [kt/10 ⁶ m ³]	0.000014	IPCC 2006 page 4.48 table 4.2.4.
Gas production - onshore [kt/10 ⁶ m ³]	0.000082	IPCC 2006 page 4.48 table 4.2.4.
Gas processing default weighted total [kt/10 ⁶ m ³]	0.00032	IPCC 2006 page 4.49 table 4.2.4.
Gas transmission and storage – transmission [kt/10 ⁶ m ³]	0.00000088	IPCC 2006 page 4.49 table 4.2.4.
Gas transmission and storage – storage [kt/10 ⁶ m ³]	0.00000011	IPCC 2006 page 4.49 table 4.2.4.
Gas distribution [kt/10 ⁶ m ³]	0.000051	IPCC 2006 page 4.50 table 4.2.4.
CH₄		
Gas production - offshore [kt/10 ⁶ m ³]	0.00038	IPCC 2006 page 4.48 table 4.2.4.
Gas production - onshore [kt/10 ⁶ m ³]	0.0023	IPCC 2006 page 4.48 table 4.2.4.
Gas processing default weighted total [kt/10 ⁶ m ³]	0.00103	IPCC 2006 page 4.49 table 4.2.4.
Gas transmission and storage – transmission [kt/10 ⁶ m ³]	0.00048	IPCC 2006 page 4.49 table 4.2.4.
Gas transmission and storage – storage [kt/10 ⁶ m ³]	0.000025	IPCC 2006 page 4.49 table 4.2.4.
Gas distribution [kt/10 ⁶ m ³]	0.0011	IPCC 2006 page 4.50 table 4.2.4.

* Other Leakage are included to underground storage of gas (1.B.2.b.6. emissions associated with the exploitation of the gas storage)

Emissions associated with the exploitation of the gas storage.

Polish gas system (high-methane gas system) has four underground gas storage tanks gas with a total capacity of 0.6 billion m³. The emission includes:

- Emissions from leaks from heads exploiting operating holes,
- Emissions from pneumatic devices,
- Emissions from gas compressor station,
- Emissions from repair and maintenance,
- Emissions from breakdown [country study: Steczko 2003].

3.3.2.2.3 Fugitive emissions from fuels – Venting and Flaring (CRF sector 1.B.2.c)

Venting and Flaring in oil subsystem

CO₂ and CH₄ emission from venting and CO₂, CH₄ and N₂O emission from flaring were calculated in oil subsystem. Emission factors for both emissions were taken default from [IPCC 2006 page 4.50. table 4.2.4.]:

CO ₂ EF from venting:	0.000095	kt/10 ³ m ³
CH ₄ EF from venting:	0.00072	kt/10 ³ m ³
CO ₂ from flaring:	0.00002500	kt/10 ³ m ³
CH ₄ from flaring:	0.04100000	kt/10 ³ m ³
N ₂ O from flaring:	0.00000064	kt/10 ³ m ³

Extraction of oil is used as activity data and is in accordance with whole oil subsystem. Other emissions from venting and flaring in oil subsystem are included in 1.B.2.a.

Flaring in natural gas subsystem

CO₂, CH₄ and N₂O emissions from flaring in gas extraction and consumption were calculated in natural gas subsystem. Emission factors for those emissions were taken default from [IPCC 2006 page 4.48. table 4.2.4.]:

CO ₂ EF from flaring in gas extraction:	0.00000076	kt/10 ⁶ m ³
CH ₄ EF from flaring in gas extraction:	0.0012	kt/10 ⁶ m ³
N ₂ O EF from flaring in gas extraction:	0.000000021	kt/10 ⁶ m ³
CO ₂ EF from flaring in gas consumption:	0.00360	kt/10 ⁶ m ³
CH ₄ EF from flaring in gas consumption:	0.0000024	kt/10 ⁶ m ³
N ₂ O EF from flaring in gas consumption:	0.000000054	kt/10 ⁶ m ³

Extraction and consumption of natural gas are used as activity data and are in accordance with whole natural gas subsystem. Other emissions from venting and flaring in natural gas subsystem are included in 1.B.2.b.

3.3.2.2.4 Fugitive emissions from fuels – CO₂ process emission (CRF sector 1.B.2.d)

CO₂ process emission from refineries and flaring was included into sub-category 1.B.2.d. This emission was estimated based on the verified reports for refineries which participate in EU ETS [KOBIZE (database)] and are given in Table 3.3.14.

Table 3.3.14. CO₂ process emission from refineries and flaring

Years	CO ₂ emission [kt]
2005	1 090.83
2006	1 148.86
2007	960.93
2008	1 094.27
2009	1 093.46
2010	991.64
2011	1 555.46
2012	1 673.65
2013	1 742.26
2014	1 674.85
2015	1 955.57
2016	1 922.99
2017	1 833.89
2018	1 767.35
2019	1 625.50
2020	1 789.68
2021	1 736.55
2022	1 820.84

Years	CO ₂ emission [kt]
2023	1 532.93
2024	1 557.37

Generally CO₂ emission from refineries mainly results from the following processes:

- hydrogen production,
- regeneration of catalysts,
- discharges of hydrocarbons,
- refining of mineral oils,
- tail gas flaring,
- airdrop gas flaring etc.

3.3.2.3. Uncertainties and time-series consistency

See chapter 3.2.6.3.

3.3.2.4. Source-specific QA/QC and verification

See chapter 3.3.1.4.

3.3.2.5. Source-specific recalculations

Recalculations in subcategory 1.B.2.:

- 1B2a – correction of swapped CH₄ and CO₂ emission factors for flaring,
- 1B2a – implementation of EMRT recommendation on correction of missing m³ to kt recalculation of AD in 1B2ai *Oil production – venting*,
- 1B2b – implementation of EMRT recommendation PL-1B2b-2025-0001 on change of value of natural gas consumption,
- 1B2c – correction of swapped CH₄ and CO₂ emission factors for flaring.

Table 3.3.15. Emission changes for subcategory 1.B.2. *Fugitive from oil and natural gas*

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
kt CO ₂ eq.	-508.94	-494.80	-516.88	-515.59	-530.96	-618.55	-664.53	-711.62	-767.70	-700.60	-814.62	-900.49
%	-35%	-35%	-41%	-41%	-41%	-41%	-43%	-44%	-46%	-43%	-47%	-49%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
kt CO ₂ eq.	-1239.00	-1396.44	-1326.40	-1396.75	-1586.39	-1545.52	-1484.88	-1386.36	-1414.85	-1300.25	-1306.19	-1246.40
%	-56%	-57%	-55%	-56%	-58%	-41%	-39%	-39%	-39%	-37%	-37%	-31%

Change	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	-1369.43	-1745.21	-1739.14	-1718.33	-1802.09	-1849.25	-1904.57	-1854.57	-1880.94	-1760.96	-1569.13	-1581.04
%	-32%	-37%	-38%	-35%	-36%	-38%	-39%	-39%	-39%	-37%	-34%	-37%

3.3.2.6. Source-specific planned improvements

No improvements are planned at the moment.

4. Industrial processes and product use (CRT sector 2)

4.1. Source category description

Following subcategories from sector 2 have been identified as key category (excluding LULUCF):

IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)		
2.A.1 Cement Production	CO ₂	L	T	
2.A.4 Other Process Uses of Carbonates	CO ₂	L	T	
2.B.1 Ammonia Production	CO ₂	L		
2.B.2 Nitric Acid Production	N ₂ O		T	
2.C.1 Iron and Steel Production	CO ₂		T	
2.F.1 Refrigeration and Air conditioning	F-gases	L	T	

Share of these subcategories in total Poland's GHG emissions amounts ca. 4.91%.

Figure bellow shows GHG emission trend in *Industrial processes and product use* sector.

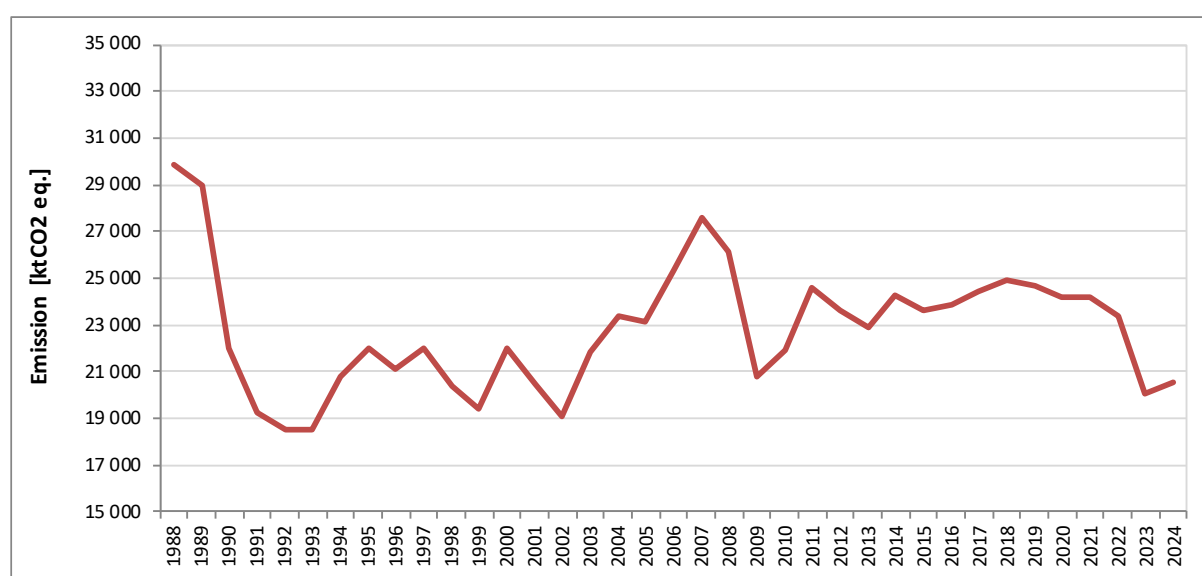


Figure 4.1.1. Emission trend in *Industrial processes and product use* sector in period 1988-2024

Figure 4.1.2 shows GHG emissions according to subcategories of sector 2:

- 2.A Mineral industry,
- 2.B Chemical industry,
- 2.C Metal industry,
- 2.D Non-energy products from fuels and solvent use,
- 2.E Electronics industry,
- 2.F Product uses as substitutes for ODS,
- 2.G Other product manufacture and use,
- 2.H Other.

For estimation of the 2024 emission in sector 2. *Industrial processes and product use* some data from EU ETS installation reports was applied in the following subcategories:

- 2.A *Mineral industry*: 2.A.1 *Cement production*, 2.A.4.a *Other process uses of carbonates – Ceramics*,
- 2.B *Chemical industry*: 2.B.1 *Ammonia production*,
- 2.C *Metal industry*: processes included into *Iron and steel production* (2.C.1) such as: steel production, sinter production and pig iron production.

Emissions in individual subcategories in period 1988-2024 are shown in figure 4.1.2.

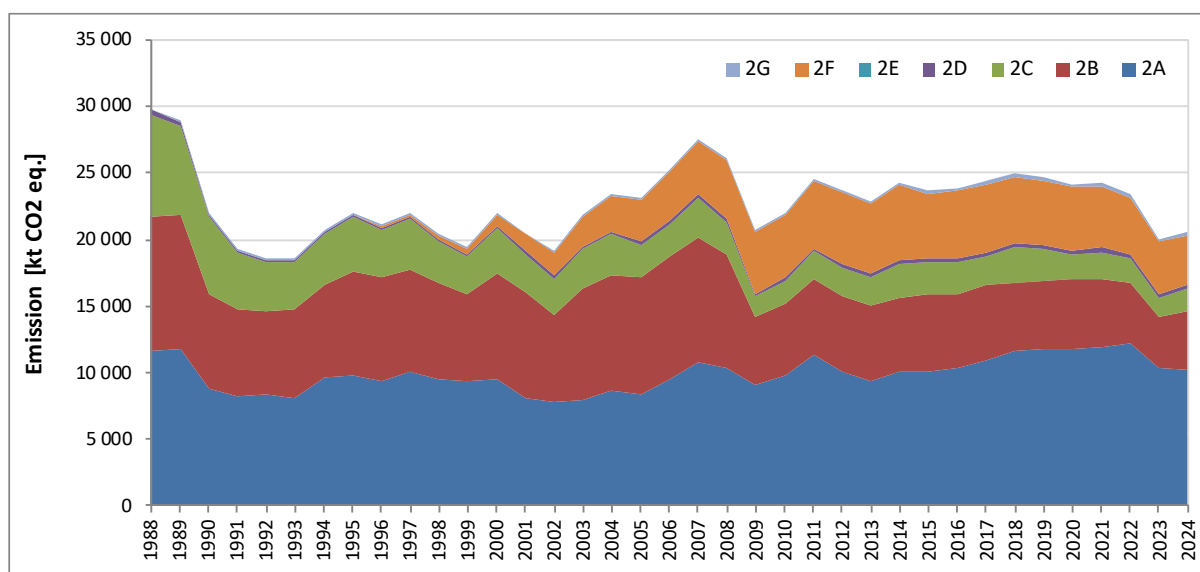


Figure 4.1.2. GHG emissions from *Industrial processes and product use* in 1988-2024 according to subcategories

4.2. Mineral industry (CRT sector 2.A)

4.2.1. Source category description

Estimation of emissions in 2.A *Mineral industry* is carried out in sub-categories listed below:

- a) *Cement production* (2.A.1),
- b) *Lime production* (2.A.2),
- c) *Glass production* (2.A.3),
- d) *Other process uses of carbonates* (2.A.4):
 - *Ceramics* (2.A.4.a),
 - *Other uses of soda ash* (2.A.4.b),
 - *Non-metallurgical magnesium production* (2.A.4.c),
 - *Other* (2.A.4.d).

Subsector 2.A.1 *Cement production* is by far the largest contributor to emissions from this category (see figure 4.2.1) – 64.1% in 2024.

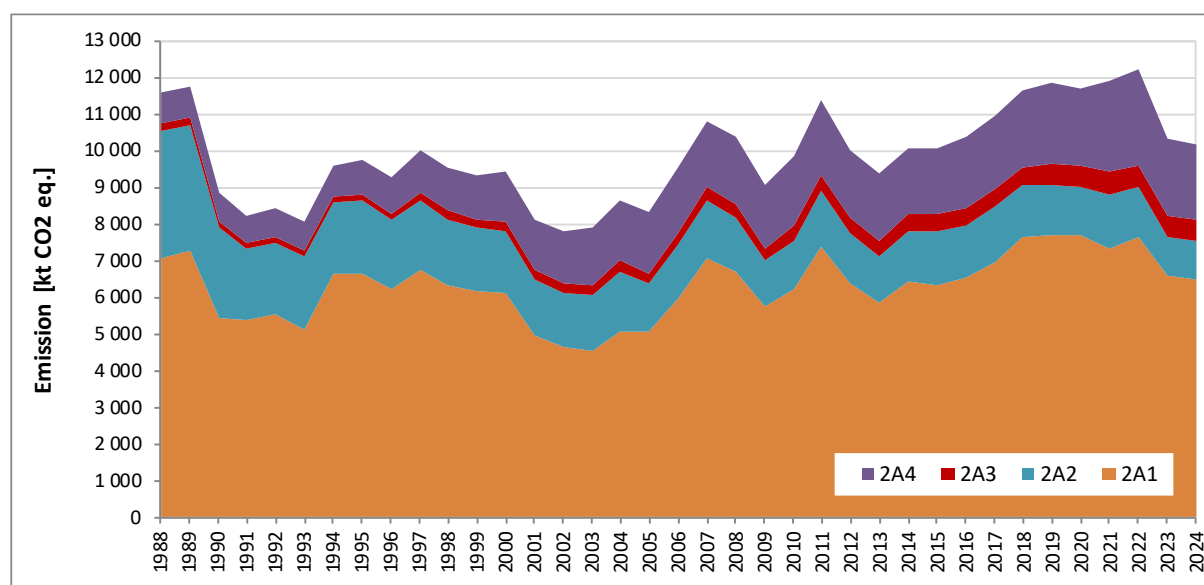


Figure 4.2.1. Emissions from *Mineral industry* sector in years 1988-2024 according to subcategories

4.2.2. Methodological issues

4.2.2.1. Cement production (CRT sector 2.A.1)

CO₂ emission from clinker production is the sum of the process emissions given in the verified reports for 2024 for installation of clinker production, which participate in the EU ETS [KOBIZE database]. This emission was estimated as 6519.8 kt CO₂. Data on clinker production was taken from [GUS 2025b].

The clinker production in the period 1988-2024 is shown on figure 4.2.2. Data on clinker production for the entire inventoried period was taken from [GUS 1989b-2025b].

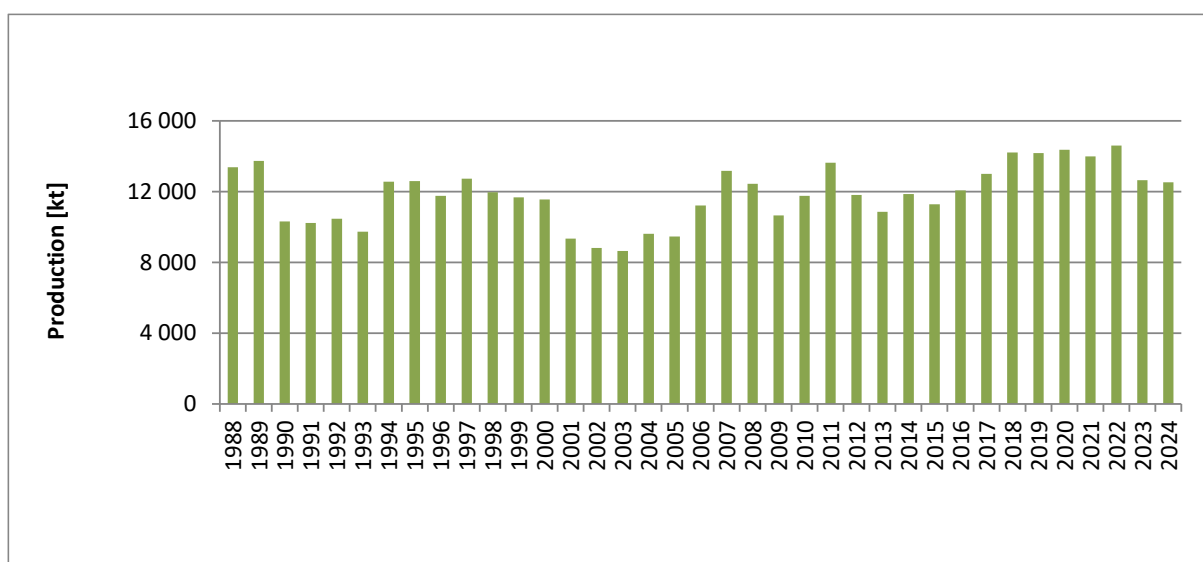


Figure 4.2.2. Clinker production in 1988-2024

Process emission of CO₂ from clinker production was taken from the EU-ETS verified reports for the years: 2005-2024. For earlier years emissions were estimated based on clinker production and emission factors. Emission factors which were used to estimate CO₂ process emissions from subcategory 2.A.1 for the period 1988-2004 are given below:

- for years: 1988-2000 – emission factor equal 529 kg CO₂/t of clinker – average from country specific factors for years: 2001-2004 (2001 – 531 kg CO₂/t, 2002 – 530 kg CO₂/t, 2003 – 528 kg CO₂/t, 2004 – 527 kg CO₂/t). Country specific EFs as listed above come from elaboration [IMMB 2006].
- for years: 2001-2004 – country specific factors (given above) from [IMMB 2006].

The cited report [IMMB 2006] includes emission data for period 1988-2004 but only emission calculation for 2001-2004 was based on country specific data (chemical analysis of clinker, kiln input etc.). The CO₂ emission for the years 1988-2000 was estimated (in cited reports) based on default calcination factor (525 kg CO₂/tonne clinker) because of lack of adequate country specific data. For this reason Poland uses average EFs value for 2001-2004 as CS EF for the period before 2001 in the inventory.

Re-attempts to obtain data for calculation of national indicators for clinker production for the years 1988-2000 (in response to the review recommendations) have confirmed that full information needed for that estimation is not available. The difficulty in gathering the necessary information results mainly from the fact that some plants operating in the period 1988-2000 no longer exist. Therefore historical data on input components for cement production process collected currently could be incomplete and unrepresentative. Additionally, Polish Cement Association and the main author of the study [IMMB 2006] confirmed that the data for the 1988-2004 analysis purpose was obtained directly from the cement plants. Wherein clinker production installations provided the best available data for that study.

As already mentioned, since 2005 CO₂ process emission from clinker production in GHG inventory corresponds to the sums of emissions provided in the EU-ETS verified reports, due to the fact that all installations for clinker production participate in EU-ETS.

Emissions of CO₂ for installations covered by the EU ETS are calculated since 2021 following the Commission Regulation (EU) No 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European

Parliament and of the Council (Monitoring and Reporting Regulation – MRR) with further amendments. On 14th December 2020 Commission published Implementing Regulation (EU) 2020/2085 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. In addition, the Commission published the following regulations changes: *Commission Implementing Regulation (EU) 2023/2122 of 17 October 2023 amending Implementing Regulation (EU) 2018/2066 as regards updating the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Commission Implementing Regulation (EU) 2024/2493 of 23 September 2024 amending Implementing Regulation (EU) 2018/2066 as regards updating the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.*

Since the beginning of 2013 until the end of 2020 emission of CO₂ for installations covered by the EU ETS were calculated in accordance with the 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 (Monitoring and Reporting Regulation – MRR).

For the earlier years (before 2013) the emission in ETS reports was estimated based on national Ordinance of the Minister of Environment of 12 September 2008 on the way of monitoring of emission amounts of substances covered by the Community Emission Trading Scheme (Dz. U. Nr 183, poz. 1142). The ordinance transposes to the Polish law the UE Monitoring and Reporting Guidelines for ETS (Commission Decision 2007/589/EC).

Until 2012 methods applied for CO₂ process emission estimation from clinker production in the EU-ETS are described in ANNEX VII of mentioned EC Decision: Activity-specific guidelines for installations for the production of cement clinker as listed in Annex I to Directive 2003/87/EC. Starting from 2013 methods for CO₂ process emission calculation from clinker production in the EU-ETS are described in section 9 of ANNEX IV of previously mentioned Commission Regulations (From 2013 until 2020 - EU No 601/2012 and from 2021 - EU No 2018/2066).

Each of the ETS operator is required to have permit with monitoring plan (dedicated Excel template) approved by Competent Authority. Approval process consist of formal process handled by regional Competent Authority and technical opinion prepared by KOBIZE – Polish central Competent Authority. During approval process qualified unit checks operators CO₂ monitoring methodology, consistency with requirements set in EU Regulation 2018/2066, completeness of information provided including uncertainty assessment, risk analyses and sampling plans etc. Requirements and each step of approval process are described in national law - Emission Trading Scheme Act.

Based on methodology approved in monitoring plan each of the EU ETS operator needs to prepare annual emission report (dedicated Excel template). Each annual emission report prepared by operator is verified (reviewed) by independent verifier. Verification process includes in-site visit and checking if report is in line with installation approved monitoring plan and with requirements set in Monitoring and Reporting Regulation. During verification process of annual emission report verifier checks:

- If permit with complete monitoring plan is approved by Competent Authority;
- list of emission sources;
- types and amount of fuel used in reporting year (with control over measurements instruments – like calibration of meters etc.);

- tiers with uncertainty levels for each emission source and each part of calculation;
- appropriate usage of worldwide/national net caloric values, emission factors and oxidation factors;
- accreditation and standards used in laboratories;
- sampling methodology and frequency;
- control and management of data;
- CEMS technology and meters (if used);
- CO₂ exported outside of the installation (as a part of a fuel or as a product).

After verification process is over verifier issue verification opinion (positive, positive with minor misstatements or negative) with information about action undertake during verification, with precise information about mistakes that he found (if any) and with any recommendation for improvement (if any). Both report and opinion are send to central Competent Authority (in case of Poland – KOBiZE) where they are once again checked (calculation, tiers used etc.) by qualified unit before emission data is uploaded into National Registry.

Each Member State have one or more Accreditation Body that are responsible for accreditation process of Verifiers. Before verifier receive his accreditation he must prove that he have enough experience and knowledge in audit and EU ETS field. Most of EU Accreditation Bodies are organized into European Co-operation for Accreditation and work very closely with each other. They publish standard book for accreditation and verification process (EA document for recognition of Verifiers under EU ETS Directive - <http://www.european-accreditation.org>) with detailed information about competences of verifiers and with precise information how verification process should look like (with mandatory steps and outcomes).

Starting from 2013 whole verification and accreditation process is described in details in Commission Regulation (EU) No 600/2012 of 21 June 2012 *on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council* (Accreditation and Verification Regulation – AVR). Since 1st January 2019 Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 *on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council* is applied. On 14th December 2020 Commission published implementing regulation (EU) 2020/2084 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

In addition, the Commission published the following regulations changes: *Commission Implementing Regulation (EU) 2024/1321 of 8 May 2024 amending Implementing Regulation (EU) 2018/2067 as regards the verification of data and the accreditation of verifiers* and *Commission Implementing Regulation (EU) 2025/1192 of 18 June 2025 amending Implementing Regulation (EU) 2018/2067 as regards certain aspects on the verification of data and on the accreditation of verifiers*.

Until 2012 information about production activities from installations covered by EU ETS were additionally collected in Poland in accordance with Ordinance of the Minister of Environment of 12 September 2008 on the way of monitoring of emission amounts of substances covered by the Community Emission Trading Scheme (Dz. U. Nr 183, poz. 1142) because according to Commission Decision 2007/589/EC there was no obligation to provide information concerning production.

Starting from 2013 production amounts were collected in line with requirements set in

national law - Emission Trading Scheme Act based on dedicated sub sheet in annual emission report template.

Data on clinker production provided in ETS reports are comparable to data collected by GUS (differences in production values between GUS data and data based on ETS reports are mostly below 1%).

CO₂ emissions from clinker production in period 1988-2024 are shown in the figure 4.2.3.

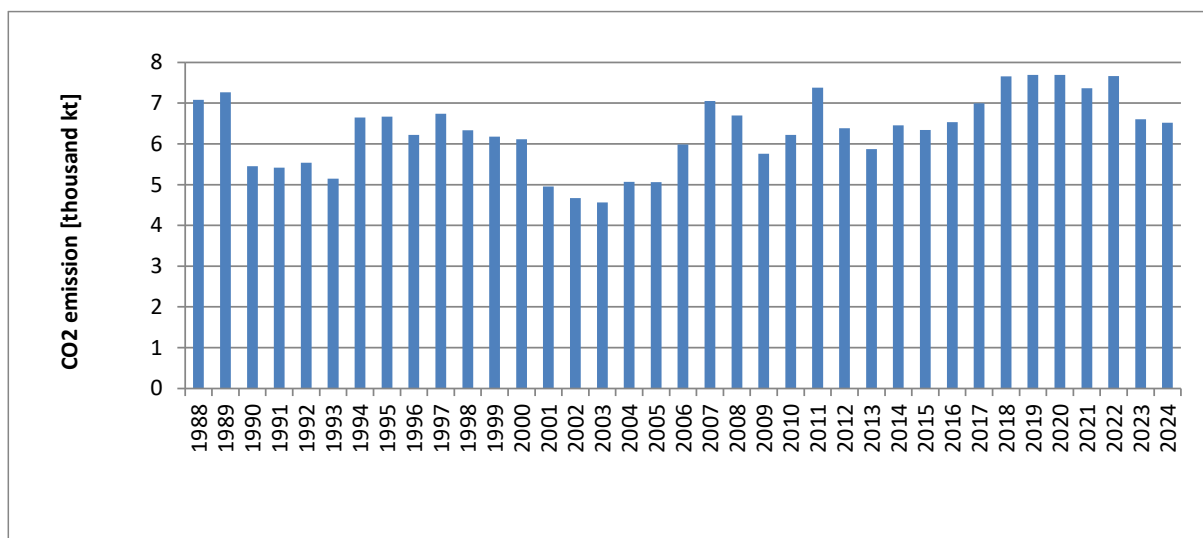


Figure 4.2.3. CO₂ process emission for clinker production in 1988-2024

4.2.2.2. Lime production (CRT sector 2.A.2)

Emission of CO₂ from lime production was calculated based on lime production data from Statistics Poland. Since 2000 activity data divided into quicklime, hydrated lime and hydraulic lime has been applied and emission has been estimated for each type of lime separately using default emission factors for high calcium lime and hydraulic lime from IPCC 2006 GLs (tab. 2.4. p. 2.22). For hydrated lime appropriate correction was considered. Due to the lack of the disaggregated lime production data for the years before 2000, the IEFs (average emission factor from the years 2000-2013) and total lime production was used for CO₂ emission estimation.

Dolomite lime production is given separately in the Polish statistical yearbook, as calcined and sintered dolomite [GUS 1989b-2025b]. Emission from production of this type of lime was estimated based on dolomite consumption in production process according to the study [Galos 2013]. Emission from dolomite lime production was added to the emission from production of other lime types.

According to information from lime production sector vertical shaft kilns are used in lime production in Poland. This type of kilns generate small amounts of LKD, and it is judged that correction factor for LKD would be negligible and do not need to be estimated (2006 IPCC GLs, Vol. 3, p. 2.24).

The figure 4.2.4 presents data concerning lime production (including dolomite lime) for the entire period. CO₂ emissions in period 1988-2024 are shown in the figure 4.2.5.

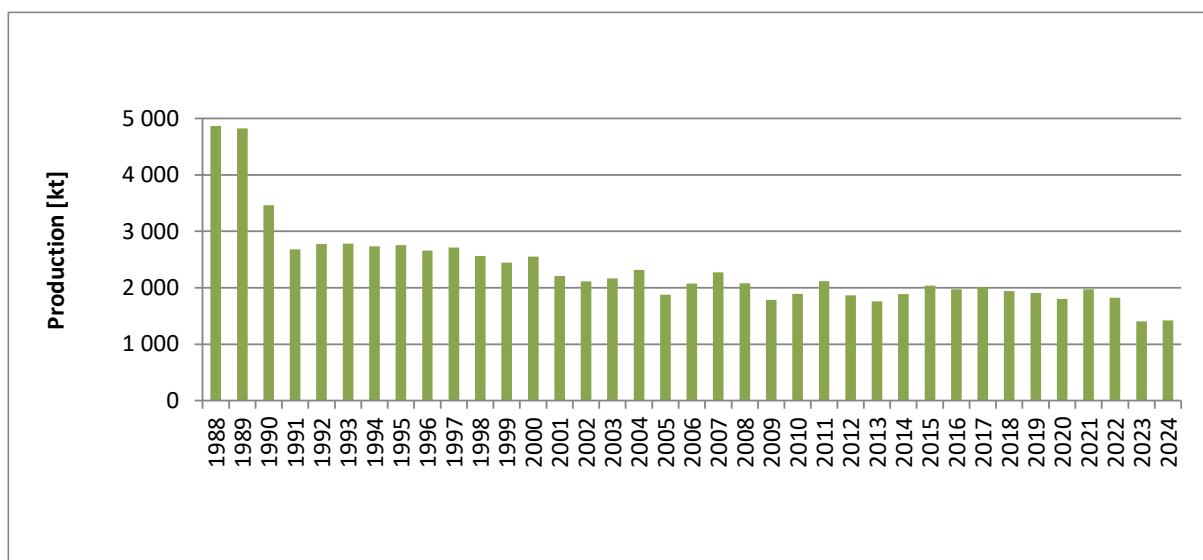
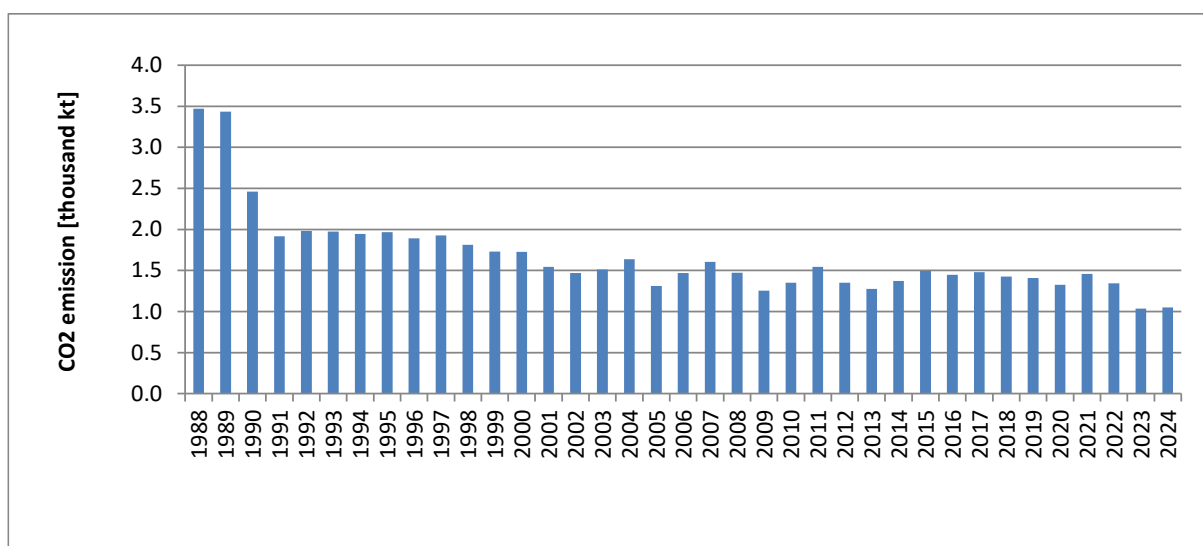


Figure 4.2.4. Lime (including dolomite lime) production in 1988-2024

Figure 4.2.5. CO₂ process emission for lime production in 1988-2024

4.2.2.3. Glass production (CRT sector 2.A.3)

Emission of CO₂ from glass production was calculated based on glass production data from Statistics Poland. Default CO₂ emission factor amounted to 0.2 tonnes CO₂/tonne glass was applied for emission estimation in entire period, according to IPCC 2006 GLs – equation 2.13 p. 2.29. In accordance with information obtained from glass production sector and analysis of available statistical data, cullet ratio in glass production was assumed at the level of 20%. It was decided to adopt the constant value for the entire period. Such a rough ratio was adopted on the basis of the analysis of data on turnover of waste suitable for recycling in production and commercial units. Mentioned information is available in the statistical yearbooks: *Materials management* (<https://stat.gov.pl/en/topics/industry-construction-fixed-assets/industry/materials-management-in-2024,6,19.html>) and *Environment* (<https://stat.gov.pl/en/topics/environment-energy/environment/environment-2025,1,17.html>). The data is based mainly on the information from the annual forms: G-06 - *Report on wastes suitable for recycling* (<http://form.stat.gov.pl/formularze/2025/passive/G-06.pdf>).

The analysis of the data on waste turnover indicated that the amount of cullet used in the glass production process in Poland is lower than the assumed default value in the 2006 IPCC GLs. The average annual cullet consumption, calculated on the basis of the data from

production and commercial units over the last ten years, amounted to approx. 30%. It should additionally be taken into account, that estimated cullet consumption did not apply only to the use of it for the production of glass in glassworks. Glass cullet can also be used, inter alia, for the production of grits, cleaning pastes, as a filler for the production of insulation boards, for road construction, in the building and bonding material industry. It should be underlined that accepted share of cullet use is of relatively high uncertainty.

Glass production and CO₂ emission values from that process in period 1988-2024 are shown in the figures 4.2.6 and 4.2.7 respectively.

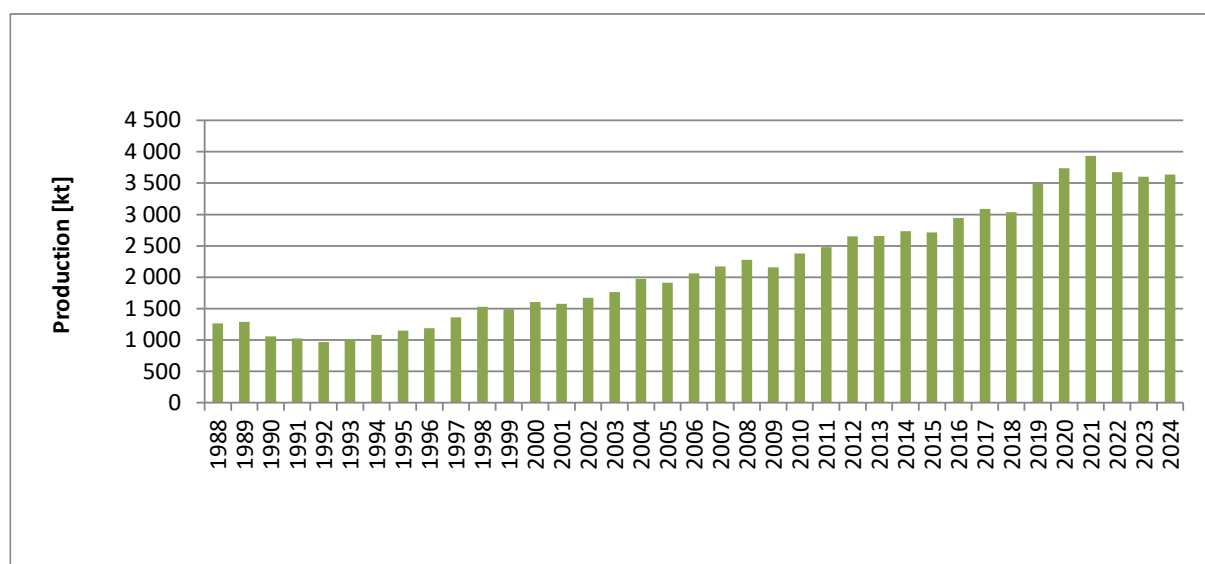


Figure 4.2.6. Glass production in 1988-2024

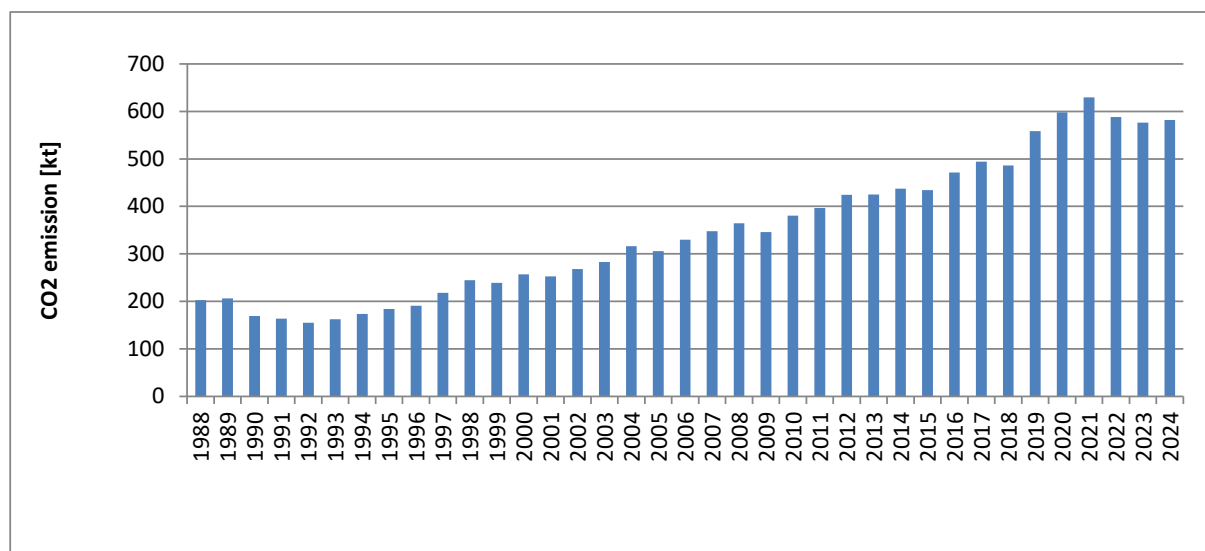


Figure 4.2.7. CO₂ process emission for glass production in 1988-2024

4.2.2.4. Other processes uses of carbonates (CRT sector 2.A.4)

This category includes CO₂ emission from sources as follows:

- *Ceramics (2.A.4.a),*
- *Other uses of soda ash (2.A.4.b),*
- *Non-metallurgical magnesium production (2.A.4.c),*
- *Other (2.A.4.d).*

2.A.4.a. Ceramics

Estimation of CO₂ emission from ceramics was based on ceramics production data from Statistics Poland (fig. 4.2.8). CO₂ emission factors for the years 2005-2024 (Table 4.2.1) was grounded on the verified reports for ceramic installation covered by EU ETS [KOBIZE database]. For the years before 2005 average value of EFs from 2005-2013, amounted to 51.23 kg CO₂/t of ceramics, was applied.

Table 4.2.1. CO₂ EFs values [kg CO₂/t] in *Ceramics* subcategory

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
56.69	48.20	54.30	53.88	48.52	51.44	48.77	49.41	49.86	43.52	50.99
2016	2017	2018	2019	2020	2021	2022	2023	2024		
51.95	52.97	51.85	48.58	45.65	45.07	42.56	39.85	44.19		

Due to the fact that the ETS specifies threshold values for installations producing ceramics, it was assumed that the data on the production volume from the Statistics Poland (GUS) for this subcategory would be more appropriate to determine AD. Data on the volume of production are collected through GUS reporting. The data is the results of annual survey of production of industrial goods in P-01 form "Questionnaire on production" (<http://form.stat.gov.pl/formularze/2025/passive/P-01.pdf>).

The entities obliged to prepare the P-01 report are entities of the national economy employing 10 people and more, which manufacture products or provide services specified in the PRODPOL nomenclature. The nomenclature is based on the Polish Classification of Goods and Services (PKWiU 2015) – introduced on January 1, 2016 for use in statistics, registration, documentation and accounting, and also in official registers and public administration information systems (Regulation of the Council of Ministers of 4 September 2015, Journal of Laws, item 1676) and on the PRODCOM List used in the European Union.

It is assumed that the data from official statistics (i.e. from GUS) is the best available verified national data. Due to the fact that in 2006 IPCC GLs no default emission factors of CO₂ emissions from the production of ceramic products are available, CS EFs were determined for each year on the basis of reports of installations covered by the ETS system, which provided the emission volume with the corresponding production volume.

CO₂ emission values in 2.A.4.a subcategories for entire period 1988-2024 were presented in the figure 4.2.9.

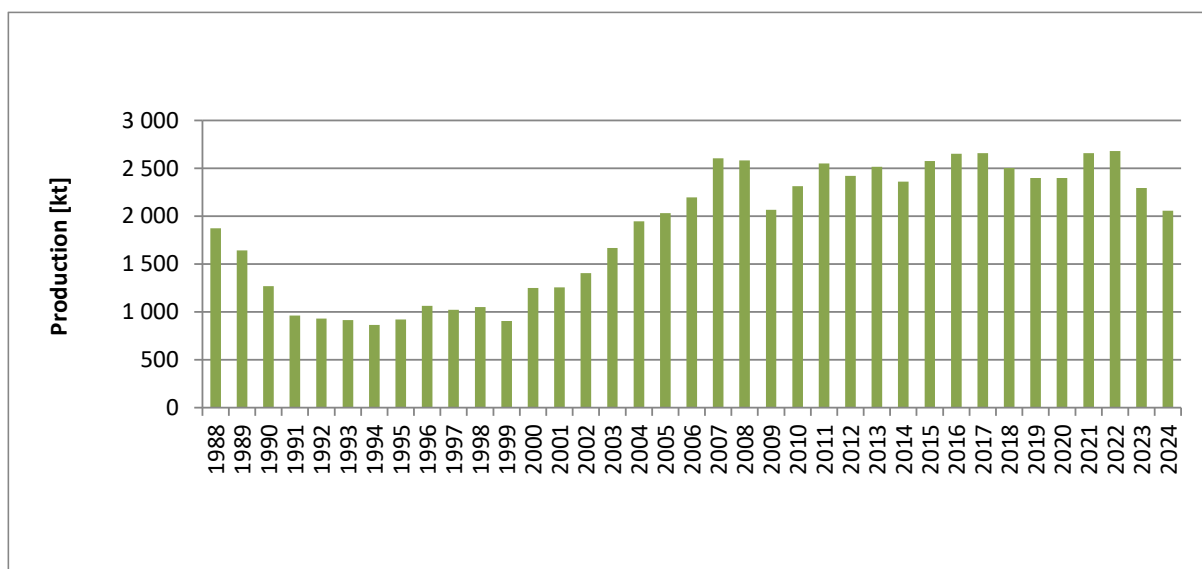
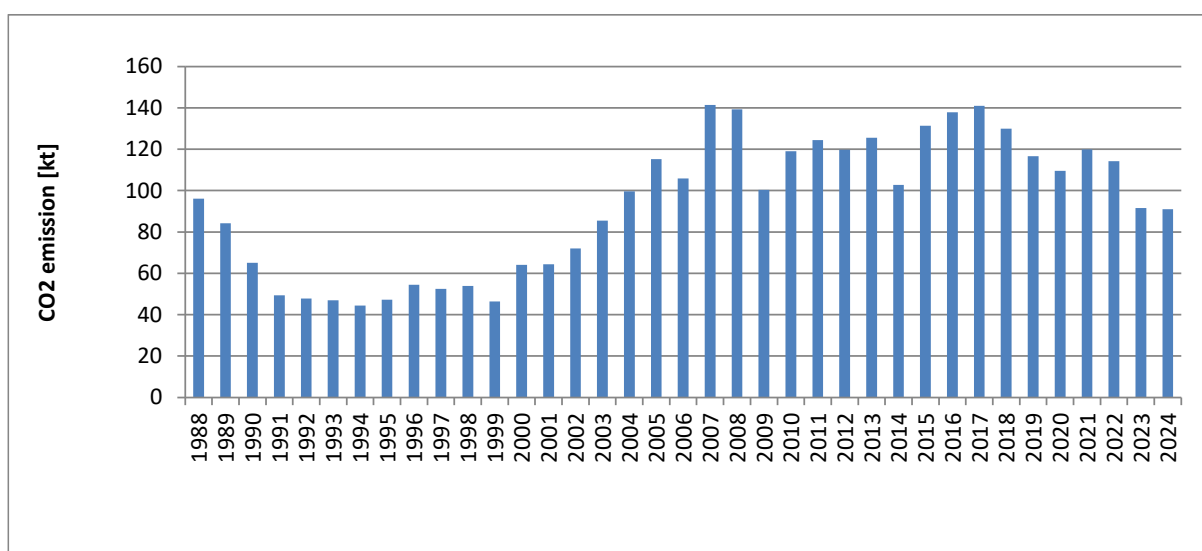


Figure 4.2.8. Ceramic production in 1988-2024

Figure 4.2.9. CO₂ process emission from ceramics in 1988-2024

2.A.4.b. Other uses of soda ash

CO₂ emission from soda ash use was estimated based on annually consumption of soda ash, which was published in GUS yearbook: *Materials Management in 2024* [GUS 2025f]. Additionally to assumed that half of soda ash use was consumed in glass and ceramics production and that amount was subtracted from AD because it was included in 2.A.3 and 2.A.4.a subcategories respectively.

EF amounting to 414.92 kg CO₂/t of soda ash used was applied for inventory calculation for the entire period (EF was taken from IPCC 2006 GLs, tab. 2.1. p. 2.7).

CO₂ emission for the years 1992-2024 was estimated based on data concerning soda ash consumption taken from *Materials Management* [GUS 1994f-2025f]. For the years before 1992, due to lack of the published statistical data, the assumption was made, that total soda ash consumption amounts to 50% of soda ash production. This assumption was based on the analysis, which considered production [GUS 1993e-2002e] and corresponding use of soda ash [GUS 1994f-2002f] in the period 1992-2001.

An additional assumption was applied that only 50% of the total consumption is reported in 2.A.4.b subcategory. The rest of soda ash consumption is included in the other 2.A

subcategories (mainly in glass production). The adopted assumption is confirmed by the share of NACE 23 in the total consumption of soda ash in Poland calculated on the basis of data included in mentioned yearbook.

CO₂ emission values from soda ash use in 2.A.4.b subcategories, for entire period 1988-2024, were presented in the figure 4.2.10.

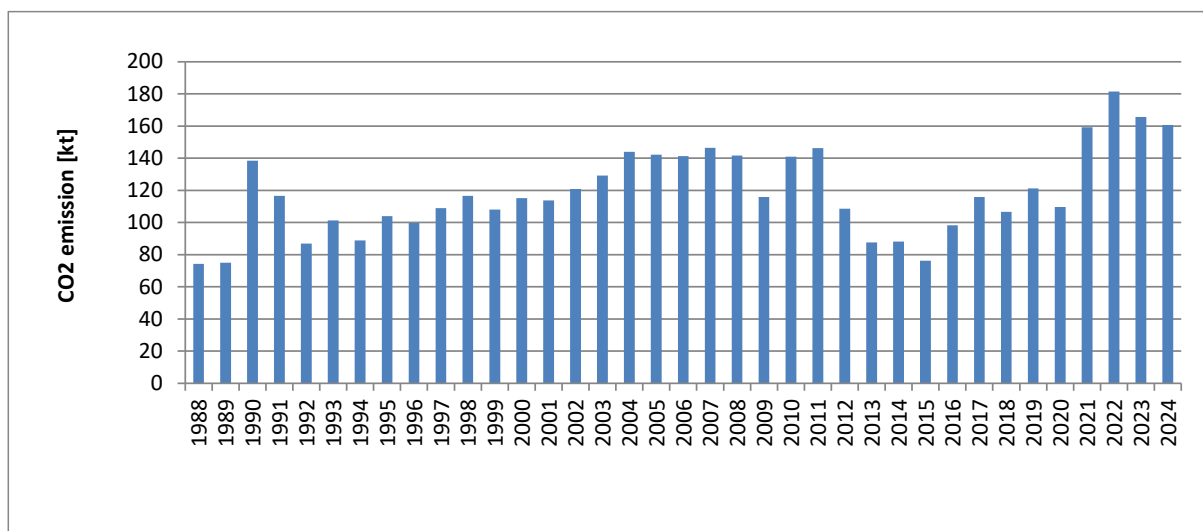


Figure 4.2.10. CO₂ emission values from soda ash use in 2.A.4.b subcategory in the years 1988-2024

2.A.4.c. Non-metallurgical magnesium production

Magnesium has not been produced in Poland.

2.A.4.d. Other

CO₂ emission from limestone use as a sorbent in lime wet flue-gas desulfurization, FGD in FBB (fluidized bed boiler) and other method of flue gas desulfurization was considered under this subcategory. Estimation of emission was based on study [Galos 2013]. The results were presented in figure 4.2.11. Details concerning calculations of CO₂ emission for 2.A.4.d category were provided in the Annex 5.5.

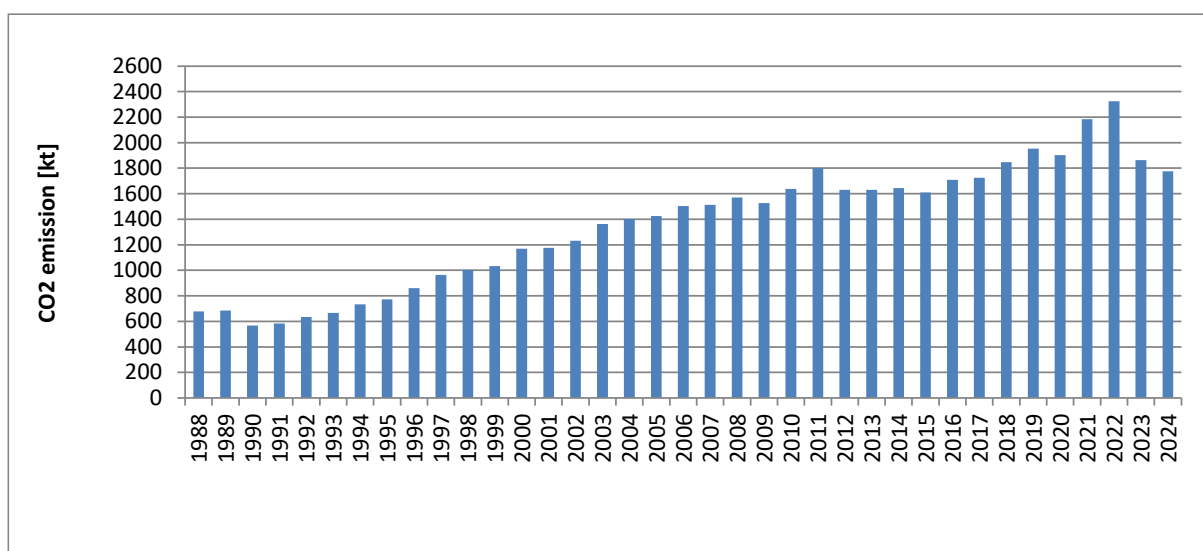


Figure 4.2.11. CO₂ emission from carbonate use in 2.A.4.d subcategory for 1988-2024

4.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the year 2024 for IPCC sector 2. *Industrial processes and product use* was estimated with use of approach 1 described in 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in Annex 2.

Recalculation of data for years 1988-2023 ensured consistency for whole time-series.

2024	CO ₂ [kt]	CH ₄ [kt]	N ₂ O [kt]	CO ₂ Emission uncertainty [%]	CH ₄ Emission uncertainty [%]	N ₂ O Emission uncertainty [%]
2. Industrial processes and product use	16 117.71	1.79	2.06	3.8%	29.2%	43.1%
A. Mineral industry	10 178.72	-	-	5.7%	-	-
B. Chemical industry	4 023.20	1.44	1.60	4.3%	36.0%	54.3%
C. Metal industry	1 601.22	0.35	0.00	5.4%	16.9%	0.0%
D. Non-energy products from fuels and solvent use	314.57	-	-	11.7%	-	-
G. Other product manufacture and use	-	-	0.46	-	-	40.3%

4.2.4. Source-specific QA/QC and verification

Activity data used in the GHG inventory concerning industry sector come from yearbooks published by the Statistics Poland (GUS). GUS is responsible for QA/QC of collected and published data. Depending on type of emission factor and *Tier* method applied in the GHG inventory, EF is compared with plant specific emission factor or the default one, respectively.

While preparing national inventory data from ETS reports is partially used to estimate emissions from such subcategories like: mineral, chemical and metallurgical industries. In category 2.A, CO₂ emissions submitted in ETS reports by installations in the clinker production sector were directly used in the national emission inventory in category 2.A.1 *Cement production*. The aggregate production volumes given in individual years by the cement industry installations are also compared with the data published in official statistics. In subcategory 2.A.4.a *Ceramics*, information from ETS reports is used to calculate CO₂ emission factors that are used in the national GHG inventory. In sector 2.B *Chemical industry*, data from ETS reports is used to estimate emissions from ammonia production, specifically for calculating of country specific carbon content in natural gas, which is used for ammonia production. ETS reports are also used when estimating emissions from category 2.C. *Metal industry*. Data sent from steel plants under the ETS allow estimation of CO₂ emissions from sinter plants (reports are the source of AD and data relating to input and output of sintering of iron ore process). They are also used to estimate CO₂ emissions from pig iron production as they are a source of data for the C balance of BF process (some quantities data on input and output components and the content of carbon in them). The estimation of CO₂ emission for the production of steel from BOF and electric furnaces in GHG inventory is also based on detailed data from reports prepared under ETS (as described in chapter 4.4.2 of the NIR). In the case of 2.C.2. *Ferroadloys production*, AD relating to ferrosilicon reported in GHG inventory, which is taken from statistical yearbook, is compared with information in the ETS database.

Comparison of emissions from the national GHG inventory and EU ETS for the main IPCC subcategories, on an annual basis, is reported to the EU in the form of the Annex XII under Art. 14 of the Implementation Regulation No 2020/1208 where consistency of reported inventory emissions with data from the emissions trading system is checked. However, there may be differences that result, among others, from the use of different emission estimation methodologies. There are additional issues that complicate the comparison between inventory and ETS data, for example: the dual role of fuels i.e. action of coke or coal as an

energy carrier and as a reducer in industrial processes or problem of aggregated emissions for some ETS installations, e.g. in chemistry, where the reported emissions do not correspond to the production of only one product what is required by national inventory guidelines.

It should be mentioned that data reported by ETS installations is verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBIZE).

Calculations in industry sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 4.

4.2.5. Source-specific recalculations

- Ceramic production and relating CO₂ EF were updated for 2023 according to ETS data
- Data on lime production was slightly adjusted for 2015-2023 based on updated GUS yearbook (cement clinker production was slightly corrected as well, but these changes did not affect the CO₂ emission levels)

Table 4.2.2. Changes of GHG emission values in 2.A. subcategory as a result of recalculations

Change	1988	1989	1990	1991	1992	1993	1994	1995
CO ₂								
kt	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
Change	1996	1997	1998	1999	2000	2001	2002	2003
CO ₂								
kt	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
Change	2004	2005	2006	2007	2008	2009	2010	2011
CO ₂								
kt	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
Change	2012	2013	2014	2015	2016	2017	2018	2019
CO ₂								
kt	0.00	0.00	0.00	-0.28	-0.46	0.00	-0.83	-0.28
%	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
Change	2020	2021	2022	2023				
CO ₂								
kt	0.00	-0.55	0.09	1.21				
%	0.00	0.00	0.00	0.01				

4.2.6. Source-specific planned improvements

No improvements are planned at the moment.

4.3. Chemical industry (CRT sector 2.B)

4.3.1. Source category description

Estimation of emissions in 2.B *Chemical industry* are carried out in sub-categories listed below:

- a) *Ammonia production* (2.B.1),
- b) *Nitric acid production* (2.B.2),
- c) *Adipic acid production* (2.B.3),
- d) *Caprolactam, glyoxal and glyoxylic acid production* (2.B.4),
- e) *Carbide production* (2.B.5),
- f) *Titanium dioxide production* (2.B.6),
- g) *Soda ash production* (2.B.7),
- h) *Petrochemical and carbon black production* (2.B.8).

Subsector 2.B.1 *Ammonia production* is the largest contributor to emissions from this category (see figure 4.3.1) – 70.1% in 2024. Adipic acid was produced up to 1994.

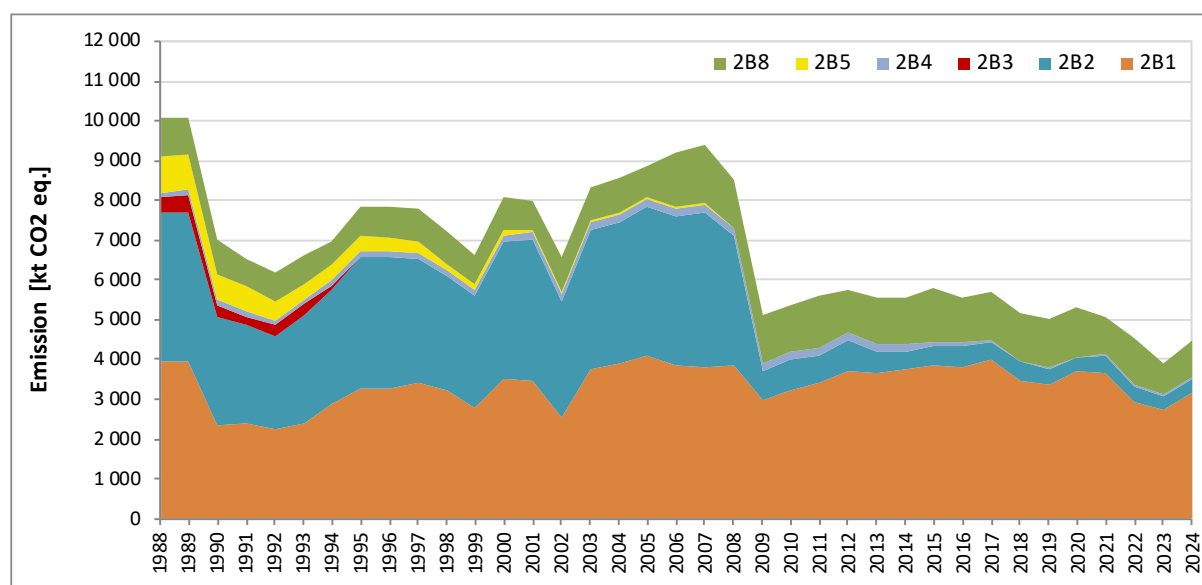


Figure 4.3.1. Emissions from *Chemical industry* category in years 1988-2024 according to subcategories

4.3.2. Methodological issues

4.3.2.1. Ammonia production (CRT sector 2.B.1)

CO₂ emissions for ammonia production are estimated based on the data on natural gas use in this process (natural gas consumption for the years 1988-2024 was presented in Annex 5.6). The amount of natural gas consumption expressed in volume units was taken from [GUS 2025e]. The amount of natural gas reported by installations in G-03 questionnaires as consumption for ammonia production was supplemented by the amount of natural gas reported as consumed for the production of hydrogen used for ammonia production by ammonia producers. In order to calculate CO₂ emission, country specific carbon content in natural gas was estimated, based on the data from verified EU ETS reports provided by ammonia production installations [KOBiZE database]. Carbon content was estimated as 0.567 kg C/m³ for 2024 and 0.542-0.567 kg C/m³ for the years 2014-2023. For 2013 that amount was estimated at 0.544 kg C/m³ and the same value was applied for previous years back to 1988. According to above-mentioned information, the CO₂ process emission from ammonia

production was calculated using the following formula:

$$E_{CO_2} = Z_{\text{natural gas}} * C_{\text{content}} * 44/12$$

where:

E_{CO_2}	– CO ₂ process emission from ammonia production [t]
$Z_{\text{natural gas}}$	– natural gas use [thousands m ³]
C_{content}	– carbon content in natural gas [kg C/m ³]

This method was used for entire period: 1988-2024. Hydrogen consumption for ammonia production has been reported in G-03 reports since 2022. In the GHG inventory, natural gas consumption for the production of this hydrogen was also included in category 2.B.1 since 2022 (data for 2022 and 2023 was recalculated in the current submission). In years 1988-1990, also coke-oven gas was used for ammonia production and this fact was reflected in the inventory calculations (Annex 5.6). The coke-oven gas consumption was taken in energy units – also based on G-03 reports – and the carbon content factor is taken from IPCC [IPCC 2006].

CO₂ recovered for fertilizer urea production was deducted in calculation of emission for 2.B.1 subcategory. The estimation of CO₂ amounts for subtraction in entire period submission 1988-2024 were detailed presented in the Annex 5.6.

Should be noted that significant elements in the urea balance in Poland, apart from production, are the export and import of this product. This is indicated by data from Eurostat database for the main goods containing urea (i.a. products with PRODCOM codes 20153130 and 20153180).

CO₂ process emissions from ammonia production including subtraction of CO₂ used in fertilizer urea production for the period: 1988-2024 are shown in figure 4.3.2 while the ammonia production values [GUS 1989e-2025e] are presented in figure 4.3.3.

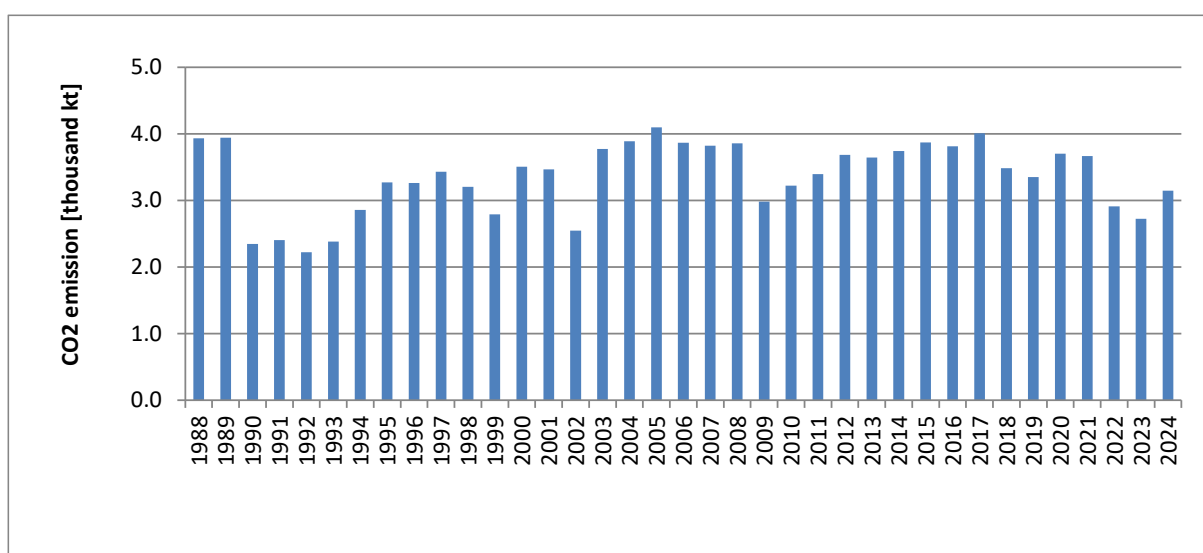


Figure 4.3.2. CO₂ process emission from ammonia production in 1988-2024 (including subtraction of CO₂ connected with fertilizer urea production)

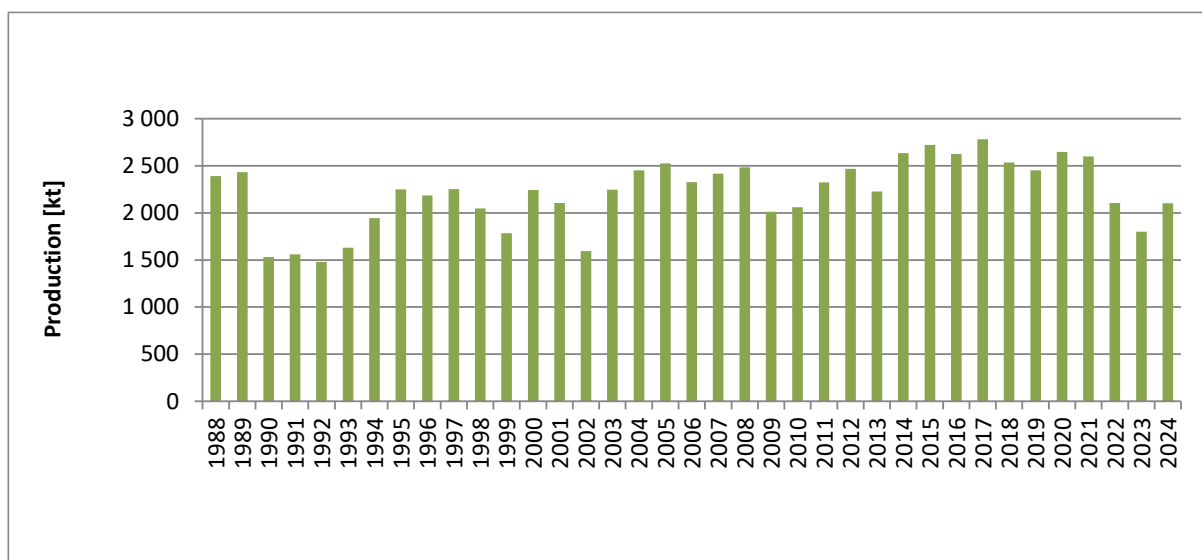


Figure 4.3.3. Production of ammonia in 1988-2024

4.3.2.2. Nitric acid production (CRT sector 2.B.2)

Estimation of N₂O emission from nitric acid production for 2024 was based on annual HNO₃ production data from [GUS 2025b]. The country specific emission factor of 0.61 kg N₂O/t nitric acid for 2024 was estimated based on the reports from all producers of HNO₃ [KOBIZE database]. The N₂O emission factors for years 2005-2024 (Table 4.3.1) were calculated also based on the reports provided by installations of nitric acid production.

Table 4.3.1. N₂O EFs in 2.B.2 subcategory for the years 2005-2024 [kg N₂O/t]

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
6.36	6.37	6.43	5.40	1.31	1.34	1.21	1.28	0.92	0.70	0.72
2016	2017	2018	2019	2020	2021	2022	2023	2024		
0.87	0.66	0.74	0.66	0.54	0.65	0.74	0.64	0.61		

Emission factors mentioned above were estimated as weighted average of plant specific emission factors obtained from all nitric acid producers (from 5 installations located in 4 enterprises). Drop of the N₂O EF value from nitric acid production in 2008 and its further decrease between 2009 - 2011 are the result of the implementation of the JI projects. N₂O catalytic decompose inside the oxidation ammonia reactor is the abatement technology applied in these installations.

Decline of emission factor value in 2012-2014 is mainly the result of change the catalyst for more effective one in the largest HNO₃ production installation. The main reason for N₂O EF increase in 2016 is bypassing of nitrous gases outside the catalyst bed for reduction of nitrous oxide in one of the nitric acid production plants.

Individual data obtained from nitric acid producers is confidential, so was not published in the NIR (it could be available for ERT review purpose only). For the period 1988-2004, N₂O EF amounted to 6.47 kg/t nitric acid was applied. This country specific emission factor was taken from [Kozłowski 2001].

Activity data (i.e. HNO₃ production) for estimation of nitrous oxide emissions in 2.B.2 subcategory was taken from [GUS 1989b-2025b] for the entire period 1988-2024. Since 2005, AD is cross-checked with the HNO₃ production reported by all nitric acid installations that are required to submit annual reports for emission database (KOBIZE database). A comparison of this data indicates only slight differences, ranging from -1.5% to 2.6% in individual years, what

confirms that all nitric acid production is taken into account in AD applied in emission estimation.

The amount of production and N₂O emissions from nitric acid production are shown in figures 4.3.4 and 4.3.5, respectively.

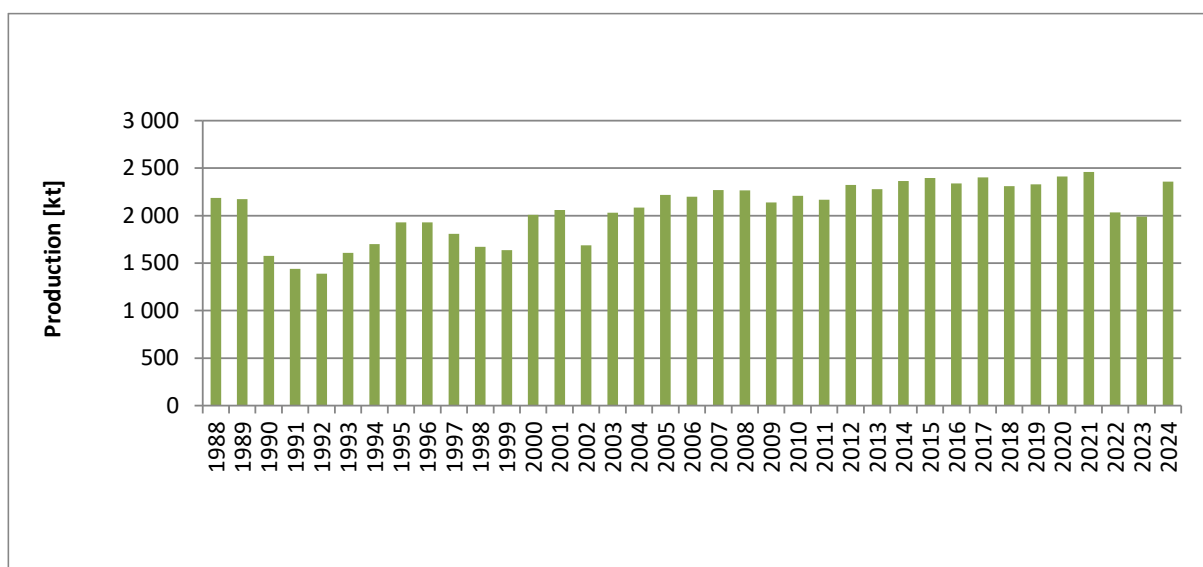


Figure 4.3.4. Production of nitric acid in 1988-2024

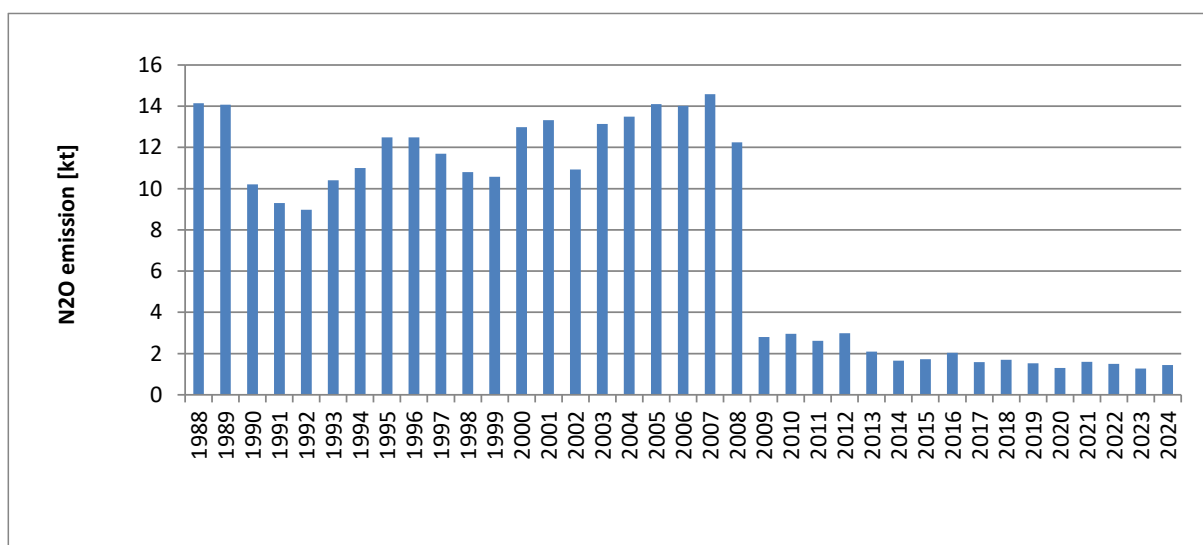


Figure 4.3.5. N₂O process emission for nitric acid production in 1988-2024

4.3.2.3. Adipic acid production (CRT sector 2.B.3)

Production of adipic acid was continued up to 1994. Activity data concerning adipic acid production was taken from the only adipic production plant. N₂O emission factor for this category, which is equal 300 kg N₂O/t, was taken from table 3.4, p. 3.30, 2006 IPCC GLs [IPCC 2006].

4.3.2.4. Caprolactam, glyoxal and glyoxylic acid production (CRT sector 2.B.4)

Caprolactam Production

Data on annual caprolactam production for inventory calculation purpose, in entire time series, was taken from GUS publications [GUS 1989b-2025b]. From the base year up to 2014,

the CS N₂O EF of 4.74 kg N₂O/t caprolactam produced was applied, based on the Polish study [Kozłowski 2001] containing an analysis of technologies in the existing caprolactam production installations in Poland and projection of N₂O emissions until 2020, taking into account the planned changes and shares of individual installations in domestic production.

Since 2015, N₂O emission factor is based on the data obtained from the caprolactam production installations. The emission factors for individual years from the 2015-2024 period are presented in the table 4.3.2.

Table 4.3.2. N₂O EFs for caprolactam production in the years 2015-2024 [kg N₂O/t]

2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2.70	1.50	0.80	0.80	0.90	0.60	0.80	1.18	1.52	1.58

Values of EFs obtained from caprolactam producer for GHG inventory purpose is consistent with data submitted by installation to National Database managed by KOBIZE (National Centre for Emissions Management). The annual productions reported by the installations are fully in line with the amounts published in the statistical yearbook.

Such a significant decrease in N₂O emission from caprolactam production in years 2015-2020, was possible due to the use of effective nitrous oxide reduction catalysts. The N₂O emission occurs at the stage of production of ammonium nitrite, which is an intermediate in the production of hydroxylamine sulphate in the caprolactam production process. Reduction in the N₂O EF value was achieved due to the development of more and more effective catalysts as a result of the cooperation of the caprolactam producers with the Łukasiewicz Research Network - Institute of New Chemical Syntheses in Puławy which included research and testing of new catalysts for the reduction of nitrous oxide.

The increase in the N₂O emission factors in 2022 and 2023 result from deterioration in the performance of the catalyst for N₂O reduction in the ammonium nitrite installation.

Glyoxal and glyoxylic acid production

Glyoxal and glyoxylic acid have not been produced in Poland.

4.3.2.5. Carbide production (CRT sector 2.B.5)

CO₂ emission from calcium carbide category was estimated for years 1988-2007 based on annual production amounts taken from [GUS 1989b-2008b]. Starting from 2008 carbide is no longer produced in Poland.

EF equal 2190 kg CO₂/t of carbide (i.e.: 1090 kg CO₂/t carbide from production + 1100 kg CO₂/t carbide from use) was applied for CO₂ emission estimation in entire period 1988-2007. The factors given above were taken from tab. 3.8, 2006 IPCC GLs [IPCC 2006].

Silicon carbide has not been produced in Poland.

4.3.2.6. Titanium dioxide production (CRT sector 2.B.6)

Titanium dioxide is produced in Poland in sulphate route process, so it was assumed, that the GHG emission is insignificant from TiO₂ production (in accordance with 2006 IPCC GLs (Chapter 3.7, p. 3.47).

4.3.2.7. Soda ash production (CRT sector 2.B.7)

In Poland, soda ash is produced in the Solvay process. Emission of CO₂ from this process was assumed as 0 as coke consumption in soda ash production process is included in fuel use in *Final Energy Consumption - Chemical and Petrochemical* category in Polish energy balance and CO₂ emission is accounted in 1.A.2.c IPCC sector.

It is due to the amount of coke used for the production of soda ash is not separated in the national statistics. This consumption is aggregated with consumption in the production of other chemicals and given as final consumption (reported in category 1.A.2.c). It would therefore be difficult to distinguish emissions related to the consumption of coke in analyzed process.

An additional problem is the issue of transfer of CH₄ and N₂O emissions from coke from category 1.A.2.c to 2.B.7 within CRT. As the cells related to these gases in CRT Table for 2.B.7 are grayed out - no emissions of these gases are expected to be reported. Additionally when leaving the CH₄ and N₂O emissions in category 1.A.2.c, if the fuel was reallocated to 2.B.7, then IEFs for these gases would be not consistent.

The best option seems to be leaving emissions from coke used in the production of soda in category 1.A.2.c while in category 2.B.7 therefore notation key "IE" is reported (pointing to the 1.A.2.c).

4.3.2.8. Petrochemical and carbon black production (CRT sector 2.B.8)

a. Methanol production

According to statistics, in 2019-2024 methanol was not produced in Poland. Process emissions of CO₂ and CH₄ from methanol production for the period 1988-2018 were estimated based on data on annual production from [GUS 1989b-2020b]. CO₂ EF = 670 kg CO₂/t from tab. 3.12 of 2006 IPCC GLs [IPCC 2006] was applied. CH₄ emission values were calculated based on CH₄ EF = 2.3 kg CH₄/t [IPCC 2006].

b. Ethylene production

CO₂ and CH₄ process emissions related to ethylene production were estimated for the entire period 1988-2024 based on the data on annual production amounts taken from [GUS 1989b-2025b]. CO₂ EF = 1903 kg CO₂/t was applied. It is value of CO₂ EF (for default feedstock) given in tab. 3.14 of 2006 IPCC GLs adjusted by recommended regional factor (110% in case of Eastern Europe; tab. 3.15) [IPCC 2006]. CH₄ emission values were calculated based on CH₄ EF = 3.0 kg CH₄/t according to the table 3.16 [IPCC 2006].

c. Ethylene dichloride and vinyl chloride monomer production

CO₂ and CH₄ emission in this IPCC category was estimated based on vinyl chloride monomer production. Activity data for the years 2002-2024 was taken from Statistics Poland. Data for the years 1988-2001 come directly from VCM producer. CO₂ EF amounted to 294.3 kg CO₂/t VCM produced, recommended for balanced process (default process) in the table 3.17 of 2006 IPCC GLs [IPCC 2006], was applied for emission estimation in entire period. CH₄ emission was calculated using EF=0.0226 kg/t VCM produced (tab. 3.19, 2006 IPCC GLs).

d. Ethylene oxide production

Ethylene oxide production amounts from Statistics Poland were used for estimation of CO₂ and CH₄ emissions. Default EFs for both CO₂ and CH₄ were applied in order to calculation of

emissions. Utilized EF values were as follow: CO₂ EF = 863 kg CO₂/tonne ethylene oxide (tab. 3.20, 2006 GLs), CH₄ EF = 1.79 kg CH₄/tonne ethylene oxide (tab. 3.21, 2006 GLs).

e. Acrylonitrile production

According to data from Statistics Poland production of acrylonitrile in Poland occurred only in the following years: 1988-1990 and 1996-2003. Emission of CO₂ and CH₄ from this production was estimated according to 2006 IPCC GLs. CO₂ EF = 1000 kg CO₂/tonne acrylonitrile produced (tab. 3.22, 2006 GLs) and CH₄ EF = 0.18 kg CH₄/tonne acrylonitrile produced (p. 3.79, 2006 GLs) were applied for GHG inventory purpose.

f. Carbon black production

CO₂ and CH₄ emissions from production of carbon black were estimated based on annual carbon black production taken from [GUS 1989b-2000b] and [GUS 2001e-2025e] respectively. CO₂ EF equal to 2620 kg CO₂/tonne carbon black produced (tab. 3.23, 2006 GLs) and CH₄ EF = 0.06 kg CH₄/tonne carbon black produced (tab. 3.24, 2006 GLs) were used.

g. Other - Styrene Production

Data on styrene production applied for emission estimation was obtained from [GUS 1996e-2025e] for the years 1995-2024 and directly from the only styrene producer for previous years (1988-1994). Methane emissions values for the entire period 1988-2024 were estimated by applying the same emission factor of 4 kg CH₄/t styrene produced [IPCC 1997].

4.3.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.3.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.3.5. Source-specific recalculations

- The amount of natural gas used for ammonia production in 2022 and 2023 was updated and the CO₂ emissions from category 2.B.1 were corrected accordingly;
- N₂O EF value for nitric acid production was slightly adjusted for 2023.

Table. 4.3.3. Changes of GHG emission values in 2.B. subcategory as a result of recalculations

Change	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂								
kt	0.00	0.00	0.00	0.00	0.00	0.00	-30.54	426.49
%	0.00	0.00	0.00	0.00	0.00	0.00	-0.75	14.00
N ₂ O								
kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.012
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84

4.3.6. Source-specific planned improvements

No improvements are planned at the moment.

4.4. Metal industry (CRT sector 2.C)

4.4.1. Source category description

Estimation of emissions in 2.C *Metal industry* are carried out in sub-categories listed below:

1. *Iron and steel production* (2.C.1):
 - a. *Steel* (2.C.1.a),
 - b. *Pig iron* (2.C.1.b),
 - c. *Direct reduced iron* (2.C.1.c),
 - d. *Sinter* (2.C.1.d),
 - e. *Pellet* (2.C.1.e),
 - f. *Other* (2.C.1.f).
2. *Ferroalloys production* (2.C.2);
3. *Aluminium production* (2.C.3);
4. *Magnesium production* (2.C.4);
5. *Lead production* (2.C.5);
6. *Zinc production* (2.C.6);
7. *Other* (2.C.7).

Subsector 2.C.1 *Iron and steel Production* is by far the largest contributor to emissions from this category (see figure 4.4.1) – over 69.7% in 2024.

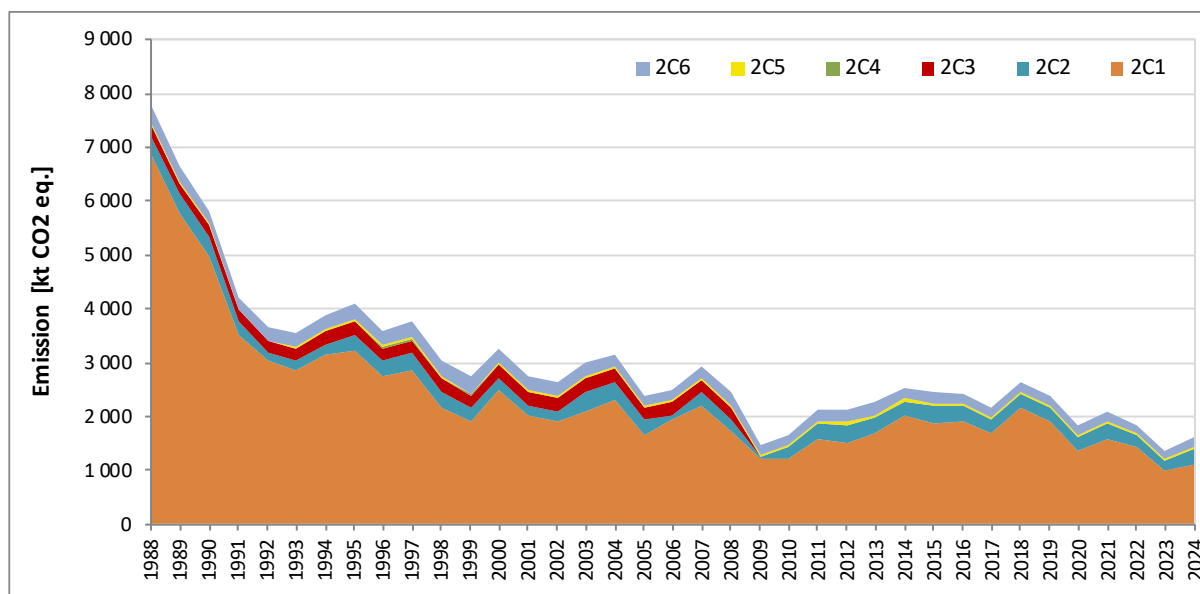


Figure 4.4.1. Emissions from *Metal industry* sector in years 1988-2024 according to subcategories

4.4.2. Methodological issues

4.4.2.1. Iron and steel production (CRT sector 2.C.1)

4.4.2.1.a. Steel (CRT sector 2.C.1.a)

Basic oxygen furnace steel production

Amount of CO₂ process emission from steel production in basic oxygen furnace was estimated based on the carbon balance in converter process (table 4.4.1). For the years 1988-2006 the Polish Steel Association (HIPH) study [HIPH 2007] was the main source of data for C balance purpose. The HIPH data was supplemented for the years 1988-2004 with the information from questionnaires collected by the National Centre for Emissions Management (KOBiZE) for installations covered by EU ETS and starting from 2005 with the data from verified reports concerning CO₂ emission, prepared as part of EU ETS. Based on mentioned verified reports, C balances for basic oxygen steel plants were prepared for the years not included in the HIPH study, it means for the period 2007-2024. Steel production amounts applied in the C balance were in accordance with data published in yearbook GUS [2005b-2025b].

Table 4.4.1. Carbon balance for steel production in basic oxygen process in years 1988-2024

	1988	1989	1990	1991	1992	1993	1994	1995	1996
CHARGE									
Pig iron [t]	6 437 194	6 274 714	6 212 430	4 835 755	5 279 309	5 205 226	5 873 001	6 440 439	5 669 525
Scrap [t]	1 895 954	1 841 725	1 840 367	1 468 313	1 595 404	1 573 016	1 796 072	1 962 554	1 725 579
Carbon pick-up agent [t]	0	0	0	0	0	0	0	0	0
Ferroalloys [t]	61 135	58 311	57 193	45 416	48 066	46 278	53 217	57 027	51 883
Dolomite [t]	187 960	182 054	189 020	144 459	155 741	144 853	163 776	177 073	156 867
Technological indicator [t/t of steel]									
Pig iron	0.867	0.870	0.862	0.841	0.845	0.845	0.835	0.838	0.839
Scrap	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554	0.2554
Carbon pick-up agent	0	0	0	0	0	0	0	0	0
Ferroalloys	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.008
Dolomite	0.025	0.025	0.026	0.025	0.025	0.024	0.023	0.023	0.023
Material-specific carbon content									
Pig iron [t C/t]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Scrap [t C/t]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon pick-up agent [t C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Ferroalloys [t C/t]	0.033	0.033	0.033	0.033	0.032	0.033	0.033	0.033	0.032
Dolomite [t C/t]	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
Carbon contents in charge components [t C]									
Pig iron	257 488	250 989	248 497	193 430	211 172	208 209	234 920	257 618	226 781
Steel scrap	7 584	7 367	7 361	5 873	6 382	6 292	7 184	7 850	6 902
Carbon pick-up agent	0	0	0	0	0	0	0	0	0
Ferroalloys	2 019	1 936	1 868	1 481	1 557	1 518	1 741	1 862	1 686
Dolomite	24 435	23 667	24 573	18 780	20 246	18 831	21 291	23 019	20 393
Carbon contents in charge – SUM [t]	291 526	283 959	282 299	219 564	239 357	234 850	265 136	290 349	255 762
OUTPUT									
Steel [t]	7 424 676	7 212 315	7 206 995	5 750 006	6 247 703	6 160 031	7 033 534	7 685 488	6 757 479
Material-specific carbon content									
Steel [t C/t]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon content in products [t C]									
Steel	29 699	28 849	28 828	23 000	24 991	24 640	28 134	30 742	27 030
Carbon content in products – SUM [t]	29 699	28 849	28 828	23 000	24 991	24 640	28 134	30 742	27 030
C emission from steel production [t]	261 827	255 109	253 471	196 564	214 366	210 210	237 002	259 607	228 732
CO ₂ process emission from steel production [kt]	960.033	935.401	929.394	720.734	786.009	770.769	869.006	951.893	838.684
CO ₂ EMISSION FACTOR [kg CO ₂ /t of steel]	129.30	129.69	128.96	125.34	125.81	125.12	123.55	123.86	124.11

Table 4.4.1. Carbon balance (cont.) for steel production in basic oxygen process in years 1988-2024

	1997	1998	1999	2000	2001	2002	2003	2004	2005
CHARGE									
Pig iron [t]	6 311 208	5 233 149	4 640 291	6 491 867	5 440 047	5 296 410	5 629 786	6 304 253	4 538 670
Scrap [t]	1 923 174	1 588 976	1 303 910	1 657 053	1366064.9	1 360 557	1 424 125	1 608 909	1 147 906
Carbon pick-up agent [t]	0	0	0	0	1 201	2 645	4 286	1 689	1 205
Ferroalloys [t]	59 896	50 915	45 285	57 840	50 035	49 610	48 197	57 157	56 566
Dolomite [t]	188 810	157 145	141 317	174 301	156 426	161 404	127 127	162 673	191 374
Technological indicator [t/t of steel]									
Pig iron	0.838	0.841	0.851	1.047	1.070	1.095	1.078	1.088	1.078
Scrap	0.2554	0.2554	0.2391	0.2437	0.2346	0.2346	0.2346	0.2346	0.2346
Carbon pick-up agent	0	0	0	0	0.0002	0.0005	0.0007	0.0002	0.0002
Ferroalloys	0.008	0.008	0.008	0.009	0.009	0.009	0.008	0.008	0.012
Dolomite	0.025	0.025	0.026	0.026	0.027	0.028	0.021	0.024	0.039
Material-specific carbon content									
Pig iron [t C/t]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Scrap [t C/t]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon pick-up agent [t C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Ferroalloys [t C/t]	0.033	0.033	0.032	0.033	0.032	0.032	0.032	0.033	0.031
Dolomite [t C/t]	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
Carbon contents in charge components [t C]									
Pig iron	252 448	209 326	185 612	259 675	217 602	211 856	225 191	252 170	181 547
Steel scrap	7 693	6 356	5 216	6 628	5 464	5 442	5 696	6 436	4 592
Carbon pick-up agent	0	0	0	0	992	2 184	3 539	1 395	995
Ferroalloys	1 951	1 659	1 466	1 905	1 623	1 598	1 560	1 860	1 779
Dolomite	24 545	20 429	18 371	22 659	20 335	20 983	16 527	21 147	24 879
Carbon contents in charge – SUM [t]	286 637	237 769	210 665	290 867	246 016	242 063	252 514	283 008	213 791
OUTPUT									
Steel [t]	7 531 274	6 222 532	5 452 751	6 799 681	5 822 518	5 799 042	6 069 985	6 857 583	4 892 671
Material-specific carbon content									
Steel [t C/t]	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon content in products [t C]									
Steel	30 125	24 890	21 811	27 199	23 290	23 196	24 280	27 430	19 571
Carbon content in products – SUM [t]	30 125	24 890	21 811	27 199	23 290	23 196	24 280	27 430	19 571
C emission from steel production [t]	256 512	212 879	188 854	263 668	222 726	218 867	228 234	255 578	194 220
CO ₂ process emission from steel production [kt]	940.545	780.557	692.464	966.782	816.662	802.513	836.857	937.119	712.141
CO ₂ EMISSION FACTOR [kg CO ₂ /t of steel]	124.89	125.44	126.99	142.18	140.26	138.39	137.87	136.65	145.55

Table 4.4.1. (cont.) Carbon balance for steel production in basic oxygen process in years 1988-2024

	2006	2007	2008	2009	2010	2011	2012	2013	2014
CHARGE									
Pig iron [t]	5 338 401	5 723 961	4 892 172	2 988 979	3 599 854	3 942 754	3 934 606	3 951 192	4 620 431
Scrap [t]	1 352 895	1 414 926	1 105 439	727 586	965 296	1 106 613	912 706	925 533	1 046 608
Carbon pick-up agent [t]	1 036	753	8 270	12 826	16 033	24 905	8 845	9 044	7 874
Ferroalloys [t]	68 765	71 480	65 149	40 273	53 926	59 738	53 477	57 253	66 718
Dolomite [t]	35 776	37 149	18 930	10 786	16 375	14 220	15 560	20 627	15 305
Technological indicator [t/t of steel]									
Pig iron	1.080	0.924	0.936	0.924	0.901	0.891	0.908	0.874	0.892
Scrap	0.2346	0.228	0.212	0.225	0.242	0.250	0.211	0.205	0.202
Carbon pick-up agent	0.0002	0.000	0.002	0.004	0.004	0.006	0.002	0.002	0.002
Ferroalloys	0.012	0.012	0.012	0.012	0.013	0.014	0.012	0.013	0.013
Dolomite	0.006	0.006	0.004	0.003	0.004	0.003	0.004	0.005	0.003
Material-specific carbon content									
Pig iron [t C/t]	0.04	0.042	0.042	0.043	0.042	0.042	0.043	0.043	0.043
Scrap [t C/t]	0.004	0.003	0.008	0.008	0.009	0.009	0.008	0.008	0.008
Carbon pick-up agent [t C/t]	0.826	0.899	0.820	0.845	0.823	0.806	0.823	0.833	0.853
Ferroalloys [t C/t]	0.029	0.032	0.035	0.035	0.033	0.028	0.031	0.031	0.033
Dolomite [t C/t]	0.130	0.130	0.124	0.125	0.125	0.125	0.126	0.125	0.126
Carbon contents in charge components [t C]									
Pig iron	213 536	239 730	207 333	127 337	150 438	165 971	167 334	168 816	197 002
Steel scrap	5 412	4 297	8 457	5 785	9 109	9 865	7 292	6 999	8 255
Carbon pick-up agent	855	677	6 783	10 839	13 198	20 075	7 277	7 538	6 714
Ferroalloys	2 021	2 288	2 249	1 427	1 761	1 673	1 681	1 769	2 222
Dolomite	4 649	4 829	2 341	1 345	2 047	1 780	1 960	2 586	1 924
Carbon contents in charge – SUM [t]	226 474	251 821	227 163	146 733	176 553	199 365	185 544	187 708	216 117
OUTPUT									
Steel [t]	5 766 375	6 197 910	5 225 075	3 235 666	3 994 650	4 423 604	4 333 168	4 520 358	5 182 371
Material-specific carbon content									
Steel [t C/t]	0.004	0.003	0.008	0.008	0.010	0.009	0.008	0.003	0.002
Carbon content in products [t C]									
Steel	23 066	18 304	41 662	25 760	38 441	40 780	34 990	11 919	8 579
Carbon content in products – SUM [t]	23 066	18 304	41 662	25 760	38 441	40 780	34 990	11 919	8 579
C emission from steel production [t]	203 408	233 516	185 501	120 974	138 111	158 585	150 554	175 789	207 538
CO ₂ process emission from steel production [kt]	745.831	856.227	680.171	443.570	506.409	581.478	552.032	644.561	760.973
CO ₂ EMISSION FACTOR [kg CO ₂ /t of steel]	129.34	138.15	130.17	137.09	126.77	131.45	127.40	142.59	146.84

Table 4.4.1. (cont.) Carbon balance for steel production in basic oxygen process in years 1988-2024

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CHARGE										
Pig iron [t]	4 792 153	4 614 066	4 595 349	4 778 052	4 345 972	3 469 081	3 565 671	3 006 078	2 762 859	3 440 679
Scrap [t]	1 023 858	905 766	1 130 517	1 061 825	986 300	760 965	849 048	757 661	690 437	827 212
Carbon pick-up agent [t]	8 414	7 826	8 467	8 531	7 082	7 241	10 828	9 683	6 993	7 841
Ferroalloys [t]	71 598	64 505	76 167	74 275	64 748	52 773	59 714	54 570	46 282	55 032
Dolomite [t]	23 850	17 180	14 368	9 260	5 960	-	-	-	-	-
Technological indicator [t/t of steel]										
Pig iron	0.894	0.897	0.802	0.882	0.880	0.878	0.873	0.867	0.880	0.893
Scrap	0.191	0.176	0.197	0.196	0.200	0.193	0.208	0.218	0.220	0.215
Carbon pick-up agent	0.002	0.002	0.001	0.002	0.001	0.002	0.003	0.003	0.002	0.002
Ferroalloys	0.013	0.013	0.013	0.014	0.013	0.013	0.015	0.016	0.015	0.015
Dolomite	0.004	0.003	0.003	0.002	0.001	-	-	-	-	-
Material-specific carbon content										
Pig iron [t C/t]	0.043	0.042	0.042	0.043	0.043	0.041	0.041	0.046	0.046	0.048
Scrap [t C/t]	0.008	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002
Carbon pick-up agent [t C/t]	0.859	0.872	0.872	0.865	0.875	0.864	0.873	0.881	0.861	0.886
Ferroalloys [t C/t]	0.029	0.027	0.028	0.027	0.028	0.023	0.023	0.023	0.027	0.027
Dolomite [t C/t]	0.126	0.125	0.127	0.127	0.127	-	-	-	-	-
Carbon contents in charge components [t C]										
Pig iron	203 829	194 579	193 994	206 006	185 957	141 885	145 836	139 461	127 395	163 531
Steel scrap	7 966	1 814	2 049	2 289	1 677	1 656	2 346	1 700	1 601	1 480
Carbon pick-up agent	7 229	6 824	7 379	7 381	6 196	6 255	9 457	8 529	6 019	6 945
Ferroalloys	2 067	1 766	2 150	1 971	1 811	1 220	1 399	1 238	1 227	1 644
Dolomite	3 003	2 152	1 821	1 175	756	-	-	-	-	-
Carbon contents in charge – SUM [t]	224 094	207 135	207 392	218 822	185 957	151 016	159 039	150 927	136 242	173 600
OUTPUT										
Steel [t]	5 358 991	5 145 076	5 728 091	5 418 381	4 937 654	3 950 813	4 083 338	3 468 284	3 140 725	3 852 764
Material-specific carbon content										
Steel [t C/t]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Carbon content in products [t C]										
Steel	8 860	8 238	9 261	9 184	7 673	7 380	7 969	6 652	6 237	7 289
Carbon content in products – SUM [t]	8 860	8 238	9 261	9 184	7 673	7 380	7 969	6 652	6 237	7 289
C emission from steel production [t]	261 827	198 897	198 132	209 638	188 724	143 636	151 070	144 275	130 005	166 311
CO ₂ process emission from steel production [kt]	789.194	729.290	726.484	768.673	691.988	526.665	553.924	529.008	476.685	609.807
CO ₂ EMISSION FACTOR [kg CO ₂ /t of steel]	147.27	141.75	126.83	141.86	140.15	133.31	135.65	152.53	151.78	158.28

Electric furnace steel production

Process emissions of CO₂ from steel production in electric furnaces for particular years in the period 1988-2006 were estimated based on the data from Polish Steel Association study [HIPH 2007]. For the next years information from verified reports, prepared as part of EU ETS, was applied for emission calculation. Steel production amounts was taken from Statistics Poland yearbook [GUS 2008b-2025b]. Results of CO₂ emission estimation, AD and emission factors applied for calculation are presented in the table 4.4.2.

Table 4.4.2. Values of steel production in electric furnace [kt] as well as CO₂ emission factors [kg/t of steel] and CO₂ emission [kt] connected with that process for the years 1988-2024

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production	2572.4	2264.3	2308.6	1950.9	1727.3	2044.2	2368.1	2581.9	2648.4	2906.3
CO₂ emission factor	34.75	36.94	36.94	36.11	33.21	37.82	36.44	33.05	33.05	33.05
CO₂ emission	89.38	83.63	85.27	70.45	57.36	77.32	86.29	85.34	87.54	96.07
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Production	3116.9	2825.1	3283.9	2809.1	2561.2	2916.6	3720.9	3443.2	4225.3	4432.8
CO₂ emission factor	35.83	29.15	44.13	44.10	45.64	41.90	55.10	46.97	48.88	44.76
CO₂ emission	111.66	82.35	144.91	123.89	116.90	122.20	205.00	161.74	206.53	198.41
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	4502.3	3892.8	4001.4	4352.9	4209.3	3679.0	3617.1	3977.5	4015.6	4812.3
CO₂ emission factor	53.44	52.84	50.70	54.98	52.70	61.26	58.44	52.20	56.21	58.04
CO₂ emission	240.58	205.68	202.88	239.30	221.84	225.38	211.40	207.63	225.72	279.30
	2018	2019	2020	2021	2022	2023	2024			
Production	4913.9	4184.3	4007.4	4469.2	4052.8	3381.4	3314.0			
CO₂ emission factor	56.63	57.55	55.13	50.74	52.31	58.08	54.17			
CO₂ emission	278.28	240.81	220.91	226.78	212.00	196.41	179.53			

Open-hearth furnace steel production

Steel production in open-hearth furnaces was continued up to 2002. CO₂ process emissions from this source was estimated according to case study prepared by the Polish Steel Association (HIPH) [HIPH 2007]. CO₂ emission was calculated based on carbon balance developed for steel production process in mentioned furnaces.

4.4.2.1.b. Pig iron (CRT sector 2.C.1.b)

CO₂ process emission from pig iron production for the years 1988-2024 was estimated based on carbon balance in blast furnace process. Balances for individual years were founded on the statistical data for main components of input and output. Pig iron production values for entire period were accepted according to G-03 questionnaires [GUS 1989e-2025e]. Output of blast furnace gas, input of coke and coal were taken from Eurostat database for the period 1990-2024. For the years 1988-1989 that data came from IEA database [IEA] due to data for mentioned years is not available in Eurostat database. Iron ore sinter consumption was applied in accordance with reports from steel plants. In recent years, lime and dolomite consumption data have also been taken from ETS reports. Amounts of other components in BF process were estimated according to technological factors taken from literature [Szargut J. 1983]. These applied coefficients, expressed in tonnes per tonne of pig iron produced, were as follows: for roasted ore, 0.188; for manganese ore, 0.0716; and for dolomite and limestone until 2018, 0.0845 and 0.0974 respectively. Carbon contents in components of charge and output were calculated based on C EFs from 2006 IPCC guidelines (for coke, limestone, dolomites) or based on country specific values (data for iron ore comes from [Szargut J. 1983] while for sinter, pig iron and BF gas – from steel plants). Carbon balance for blast furnace process and estimated emissions for the years 1988-2024 were presented in the table 4.4.3.

The significant decrease in the CO₂ EF from pig iron production in 2023 and 2024 is the result of reduction of coal dust consumption (given as coking coal in table 4.4.3 in the NID). Input cooking coal consumption rate per t of pig iron produced fell in the input from 2.3 in 2022 to 0.8 GJ/t of pig iron in 2023 and to 0 in 2024. Decreased use of coal dust here was replaced by natural gas. Natural gas consumption for pig iron production is reported in national energy balances as *Final Energy Consumption - Iron and Steel* so it is balanced in the GHG emission inventory in category 1.A.2.a. Coke and coal consumed in the process, on the other hand, are included in the energy balance under the *Transformation input in Blast Furnaces*, hence are included in the inventory under category 2.C.1.b. Therefore, any changes in fuel consumption in the blast furnace process (such as the described changing from coal to natural gas) significantly affect the CO₂ EF from the pig iron production. That is the reason why CO₂ EF values in 2.C.1.b often change significantly from year to year.

Table 4.4.3. Carbon balance for blast furnace process in years 1988-2024

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
CHARGE – amount used in process in given year										
Sinter [kt]	14 107.3	12 992.5	11 779.4	8 612.7	8 621.7	7 628.2	8 787.4	8 646.6	8 318.6	8 980.8
Roasted ore [kt]	1 929.3	1 783.7	1 627.5	1 222.3	1 214.9	1 183.1	1 331.3	1 399.4	1 233.6	1 394.6
Dolomite [kt]	867.2	801.7	731.5	549.4	546.0	531.7	598.4	629.0	554.5	626.8
Limestone [kt]	999.6	924.1	843.2	633.3	629.4	612.9	689.7	725.0	639.1	722.5
Manganese ore [kt]	734.8	679.3	619.8	465.5	462.7	450.6	507.0	533.0	469.8	531.1
Coke [TJ]	186 338	179 462	157 427	107 026	101 994	95 398	110 413	113 883	97 668	103 302
Coking coal [TJ]										
CHARGE – C content										
Sinter [kg/kg]	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012
Roasted ore [kg/kg]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
Dolomite [kg/kg]	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Limestone [kg/kg]	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200
Manganese ore [kg/kg]	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262
Coke [kg/GJ]	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Coking coal [kg/GJ]										
CHARGE – total C content [kt]										
Sinter	17.1	15.8	14.2	10.3	10.3	9.2	10.5	10.3	9.9	10.7
Roasted ore	21.7	20.1	18.3	13.8	13.7	13.3	15.0	15.8	13.9	15.7
Dolomite	112.7	104.2	95.1	71.4	71.0	69.1	77.8	81.8	72.1	81.5
Limestone	119.9	110.9	101.2	76.0	75.5	73.6	82.8	87.0	76.7	86.7
Manganese ore	19.2	17.8	16.2	12.2	12.1	11.8	13.3	13.9	12.3	13.9
Coke	5 441.1	5 240.3	4 596.9	3 125.2	2 978.2	2 785.6	3 224.1	3 325.4	2 851.9	3 016.4
Coking coal										
C IN CHARGE – SUM	5 731.8	5 509.0	4 841.8	3 308.8	3 160.8	2 962.6	3 423.4	3 534.2	3 036.8	3 224.9
OUTPUT IN GIVEN YEAR										
Pig iron [kt]	10 262.4	9 487.6	8 656.7	6 501.5	6 462.0	6 292.9	7 081.2	7 443.5	6 561.9	7 418.0
Blast furnace gas [TJ]	74 521	71 771	62 970	42 811	40 802	38 157	44 162	45 545	39 062	41 319
OUTPUT – C content										
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Blast furnace gas [kg/GJ]	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88
OUTPUT – total C content [kt]										
Pig iron	410.5	379.5	346.3	260.1	258.5	251.7	283.2	297.7	262.5	296.7
Blast furnace gas	4 983.7	4 799.8	4 211.2	2 863.0	2 728.7	2 551.8	2 953.4	3 045.9	2 612.3	2 763.3
C IN OUTPUT – SUM	5 394.2	5 179.3	4 557.5	3 123.1	2 987.2	2 803.5	3 236.6	3 343.6	2 874.8	3 060.0
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [kt]	337.6	329.8	284.4	185.7	173.7	159.1	186.8	190.6	162.0	165.0
CO ₂ EMISSION [kt]	1237.99	1209.09	1042.74	681.06	636.77	583.23	684.79	698.74	594.07	604.86
CO ₂ EMISSION FACTOR [kg/t]	120.63	127.44	120.45	104.75	98.54	92.68	96.71	93.87	90.53	81.54

Table 4.4.3. (cont.) Carbon balance for blast furnace process in years 1988-2024

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CHARGE – amount used in process in given year										
Sinter [kt]	6 882.1	6 475.9	8 078.7	7 352.8	7 616.9	7 732.2	8 590.6	6 168.4	6 907.8	6 954.0
Roasted ore [kt]	1 180.5	993.1	1 223.0	1 023.3	995.7	1 061.4	1 208.3	841.6	1 042.1	1 091.2
Dolomite [kt]	530.6	446.4	549.7	459.9	447.5	477.1	543.1	378.3	468.4	490.5
Limestone [kt]	611.6	514.5	633.6	530.1	515.9	549.9	626.0	436.0	539.9	565.4
Manganese ore [kt]	449.6	378.2	465.8	389.7	379.2	404.2	460.2	320.5	396.9	415.6
Coke [TJ]	85 714	70 451	92 631	79 764	71 875	77 676	84 581	58 619	72 356	86 571
Coking coal [TJ]										
CHARGE – C content										
Sinter [kg/kg]	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012
Roasted ore [kg/kg]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
Dolomite [kg/kg]	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Limestone [kg/kg]	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200
Manganese ore [kg/kg]	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262
Coke [kg/ GJ]	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Coking coal [kg/GJ]										
CHARGE – total C content [kt]										
Sinter	8.1	7.7	9.5	8.7	9.0	9.1	10.2	7.3	9.0	8.5
Roasted ore	13.3	11.2	13.8	11.5	11.2	12.0	13.6	9.5	11.7	12.3
Dolomite	69.0	58.0	71.5	59.8	58.2	62.0	70.6	49.2	60.9	63.8
Limestone	73.4	61.7	76.0	63.6	61.9	66.0	75.1	52.3	64.8	67.8
Manganese ore	11.8	9.9	12.2	10.2	9.9	10.6	12.0	8.4	10.4	10.9
Coke	2 502.8	2 057.2	2 704.8	2 329.1	2 098.7	2 268.1	2 469.8	1 711.7	2 112.8	2 527.9
Coking coal										
C IN CHARGE – SUM	2 678.4	2 205.7	2 887.8	2 482.9	2 248.9	2 427.8	2 651.3	1 838.4	2 269.6	2 691.2
OUTPUT IN GIVEN YEAR										
Pig iron [kt]	6 279.4	5 282.3	6 505.3	5 442.8	5 296.4	5 645.9	6 426.9	4 481.2	5 543.4	5 804.4
Blast furnace gas [TJ]	34 289	28 179	37 053	31 904	28 752	31 031	33 836	23 446	28 948	34 626
OUTPUT – C content										
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Blast furnace gas [kg/GJ]	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88	66.88
OUTPUT – total C content [kt]										
Pig iron	251.2	211.3	260.2	217.7	211.9	225.8	257.1	179.2	221.7	232.2
Blast furnace gas	2 293.1	1 884.5	2 478.0	2 133.6	1 922.8	2 075.2	2 262.8	1 568.0	1 935.9	2 315.7
C IN OUTPUT – SUM	2 544.3	2 095.8	2 738.2	2 351.3	2 134.7	2 301.1	2 519.9	1 747.2	2 157.7	2 547.8
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [kt]	134.1	109.9	149.6	131.6	114.3	126.7	131.4	91.2	111.9	143.3
CO₂ EMISSION [kt]	491.69	402.98	548.65	482.47	418.95	464.69	481.86	334.58	410.31	525.56
CO₂ EMISSION FACTOR [kg/t]	78.30	76.29	84.34	88.64	79.10	82.31	74.98	74.66	74.02	90.55

Table 4.4.3. (cont.) Carbon balance for blast furnace process in years: 1988-2024

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CHARGE – amount used in process in given year										
Sinter [kt]	6 306	4 356.4	5 801.5	6 465.5	6 539.3	6 615.6	7 264.6	7 270.5	6 641.7	6 897.6
Roasted ore [kt]	927.6	560.9	683.9	747.3	741.0	754.2	871.8	1 056.7	878.7	977.4
Dolomite [kt]	416.9	252.1	307.4	335.9	333.1	339.0	391.9	475.0	394.9	439.3
Limestone [kt]	480.6	290.6	354.3	387.2	383.9	390.8	451.7	547.5	455.2	506.4
Manganese ore [kt]	353.3	213.6	260.5	284.6	282.2	287.3	332.0	402.5	334.6	372.3
Coke [TJ]	71 380	44 020	50 809	52 396	52 150	54 106	63 169	63 840	61 404	61 339
Coking coal [TJ]	0	0	948	2 338	5 980	4 191	5 454	7 992	8 377	10 870
CHARGE – C content										
Sinter [kg/kg]	0.0012	0.0016	0.0016	0.0017	0.0014	0.0012	0.0013	0.0013	0.0014	0.0014
Roasted ore [kg/kg]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
Dolomite [kg/kg]	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Limestone [kg/kg]	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200
Manganese ore [kg/kg]	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262
Coke [kg/ GJ]	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Coking coal [kg/GJ]			26.02	26.03	25.97	26.01	26.02	26.02	26.02	26.01
CHARGE – total C content [kt]										
Sinter	7.6	7.1	9.1	11.0	9.1	7.7	9.2	9.7	9.0	9.5
Roasted ore	10.4	6.3	7.7	8.4	8.3	8.5	9.8	11.9	9.9	11.0
Dolomite	54.2	32.8	40.0	43.7	43.3	44.1	50.9	61.7	51.3	57.1
Limestone	57.7	34.9	42.5	46.5	46.1	46.9	54.2	65.7	54.6	60.8
Manganese ore	9.2	5.6	6.8	7.4	7.4	7.5	8.7	10.5	8.8	9.7
Coke	2 084.3	1 285.4	1 483.6	1 530.0	1 522.8	1 579.9	1 844.5	1 864.1	1 793.0	1 791.1
Coking coal			24.7	60.9	155.3	109.0	141.9	207.9	217.9	282.8
C IN CHARGE – SUM	2 223.4	1 372.1	1 614.4	1 707.8	1 792.3	1 803.6	2 119.2	2 231.6	2 144.6	2 222.0
OUTPUT IN GIVEN YEAR										
Pig iron [kt]	4 933.8	2 983.5	3 638.0	3 974.9	3 941.4	4 012.0	4 637.5	5 620.8	4 673.7	5 199.0
Blast furnace gas [TJ]	28 551	17 610	22 022	22 271	22 684	22 530	25 802	26 470	25 158	27 164
OUTPUT – C content										
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Blast furnace gas [kg/GJ]	68.37	67.85	65.67	65.51	66.97	67.12	67.31	69.90	70.58	70.20
OUTPUT – total C content [kt]										
Pig iron	209.1	127.1	152.0	167.3	167.6	171.4	197.7	239.1	197.1	219.5
Blast furnace gas	1 952.2	1 194.8	1 446.3	1 459.1	1 519.2	1 512.2	1 736.7	1 850.3	1 775.7	1 906.9
C IN OUTPUT – SUM	2 161.3	1 321.9	1 598.3	1 626.4	1 686.8	1 683.6	1 934.4	2 089.4	1 972.8	2 126.4
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [kt]	62.2	50.2	16.1	81.4	105.5	120.0	184.8	142.3	171.8	95.6
CO₂ EMISSION [kt]	227.94	183.91	58.86	298.54	386.76	439.85	677.74	521.66	629.78	350.53
CO₂ EMISSION FACTOR [kg/t]	46.20	61.64	16.18	75.11	98.13	109.63	146.14	92.81	134.75	67.42

Table 4.4.3. (cont.) Carbon balance for blast furnace process in years: 1988-2024

	2018	2019	2020	2021	2022	2023	2024
CHARGE – amount used in process in given year							
Sinter [kt]	6 256.6	6 076.4	4 797.4	4 993.4	4 078.0	3 413.4	3 937.0
Roasted ore [kt]	900.1	797.5	652.3	674.3	575.4	520.1	647.8
Dolomite [kt]	404.6	42.4	104.1	101.2	66.6	49.6	47.1
Limestone [kt]	466.3	-	-	-	-	-	-
Manganese ore [kt]	342.8	303.7	248.4	256.8	219.1	198.1	246.7
Coke [TJ]	62 615	59 263	45 850	48 682	45 269	40 273	48 579
Coking coal [TJ]	8 990	11 036	7 873	7 244	7 159	2 164	-
CHARGE – C content							
Sinter [kg/kg]	0.0015	0.0015	0.0015	0.0014	0.0016	0.0017	0.0017
Roasted ore [kg/kg]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
Dolomite [kg/kg]	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300	0.1300
Limestone [kg/kg]	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200	0.1200
Manganese ore [kg/kg]	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262	0.0262
Coke [kg/GJ]	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Coking coal [kg/GJ]	26.02	26.02	26.02	26.02	26.02	26.02	-
CHARGE – total C content [kt]							
Sinter	9.5	8.9	7.3	7.2	6.3	5.6	7.5
Roasted ore	10.1	9.0	7.3	7.6	6.5	5.9	7.3
Dolomite	52.6	5.5	13.5	13.1	8.7	6.4	6.1
Limestone	56.0	0.0	0.0	0.0	0.0	0.0	0.0
Manganese ore	9.0	7.9	6.5	6.7	5.7	5.2	6.5
Coke	1 828.4	1 730.5	1 338.8	1 421.5	1 321.9	1 176.0	1 418.5
Coking coal	233.9	287.1	204.8	188.5	186.3	56.3	-
C IN CHARGE – SUM	2 199.4	2 048.9	1 578.3	1 644.6	1 535.4	1 255.4	1 445.8
OUTPUT IN GIVEN YEAR							
Pig iron [kt]	4 787.7	4 241.9	3 469.8	3 586.9	3 060.7	2 766.5	3 445.7
Blast furnace gas [TJ]	26 377	24 327	19 443	20 336	17 941	15 880	18 554
OUTPUT – C content							
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Blast furnace gas [kg/GJ]	67.81	69.43	67.47	66.88	70.37	68.58	68.37
OUTPUT – total C content [kt]							
Pig iron	206.4	181.5	141.9	146.7	142.0	127.6	163.8
Blast furnace gas	1 788.6	1 688.9	1 311.7	1 360.1	1 262.5	1 089.1	1 268.5
C IN OUTPUT – SUM	1 995.0	1 870.4	1 453.6	1 506.9	1 404.5	1 216.6	1 432.3
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [kt]	204.4	178.5	124.7	137.8	130.9	38.8	13.5
CO₂ EMISSION [kt]	749.30	654.53	457.11	505.20	479.96	142.11	49.59
CO₂ EMISSION FACTOR [kg/t]	156.50	154.30	131.74	140.85	156.82	51.37	14.39

4.4.2.1.c. Direct reduced iron (CRT sector 2.C.1.c)

Direct reduced iron has not been produced in Poland (information confirmed by Polish Steel Association (HIPH)).

4.4.2.1.d. Sinter (2.C.1.d)

Estimation of carbon dioxide process emissions from iron ore sinter production for 2024 was based on the data from the EU ETS verified reports on annual emissions of CO₂ from iron ore sinter installations [KOBiZE database]. Sinter production (not published from 2000 in statistical materials) and data needed for estimation of country specific CO₂ EFs (i.e. amounts of components in input and output of the sintering process) were accepted according to mentioned EU ETS reports as well. Emissions for 2005-2023 were also estimated in accordance with EU ETS reports while for the years 1988-2004 according to data from questionnaires obtained by the National Centre for Emissions Management from installations entering the EU ETS [KOBiZE database]. The values of iron ore sinter production (AD), CO₂ EFs and CO₂ emissions were presented in the table 4.4.1. AD sources were as follows: G-03 reports for 1988-2000 [GUS 1989e-2002e], questionnaires from EU ETS installations collected by National Centre for Emissions Management for 2001-2004 and EU ETS verified reports for the years starting from 2005 [KOBiZE database].

For the entire period 1988-2024 emissions of CH₄ were also estimated from iron ore sinter production. The default emission factor for CH₄ (0.07 kg/t), was taken from tab. 4.2., 2006 GLs [IPCC 2006].

Table 4.4.4. Iron ore sinter production [kt], CO₂ emission factors [kg/t of sinter] and CO₂ emission values from sinter production [kt] in the years 1988-2024

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production	14107.3	12992.5	11779.4	8612.7	8621.7	7628.2	8787.4	8646.6	8318.6	8980.8
CO₂ emission factor	78.05	56.72	71.41	79.08	72.97	75.70	73.10	79.77	79.81	74.89
CO₂ emission	1101.14	736.98	841.16	681.13	629.08	577.45	642.35	689.76	663.94	672.58
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Production	6882.1	6475.9	8078.7	7352.8	7616.9	7732.2	8590.6	6168.4	6907.8	6954.0
CO₂ emission factor	73.55	83.21	79.00	72.36	73.92	85.08	76.79	72.59	84.59	88.28
CO₂ emission	506.20	538.89	638.21	532.01	563.07	657.86	659.70	447.73	584.31	613.91
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	6306.4	4362.6	5837.3	6512.8	6672.5	6854.2	7389.4	7429.9	6850.5	6992.2
CO₂ emission factor	91.11	82.25	75.77	69.29	52.63	51.86	49.10	48.09	44.00	43.82
CO₂ emission	574.59	358.80	442.32	451.29	351.14	355.48	362.79	357.28	301.43	306.40
	2018	2019	2020	2021	2022	2023	2024			
Production	6738.5	6468.0	4890.0	5021.0	4111.4	3420.4	3936.5			
CO₂ emission factor	52.72	47.90	33.49	55.83	51.23	53.49	69.11			
CO₂ emission	355.28	309.82	163.77	280.34	210.64	182.97	272.05			

4.4.2.1.e. Pellet (2.C.1.e)

Pellets have not been produced in Poland (information confirmed by Polish Steel Association).

4.4.2.2. Ferroalloys production (CRT sector 2.C.2)

Emission of CO₂ concerning ferroalloys production in 2024 was estimated based on annual ferrosilicon production taken from [GUS 2025b]. Applied emission factor of 4000 kg CO₂/t ferrosilicon, was taken from [IPCC 2006] – tab. 4.5 for ferrosilicon – 75% Si.

CH₄ emission was estimated based on emission factors from [IPCC 2006] – tab. 4.7 which is equal 1 kg CH₄/t ferrosilicon – 75% Si. In the period 1988-2023 CO₂ and CH₄ process emission from ferroalloys production was estimated also based on annual ferrosilicon production taken from [GUS 1989b-2024b] (figure 4.4.2) and emission factors as in 2024.

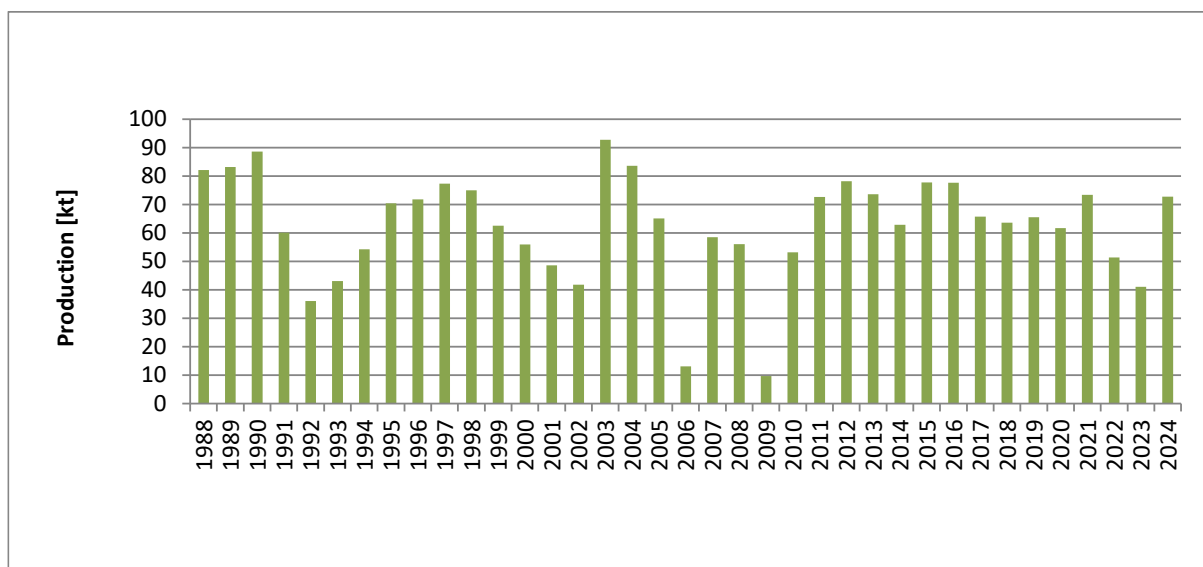


Figure 4.4.2. Production of ferrosilicon in 1988-2024

Coal consumption in ferroalloys production is submitted in national energy statistics as non-energy use of fuel. This means that coal consumed as reducer in mentioned process is not included in energy consumption of coal in 1.A.2 subsector, so double counting is avoided.

4.4.2.3. Aluminium production (CRT sector 2.C.3)

CO₂ emission from aluminium production was estimated for years 1988-2008 based on annual production amounts taken from [GUS 1989b-2009b]. Starting from 2009 primary aluminium is no longer produced in Poland.

The emission factor amounting to 1.7 t CO₂/t primary aluminium was applied in order to estimate CO₂ emission for entire period 1988-2008. Mentioned CO₂ EF is given in tab. 4.10. of 2006 IPCC GLs [IPCC 2006] as the value recommended for Soderberg process.

Emission of PFC gases from aluminium production is described in chapter 4.7.2.

4.4.2.4. Magnesium production (CRT sector 2.C.4)

Emission from use of SF₆ in magnesium foundries is described in chapter 4.7.2.

4.4.2.5. Lead production (CRT sector 2.C.5)

Process emissions of CO₂ from lead production for the years 1988-2024 were estimated based on annual lead productions taken from GUS yearbooks [GUS 1989b-2025b]. The default emission factor of 0.52 t CO₂/t lead produced, taken from the table 4.21 of 2006 GLs [IPCC 2006], was applied for the entire period.

The trend of process emissions from lead production is given in figure 4.4.3.

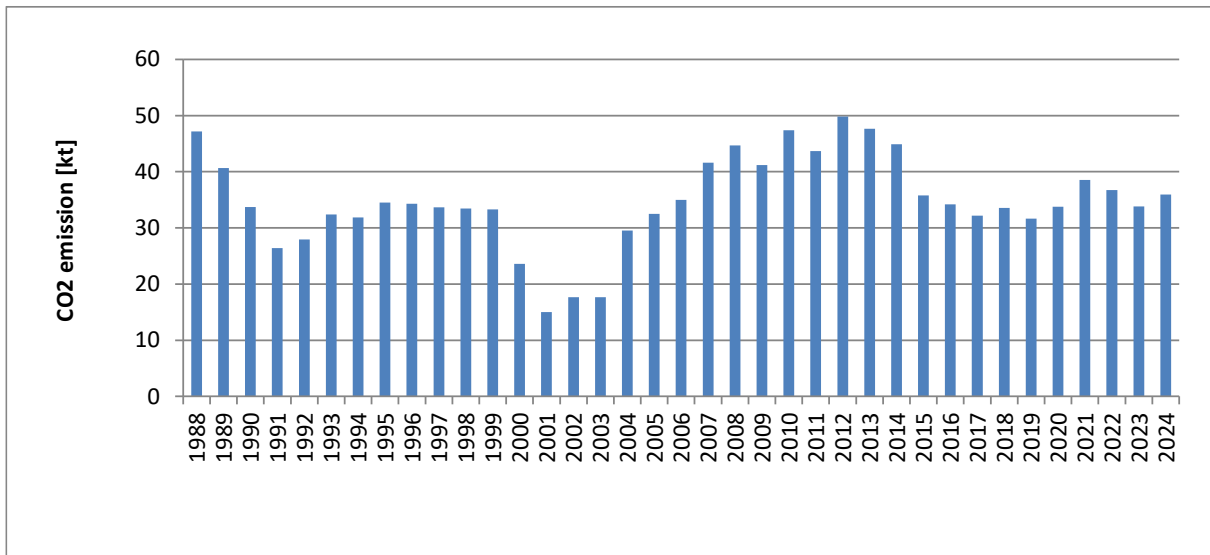


Figure 4.4.3. CO₂ process emission for lead production in 1988-2024

4.4.2.6. Zinc production (CRT sector 2.C.6)

CO₂ process emission from zinc production for the years 1988-2024 was estimated based on annual zinc production taken from GUS yearbooks [GUS 1989b-2025b]. The default emission factor amounting to 1.72 t CO₂/t zinc was used for entire reporting period. The factor comes from table 4.24 of 2006 GLs [IPCC 2006].

Process emission trend of CO₂ from zinc production is presented in figure 4.4.4.

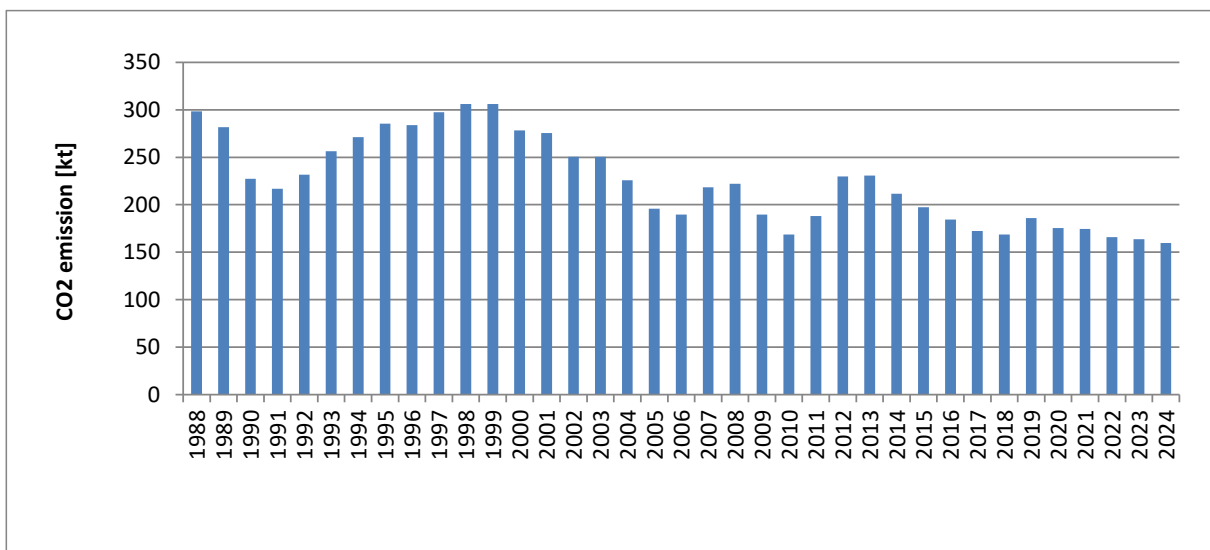


Figure 4.4.4. CO₂ process emission for zinc production in 1988-2024

4.4.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.4.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.4.5. Source-specific recalculations

- Carbon content in coking coal was adjusted in C balance for blast furnace for 2022 and 2023 and therefore CO₂ emission from BF was corrected for these years

Table. 4.4.5. Changes of GHG emission values in 2.C. subcategory as a result of recalculations

Change	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂								
kt	0.00	0.00	0.00	0.00	0.00	0.00	9.37	3.21
%	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.24

4.4.6. Source-specific planned improvements

No improvements are planned at the moment.

4.5. Non-energy Product from Fuels and Solvent Use (CRF sector 2.D)

4.5.1. Source category description

Estimation of emissions in 2.D *Non Energy Product from Fuels and Solvent Use* are performed in sub-categories listed below:

- a) *Lubricant use* (2.D.1),
- b) *Paraffin wax use* (2.D.2),
- c) *Other* (2.D.3).

Subsector 2.D.3 *Other* is by far the largest contributor to emissions from this category (see figure 4.5.1) – responsible for about 30.7% in 2024.

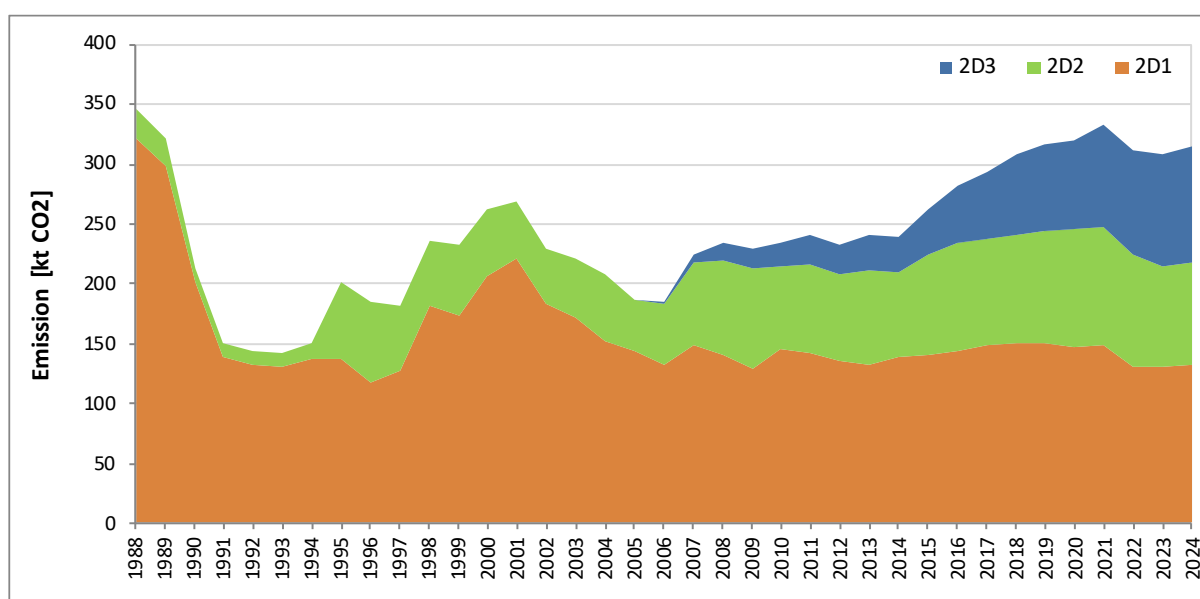


Figure 4.5.1. Emissions from *Non Energy Product from Fuels and Solvent Use* sector in years 1988-2024 according to subcategories (without indirect CO₂ emissions from Solvent use)

4.5.2. Methodological issues

4.5.2.1. Lubricant use (CRF sector 2.D.1)

This sector covers emissions from lubricants used in industry and transportation. The use of lubricants in engines is primarily for their lubricating properties and associated emissions are therefore considered as non-combustion emissions.

CO₂ emissions concerning non-energy use of lubricants were estimated based on Tier 1 method according to IPCC 2006 guidelines. Calculations were made in accordance with the following formula:

$$CO_2 \text{ emissions} = LC \times CC \times ODU \times 44/12$$

where:

LC – non-energy use of lubricants, TJ

CC – carbon content of lubricants (carbon emission factor), t C/TJ

ODU – oxidised during use factor

44/12 – mass ratio of CO₂/C

Carbon content of lubricants is default value equal 20 t C/TJ. ODU factor for lubricant is country specific and is equal 0.5.

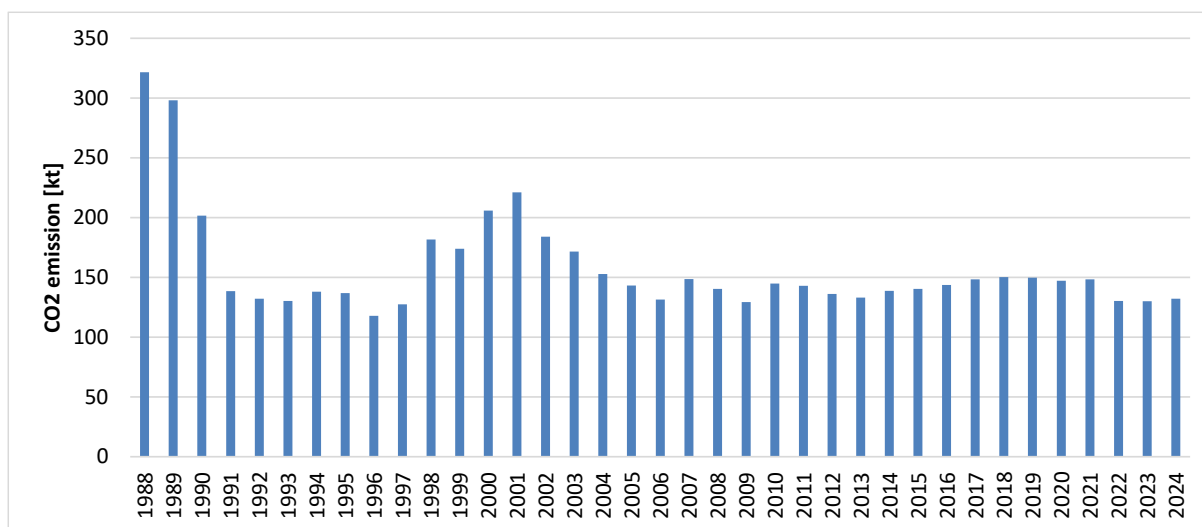


Figure 4.5.2. CO₂ emissions from non-energy use of lubricants in years 1988-2024

4.5.2.2. Paraffin wax use (CRF sector 2.D.2)

Paraffin waxes are used in applications such as: candles, corrugated boxes, paper coating, board sizing, food production, wax polishes, surfactants (as used in detergents) and many others. Emissions from the use of waxes derive primarily when the waxes or derivatives of paraffins are combusted during use (e.g., candles). CO₂ emissions concerning non-energy use of paraffin wax were estimated based on Tier 1 method according to IPCC 2006 guidelines. Calculations were made in accordance with the following formula:

$$CO_2 \text{ emissions} = PW \times CC \times ODU \times 44/12$$

where:

PW – non-energy use of paraffin wax, TJ

CC – carbon content of paraffin wax (carbon emission factor), t C/TJ

ODU – oxidised during use factor

44/12 – mass ratio of CO₂/C

Carbon content of paraffin wax is default value equal 20 t C/TJ. ODU factor for paraffin wax is default value equal 0.2.

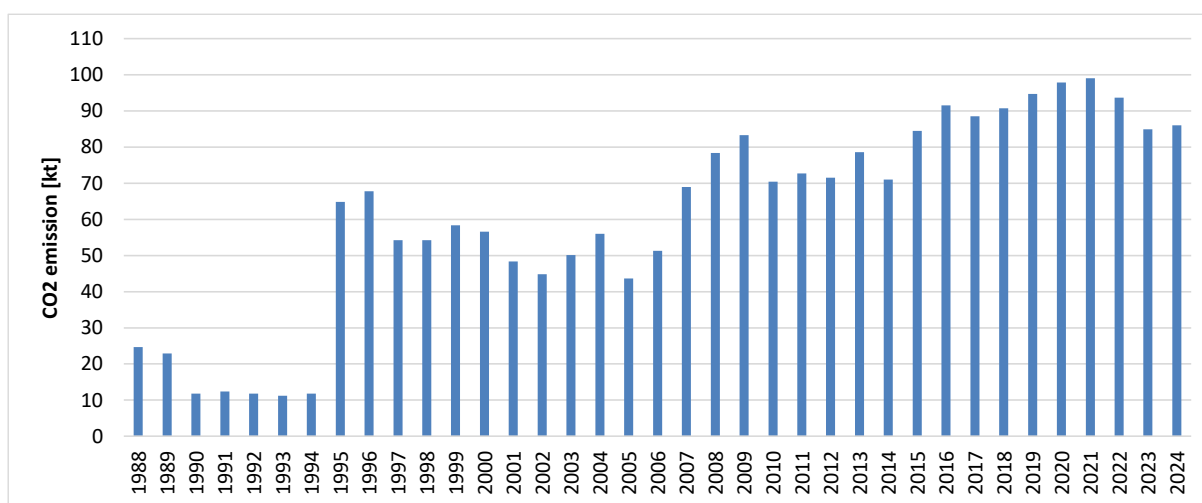


Figure 4.5.3. CO₂ emissions from non-energy use of paraffin waxes in years 1988-2024

4.5.2.3. Other (CRF sector 2.D.3)

Category contain emission from solvent use and associated CO₂ emissions concerning non-energy use of fuels.

4.5.2.3.1. Solvent use

There are no sources from sub-category Solvent Use, which are identified as key sources.

The use of solvents is one of the main sources of NMVOC emissions and is associated with following processes:

- Paint application,
- Degreasing and dry cleaning,
- Chemical products, manufacture and processing,
- Other solvents use – reported as indirect CO₂ in IPPU.

The GHG emission sources in Solvent and Other Product Use sector involve CO₂ emission from the following activities: Paint application, Degreasing and dry cleaning, Chemical Products, Manufacture and Processing and Other solvents use (Fat edible and non-edible oil extraction, Other non-specified).

Emission trend is consistent with the submission to the European Union in the framework of reporting to the Directive 2001/81/EC of European Parliament and the Council of 23 October 2001 on national emission ceilings for certain pollutants the Convention on Long-range Transboundary Air Pollution (LRTAP).

According to the new 2006 IPCC guidelines N₂O emissions from the use of N₂O for anesthesia and in food industry – to make whipped cream) is reported in sub-category 2.G.3 (2.G.3.a and 2.G.3.b). Indirect CO₂ emission from Solvent use in 2024 was estimated to 411 kt CO₂. This emission decreased by 34.04% from year 1988 to 2024 (Figure 4.5.4).

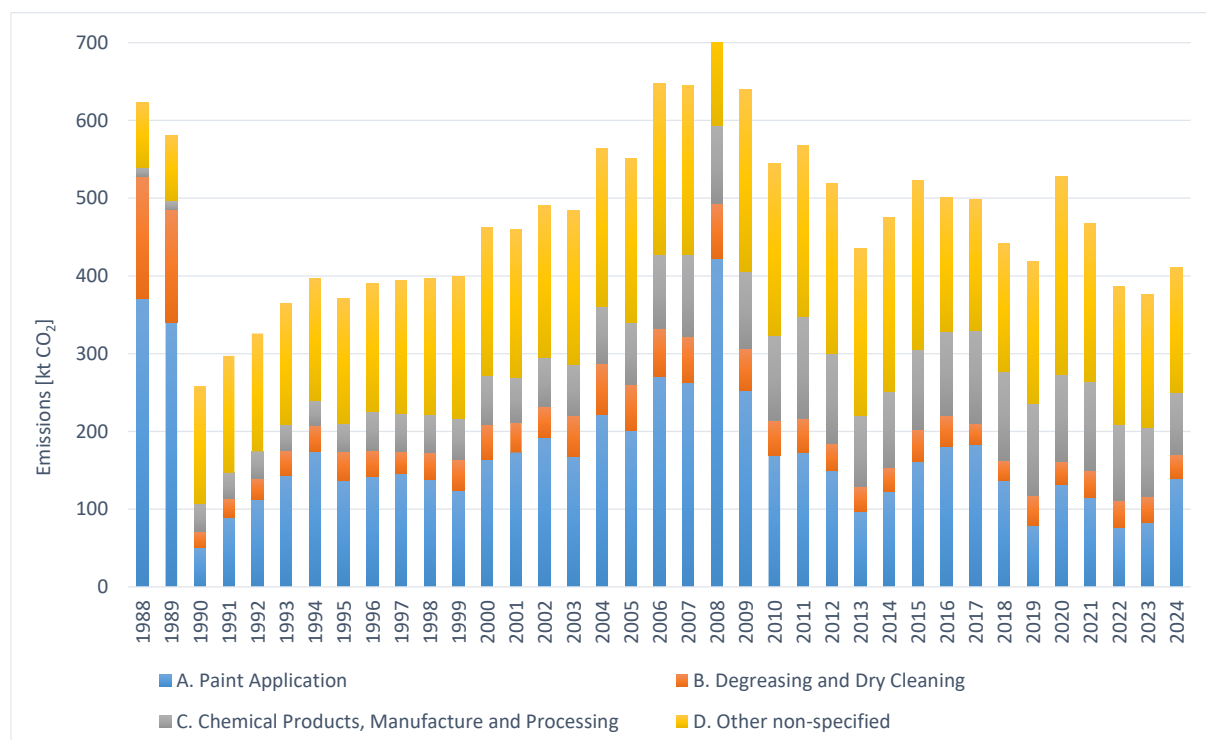


Figure 4.5.4. Indirect CO₂ emissions from Solvent and Other Product Use sector in 1988-2024

Calculations of CO₂ emissions within Sector Solvent Use, using the common methodology, were conducted on the basis of results of NMVOC emissions [EMEP/EEA 2023]. CO₂ emission factor was determined assuming, that carbon content in NMVOC is 60% [IPCC 2006, chapter

5.5.1., page 5.16.]. Then carbon content has been calculated in a stoichiometric way to CO₂. Calculations were made in accordance with the following formula:

$$\text{CO}_2 = 0.60 * 44/12 * \text{NMVOC}$$

where:

CO₂ – carbon dioxide emission from particular subsectors,

NMVOC – NMVOC emission from particular subsectors.

Paint application

Paint application includes the following processes:

- cars production,
- car repair,
- use in households,
- coil coating,
- ship building,
- wood painting,
- other applications in industry,
- other non-manufacturing applications.

In the national inventory all of these processes are considered jointly with the division on the use of paints based on organic solvents and water-based paints.

Degreasing and dry cleaning

Degreasing and dry cleaning include:

- degreasing metals,
- chemical cleaning,
- production of electronic components,
- other industrial cleaning processes.

In the Polish national inventory the first two processes were considered. It was assumed that "degreasing metals" include also solvents used for other purposes in industrial processes, which were not included separately in the inventory report for NMVOC (eg., electronic industry, textile, leather, etc.).

Chemical products, manufacture and processing

The national inventory includes emissions from the following processes:

- polyvinylchloride processing,
- polystyrene foam processing,
- rubber processing,
- pharmaceutical products manufacturing,
- paints manufacturing,
- asphalt blowing.

Other solvents use

The category "Other use of solvents" includes following processes:

- solvents in the household use (except paint),
- oil extraction (production of fats and oils),
- printing industries,
- use of glues and adhesives.

4.5.2.3.2. CO₂ emissions from urea based catalyst

For estimating CO₂ emissions from urea-based catalyst additives in catalytic converters model COPERT 5 was used. The model assumed that consumption of urea is equal share of fuel consumption. For diesel passenger cars Euro 6/VI the consumption of urea is equal 2% of fuel consumption, the selective catalytic reduction (SCR) ratio being equal to 10%; for diesel heavy duty trucks and buses, the consumption of urea is assumed to be equal 6% of fuel consumption at Euro IV and V level (SCR ratio = 76.2%) and equal 3.5% at Euro VI level (SCR ratio = 100%). The purity (the mass fraction of urea in the urea-based additive), the default value of 32.5% has been used (IPCC 2006).

AdBlue is used in SCR systems in the automotive industry in connection with new EU legislation regulating exhaust emission standards in diesel engines and has been used since 2006 for HDVs and from 2014 for HDVs and PCs.

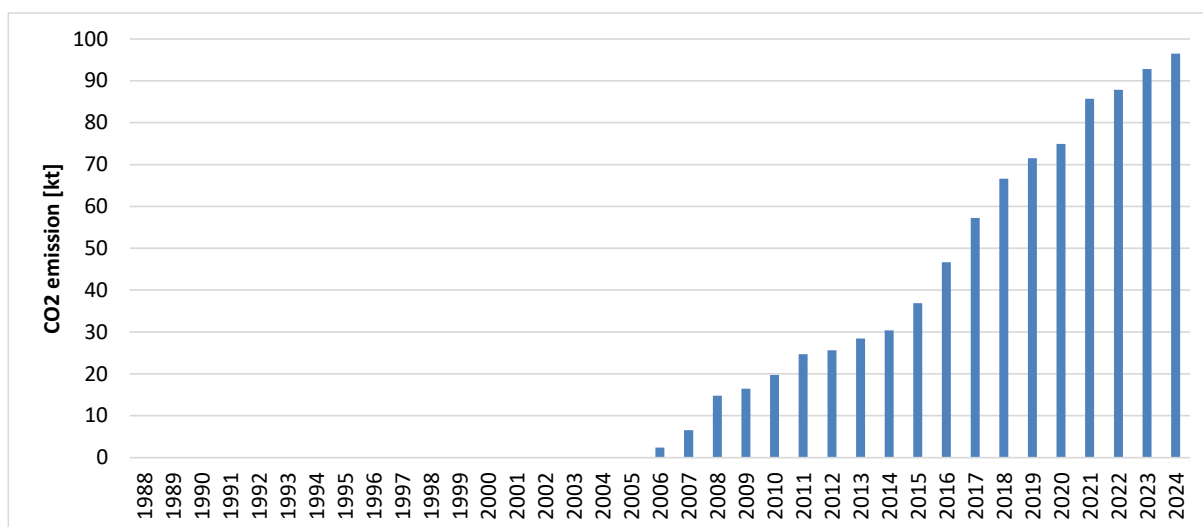


Figure 4.5.5. CO₂ emissions from urea-based catalyst additives in years 1988-2024

4.5.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.5.4. Source-specific QA/QC and verification

See chapter 4.2.4

Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 7.

4.5.5. Source-specific recalculations

Recalculation for the years 1988-2023 was made as a result of:

- revision and updating of historical activities in subcategory Preservation of wood,
- changes in the methodology for estimating emissions in Other solvent use in application of glues and adhesives.

In table 4.5.1. are shown emission recalculations for category Solvent Use (2.D.3).

Table 4.5.1. GHG emission recalculations for category Solvent Use

Difference	1988	1989	1990	1991	1992	1993	1994	1995
kt CO ₂ eq.	0.00	0.00	0.72	0.72	0.72	0.91	0.83	1.01
%	0.00	0.00	0.28	0.24	0.22	0.25	0.21	0.27
	1996	1997	1998	1999	2000	2001	2002	2003
kt CO ₂ eq.	0.58	0.77	0.78	1.01	1.18	0.41	19.14	16.37
%	0.15	0.19	0.20	0.25	0.26	0.09	3.75	3.27
	2004	2005	2006	2007	2008	2009	2010	2011
kt CO ₂ eq.	9.98	20.43	23.83	23.47	29.46	29.26	34.01	31.04
%	1.74	3.57	3.55	3.51	3.50	4.37	5.87	5.19
	2012	2013	2014	2015	2016	2017	2018	2019
kt CO ₂ eq.	32.32	31.63	34.01	38.13	43.03	43.37	46.79	44.83
%	5.86	6.78	6.69	6.80	7.91	8.01	9.58	9.67
	2020	2021	2022	2023				
kt CO ₂ eq.	44.18	51.76	46.03	44.18				
%	7.72	9.99	10.65	7.72				

4.5.6. Source-specific planned improvements

Any possible improvements will be related to further development of NMVOCs emissions methodology.

4.6. Electronic industry (CRT sector 2.E)

No sources of f-gases were identified for that sector for whole time series, thus activity data and emission were reported as not occurring.

4.7. Product uses as substitutes for ODS (CRT sector 2.F) and other minor sources of f-gases emissions

4.7.1. Source category description

Data used to estimate emissions in preparation of the greenhouse gas inventories is based on aggregated data collected by operators under Regulation (EC) 517/2014/EU. Use of the same data source for both obligations results in full consistency between datasets. Data consistency checks are performed on yearly basis for the whole reported time series.

In case of refrigeration and air-conditioning equipment containing HFCs, some information concerning e.g. amounts of gas used, are collected by experts among main domestic producers and importers/exporters [Mąkosa 2012, Popławska-Jach 2025].

To assure transparency and completeness of the description in the NIR it was decided to group description of all f-gases emission in this chapter. Methodologies described here were divided into 3 groups referring to the substance: HFCs, PFCs and SF₆.

Besides dominating category in terms of f-gases emission 2.F *Product uses as substitutes for ODS* – this chapter also includes description of **PFC emission** from IPCC category **2.C.3 Aluminium production** described under PFC section below.

This chapter also includes description of **SF₆ emissions** from IPCC categories **2.C.4 Magnesium production** and **2.G.1 Electrical equipment**.

Since submission 2023 f-gases are recalculated to CO₂ equivalent using updated global warming potentials (GWPs) from the IPCC 5th Assessment Report.

4.7.2. Methodological issues

Nitrogen trifluoride (NF₃)

Since 2015 mandatory reporting was extended to include NF₃, which is used in the manufacture of semiconductors, liquid crystal display (LCD) panels and photovoltaics. Other application of NF₃ are hydrogen fluoride and deuterium fluoride lasers.

During preparation of submission 2015 Polish market was investigated to identify potential sources of NF₃ emission. During this process **no activity resulting in NF₃ emission was identified** and all potential sources are not occurring in Poland. During preparation of f-gases inventory for submission 2026 this information was verified and confirmed by information reported by producers and suppliers of f-gases in Poland. Therefore, NF₃ emission from all potential categories was reported as not occurring.

Hydrofluorocarbons (HFC)

The national GHG inventory covers the following emission sources for HFCs:

- 2.F.1 *Refrigeration and air-conditioning equipment* (dominating category in terms of emission volume),

- 2.F.2 *Foam blowing agents,*
- 2.F.3 *Fire protection,*
- 2.F.4 *Aerosols (technical and medical),*
- 2.F.5 *Solvents.*

Information on no use of HFC-23 and limited use of HFC-152a

Law restricting use of R508A and 508B blends came into force in Poland on 1 January 2016, however since 2013 was visible that operators are aware that restrictions will be applied to the f-gases market. In scope of forthcoming restrictions and relatively high price of the blends there was no demand on the market for HFC-23 and very limited for HFC-152a. This information was confirmed by users and operators of the blends reporting under EU f-gases regulation. During this verification we confirmed that HFC-23 import or production was never identified in Poland. Import of HFC-152a was identified, but 100% of it was used in closed foam blowing installations. Also during EU review this issue was not identified as problem, despite the fact that at EU level is available border custom information, not available for Member States, allowing to track and identify missing substances.

Information on fluctuation of emission trends in MAC and increasing activities related to decommissioning of the equipment

Origin of this increase is fact that in year 2000 significant number of passenger cars containing f-gases were imported into the national market, phasing out older equipment without AC. Taking into account that assumed life time of mobile AC equipment is 15 years then this import is reflected in significant relative emission increase for year 2014/2015, when oldest equipment is reaching its life time. Passenger cars fleet was 291 551 cars in 1999 and 537 060 cars in 2000. Such significant change was result of legislation change and opening national market for used cars from western Europe.

Details on assumed lifetimes of different types of equipment using f-gases were given in the table 4.7.1 below. Assumed equipment lifetimes are measured from production moment and are constant across timeseries.

First emissions of f-gases in MAC category are observed in 1995 at very low level, when cars with AC become more widely available on Polish market. From 1995 to 2009 trend is significantly increasing, due to import of used cars from Western Europe. In year 2009 is visible peak of the emissions, which is considered to be moment when market reached its saturation with cars with AC. Since year 2009 is visible decrease of f-gases emission from MAC category due to applying EU environmental policies and phasing out HFC-134a of the market and slowly introducing HFCs substitutes with low GWP values. Significant drop in the emission between 2009 and 2010 is explained as result of announcing new f-gases policies in 2009 and in effect increased demand. In that case increased demand for f-gases was identified as effect of entities making reserves due to expected significant price growth. Those reserves were consumed in 2010.

Information on the 15-year lifetime used for transport refrigeration

Analysis of the available fleet data showed that IPCC default 10 years life time is not accurately reflecting situation in Poland. Due to economic reasons equipment used in transport refrigeration is operating for much longer than 10 years – reaching average 15 years. This effect is based on two main economic drivers – maintenance and repairing of older equipment is significantly cheaper in Poland (and other Eastern European countries) than in Western Europe due to lower work cost and spare part prices.

During review 2018 (Issue I.7, AR 2018) Expert Review Team agreed with Poland confirming that statistical data from the United Nations Economic Commission for Europe demonstrate that the lorry fleet in Poland is older than 10 years.

Information on sources for information and assumptions used in HFCs calculations

Main data source of information about f-gases on Polish market are two national f-gases register and aggregated reports available on the basis of data reported by installation operators, distributors and importers of f-gases. Those two national registers are:

- Central Register of Operators, and
- Database of Reports.

Both database were set up during implementation of EU F-gas regulation in 2017 and contain verified reports of different types.

In case of years from the beginning of the time series there is no direct information on f-gases emission available thus assumptions on percent of refrigeration equipment are based on expert's opinion – which taken into account:

- 1) Information provided in 2006 GLs,
- 2) analysis of the available national data from questionnaires sent by installations and operators,
- 3) working knowledge of experts involved in f-gases data collection,
- 4) direct contact with f-gases operators,
- 5) analysis of the parameters applied by other countries with comparable national circumstances (EU members from eastern Europe),
- 6) analysis of phasing out effect and conversion to equipment not containing f-gases due to legislation.

Information on decommissioning of equipment and recovery of f-gases

Analysis of the F-gas data used for the inventory shows that, due to the aging and retirement of various types of equipment, emissions from decommissioning are becoming a more important source. Additionally, decommissioning is a source of fluorinated gases reused on the market. Consequently, F-gases recovered during equipment dismantling are formally integrated into the aggregate pool of gases subject to distribution. These recovered volumes are strictly accounted for within the mass balance methodology used to compile the national F-gas emission inventory, ensuring an accurate representation of the domestic supply.

2.F.1 Refrigeration and air-conditioning equipment

For transparency reasons and due to importance of the emissions from the refrigeration and air-conditioning equipment (2.F.1) – the main assumptions for estimates were described with

more details below. Amount of f-gases input in each equipment type was given in table 4.7.1 below.

Methodology used for estimates of f-gases is based on IPCC 2006 Guidelines, which is mandatory for submission 2026. Applying new guidelines did not affect estimated emission values directly, because this methodology was used before, however some emissions were allocated differently than in submission 2014 to reflect new classification of categories (electrical equipment, etc).

Table 4.7.1 shows aggregated national total HFCs emissions over 1995-2024 expressed in CO₂ equivalents and HFCs emission in sub-sector: 2.F.1 *Refrigeration and Air Conditioning*. Prior to 1995, HFCs were not used in Poland.

Table 4.7.1. HFCs emissions in 2.F.1 *Refrigeration and Air Conditioning* and in Total

Year	HFCs emissions in 2.F.1 <i>Refrigeration and Air Conditioning</i> [t CO ₂ eq.]	Total HFCs emissions [t CO ₂ eq.]
1994	NO	5.20
1995	15.55	31.47
1996	42.32	117.44
1997	84.01	198.21
1998	154.60	263.93
1999	302.12	417.11
2000	809.37	915.87
2001	1 183.50	1 347.30
2002	1 613.19	1 794.80
2003	2 142.35	2 236.82
2004	2 306.97	2 676.42
2005	2 641.48	3 214.33
2006	3 069.39	3 833.97
2007	3 463.07	4 183.60
2008	4 038.89	4 557.89
2009	4 392.83	4 801.43
2010	4 372.97	4 672.79
2011	4 747.31	5 070.58
2012	5 036.50	5 370.73
2013	4 864.99	5 235.79
2014	5 256.02	5 645.01
2015	4 624.76	4 890.63
2016	4 708.07	4 965.59
2017	4 823.51	5 103.04
2018	4 685.40	4 975.13
2019	4 594.91	4 887.08
2020	4 598.30	4 766.03
2021	4 431.36	4 597.37
2022	4 110.22	4 269.75
2023	3 744.39	3 893.47
2024	3 572.13	3 717.21

2.F.2 *Foam blowing agents*

Activity data for this application was collected during the questionnaire survey of importers, suppliers and end users of HFCs. Analysis of the Polish market allowed to identify use of HFC-134a, HFC-227ea, HFC-365mfc, HFC-245ca and HFC-152a as foam blowing agents. Following IPCC 2006 GLs it was assumed that HFCs applied to open cells foam are released in first year of use.

Results of the emission estimates for foam blowing agents were presented in table 4.7.2 below.

Table 4.7.2. HFCs emissions for categories: 2.F.2 *Foam blowing agents*, 2.F.3 *Fire protection*, 2.F.4 *Aerosols* and 2.F.5 *Solvents* [kt CO₂ eq.]

Year	HFCs emissions [kt CO ₂ eq.]			
	2.F.2 <i>Foam blowing agents</i>	2.F.3 <i>Fire protection</i>	2.F.4 <i>Aerosols</i>	2.F.5 <i>Solvents</i>
1994	NO	NO	5.20	NO
1995	NO	NO	15.93	NO
1996	NO	0.04	75.08	NO
1997	NO	0.13	114.08	NO
1998	NO	0.24	109.09	NO
1999	15.60	1.47	97.92	NO
2000	15.73	1.64	89.13	NO
2001	15.86	3.66	144.29	NO
2002	0.81	3.13	177.67	NO
2003	3.23	9.46	81.78	NO
2004	12.40	8.28	348.78	NO
2005	214.08	12.13	346.11	0.53
2006	230.69	15.09	517.78	1.01
2007	258.67	20.42	440.80	0.65
2008	206.16	23.69	288.82	0.33
2009	133.69	28.80	245.12	0.99
2010	146.61	38.70	112.26	2.25
2011	161.37	45.37	113.74	2.80
2012	165.19	52.62	114.79	1.63
2013	197.42	59.37	113.60	0.41
2014	205.66	68.87	114.04	0.41
2015	74.44	76.04	114.93	0.45
2016	61.86	79.56	115.58	0.53
2017	71.17	91.18	116.60	0.57
2018	76.83	96.10	116.25	0.55
2019	75.41	100.32	115.84	0.61
2020	71.52	94.71	1.08	0.42
2021	75.01	90.69	NO	0.30
2022	71.66	87.27	0.04	0.55
2023	65.23	83.36	0.12	0.36
2024	61.58	79.40	3.41	0.69

NO – emission not occurring

2.F.3 *Fire protection*

Activity data for this application was collected during the same questionnaire survey of importers, suppliers and end users of HFCs as for categories 2.F.1 and 2.F.2. Analysis of the Polish market allowed to identify use of HFC-227ea and HFC-236fa (since 1996). Regarding release ratio from fire protection equipment it was assumed as follows:

- EF for HFC-227ea: new product = 1% manufacturing factor; 5% product life factor,
- EF for HFC-236fa: new product = 1% manufacturing factor; 5% product life factor.

Results of the emission estimates for foam blowing agents were presented in table 4.7.2 above.

2.F.4 *Aerosols*

As mentioned in description of categories above activity data for this application of technical and medical aerosols was collected during the questionnaire survey of importers, suppliers and end users of HFCs. Analysis of the Polish market allowed to identify use of HFC-134a (since 1995). Release ratio for technical and medical aerosols was assumed as follows:

- EF for HFC-134a: import for production of technical aerosols = 50% first year; 50% next year,
- EF for HFC-134a: import of technical aerosols = 50% first year; 50% next year,
- EF for HFC-134a: import of medical aerosols = 100% first year.

Results of the emission estimates for foam blowing agents were presented in table 4.7.2.

2.F.5 Solvents

As mentioned in description of categories above activity data for this application of technical and medical aerosols was collected during the questionnaire survey of importers, suppliers and end users of HFCs. Analysis of the Polish market allowed to identify use of HFC-365mfc and HFC-43-10mee (since 2005). Release ratio for solvents category was assumed as follows:

- EF for HFC-365mfc: 100% first year,
- EF for HFC-43-10mee: 100% first year.

Results of the emission estimates for foam blowing agents were presented in table 4.7.2 above.

Perfluorocarbons (PFC)

The national GHG inventory covers the following emission sources for PFCs: fire extinguishers (C₄F₁₀) and primary aluminium production (CF₄, C₂F₆).

2.C.3 Aluminium production

The dominating source of emission of PFC gases in Poland is IPCC sector 2.C.3 *Aluminium production*. Activities on aluminium production were taken from [GUS 2010b]. *Tier 1* method and the country specific emission factors were used for estimation of PFC emissions:

- for CF₄ EF = 0.373 kg/Mg aluminium produced,
- for C₂F₆ EF = 0.027 kg/Mg aluminium produced.

Country specific emission factors given above are based on plant specific reporting of installations under EU ETS.

Table 4.7.3 shows aggregated national total PFCs emissions over 1988-2024 expressed in CO₂ equivalents and PFCs emission in sub-sector: 2.C.3 *Aluminium Production*. More details on activity in this category was provided in chapter describing CO₂ emission from aluminium production. Aluminium production in Poland stopped in 2008 and is not occurring since then.

2.F.3 Fire protection

According to historical data obtained from producers and importers/exporters first use of PFCs (C₄F₁₀) in fire extinguishers began in 1996. Prior to 1996, the only known source of PFCs was primary aluminium production. On basis of IPCC 2006 GL applied emission factors for C₄F₁₀ for import and use of equipment were 1% and 5% respectively. Formula used for estimating amount of substance in use in current year (n+1) is presented below:

$$\text{in use } n+1 = \text{in use } n - \text{emission from in use } n + (\text{import } n+1 - \text{emission from import } n+1)$$

where: n - year

Table 4.7.3. PFCs emissions in 2.C.3 *Aluminium production* and 2.F.3 *Fire protection* compared to national total PFCs emission [kt CO₂ eq.]

Year	PFCs emissions in 2.C.3 <i>Aluminium Production</i>	PFCs emissions in 2.F.3 <i>Fire protection</i>	Total PFCs emissions
1988	132.31	NO	132.31
1989	132.54	NO	132.54
1990	127.47	NO	127.47

Year	PFCs emissions in 2.C.3 Aluminium Production	PFCs emissions in 2.F.3 Fire protection	Total PFCs emissions
1991	126.97	NO	126.97
1992	120.97	NO	120.97
1993	130.16	NO	130.16
1994	137.27	NO	137.27
1995	154.52	NO	154.52
1996	143.97	0.88	144.84
1997	148.66	8.22	156.87
1998	150.19	8.00	158.19
1999	141.34	11.85	153.19
2000	145.11	15.76	160.87
2001	151.39	29.96	181.35
2002	163.03	26.87	189.91
2003	158.71	25.38	184.09
2004	163.40	24.11	187.51
2005	148.57	22.91	171.47
2006	155.10	21.76	176.86
2007	148.00	20.67	168.68
2008	129.57	19.64	149.21
2009	NO	18.66	18.66
2010	NO	17.72	17.72
2011	NO	16.84	16.84
2012	NO	16.00	16.00
2013	NO	15.20	15.20
2014	NO	14.44	14.44
2015	NO	13.71	13.71
2016	NO	13.03	13.03
2017	NO	12.38	12.38
2018	NO	11.76	11.76
2019	NO	11.17	11.17
2020	NO	10.61	10.61
2021	NO	10.08	10.08
2022	NO	9.58	9.58
2023	NO	9.10	9.10
2024	NO	8.64	8.64

NO – emission not occurring

Sulfur hexafluoride (SF₆)

As concerns SF₆ the national GHG inventory covers the following emission sources: electrical equipment and magnesium foundries.

2.C.4 Magnesium casting

One of the results of f-gas monitoring and reduction policy was introducing law prohibiting use of SF₆ for magnesium casting since the beginning of 2018. Since 2018 emission is reported as not occurring.

Data on Mg casting were obtained from yearbooks of *Modern Casting*. The first use of SF₆ in magnesium foundries was identified in 1994. Due to unavailability of the data on magnesium in national statistics and other external data sources for recent years it was decided to use last verified activity data available (2007). Emission factors referring to amount of cast per year was used for calculation of SF₆ emission:

$$\text{Mg casting EF} = 1 \text{ kg SF}_6 / \text{Mg of the amount of alloy used to produce casting}$$

Amount of alloy used to produce casting is based on amount of magnesium production per year taking into account yield factor 55%.

Table 4.7.4 below presents results of estimation of SF₆ emissions over the period: 1988-2024.

2.G.1 *Electrical equipment*

Applied emissions factors were based on methodology provided in IPCC 2006 GL. Amounts of equipment on the market was assessed on the basis of data provided by producers and importers/exporters.

Electrical equipment manufacturing EF = 0.06 Mg/Mg of SF₆ used

Electrical equipment use EF = 0.05 Mg/Mg SF₆ in use (1995), EF = 0.02 Mg/Mg (since 1996)

Decommissioning emissions from retired electrical equipment:

According to the 2006 IPCC Guidelines, electrical equipment has a relatively long lifetime compared to other equipment using F-gases. In the Polish F-gas inventory, experts assumed an average 30-year lifetime for this equipment. Taking into account that the first units were introduced to the Polish market in 1995, the first emissions from decommissioning are expected to occur in 2025, or 2026 at the latest.

Table 4.7.4 below shows aggregated national total SF₆ emissions over 1994-2024 in tones compared to SF₆ emission in most important sub-sector: 2.G.1 *Electrical Equipment*.

Table 4.7.4. SF₆ emissions in 2.C.4 *Magnesium production* and 2.G.1 *Electrical equipment* compared to national total emission [t]

Year	SF ₆ emissions in 2.C.4 <i>Magnesium production</i>	SF ₆ emissions in 2.G.1 <i>Electrical equipment</i>	Total SF ₆ emissions
1994	0.58	NO	0.58
1995	0.73	0.55	1.28
1996	0.73	0.32	1.04
1997	0.63	0.38	1.00
1998	0.53	0.52	1.05
1999	0.43	0.60	1.03
2000	0.33	0.68	1.01
2001	0.23	0.77	1.00
2002	0.13	0.89	1.02
2003	0.08	0.82	0.91
2004	0.04	0.94	0.98
2005	0.05	1.12	1.18
2006	0.12	1.34	1.46
2007	0.18	1.18	1.37
2008	0.18	1.26	1.44
2009	0.18	1.47	1.65
2010	0.18	1.37	1.55
2011	0.18	1.53	1.71
2012	0.18	1.66	1.84
2013	0.18	1.90	2.08
2014	0.18	2.13	2.32
2015	0.18	3.20	3.38
2016	0.18	3.26	3.44
2017	0.18	3.43	3.62
2018	NO	4.71	4.71
2019	NO	3.98	3.98
2020	NO	3.93	3.93
2021	NO	3.94	3.94
2022	NO	5.36	5.36
2023	NO	4.96	4.96
2024	NO	5.48	5.48

NO – emission not occurring

4.7.3. Uncertainties and time-series consistency

Uncertainty analysis made for industrial gases HFC, PFC and SF₆ was significantly improved since submission 2018, as response to recommendations of the previous UNFCCC reviews. Previously uncertainty assumptions were applied directly to emission values of each pollutant due to lack of available information. In submissions 2018, 2019 and 2020 some of the applied assumptions were revised to better reflect national circumstances and in result some of the uncertainties decreased.

Present calculation model was revised and extended to include uncertainties applied to activity data and emission factors. Uncertainty assessment is now performed taking into account information given on for different subcategories and single f-gases. Uncertainty is also assessed separately for manufacture, operating and decommissioning of f-gases containing equipment.

Overall results are estimated using GWP potential from IPCC AR5. To ensure consistency with the approach taken in the NIR uncertainty assessment model for f-gases covers complete set of categories resulting in emission of gases (2.C *Metal production*, 2.F *Product uses as substitutes for ODS* and 2.G. *Other product manufacture and use*). More details on assumed input uncertainties for each of the subcategories and gases are given in annex 2 describing uncertainty assessment for whole inventory.

Table 4.7.5 Results of uncertainty analysis for F-gases by sector

Uncertainty of f-gases by categories	From manufacturing	From stocks	From disposal	Total	Contributing f-gases
TOTAL	3.41%	11.72%	19.24%	11.60%	HFC, PFC, SF₆
C. Metal production	0.00%	-	-	0.00%	SF ₆
F. Product uses as substitutes for ODS	3.40%	12.01%	19.24%	11.94%	HFC, PFC
G. Other product manufacture and use	5.39%	7.07%	-	5.84%	SF ₆

4.7.4. Source-specific QA/QC and verification

Main verification exercise is comparing amounts of HFCs, PFC and SF₆ with data available in f-gases registries (users and importers). Amount of import/export of f-gases is compared with amount recovered from decommissioned equipment and refilled during the maintenance activities. In case of potential inconsistencies direct contact with installation or operator is established. Additional second level QA/QC procedures are applied by inventory team during compiling the final all GHG inventory. Then the time series consistency and completeness are checked as priority. Results are also compared to previous submission and verified in case of outlying results. Last third level QA/QC is applied at EU level, where f-gases are reviewed in a process similar to UNFCCC review. For more information see chapter 4.2.4.

4.7.5. Source-specific recalculations

Main recalculation was applied to sector 2.F.1 *Refrigeration and air-conditioning* and were effect of additional data analysis made in 2024. Achieved results allowed us to report data for industrial refrigeration separately from commercial refrigeration. In submission 2025 for the first time new data was reported in category 2.F.1.c *Industrial refrigeration*. To avoid double counting of equipment the time series for category 2.F.1 Commercial refrigeration was also revised. To ensure timeseries consistency both recalculations were applied to whole reported timeseries. Till submission 2025, industrial refrigeration equipment was reported together with commercial equipment in category 2.F.1.a *Commercial refrigeration*.

Table 4.7.6 Results of the recalculations for 2023

kt of CO ₂ eq.	HFCs	PFCs	SF ₆
Previous submission	3878.41	9.10	116.48
Latest submission	3893.46	9.10	116.48
Difference	15.05	0	0
%	0.4%	0.0%	0.0%

4.7.6. Source-specific planned improvements

Continuing ongoing project on revision and extending dataset for f-gases. Further analysis of filling amounts in equipment containing HFCs, PFCs and SF₆. Further monitoring of HFC-152a use in medical aerosols.

4.8. Other product manufacture and use (CRF sector 2.G)

SF₆ emissions from sector 2.G.1 *Electrical equipment* is described in chapter 4.7.2.

The N₂O use in medical applications and as propellant in whipped-cream aerosol cans are covered in this subsector.

2.G.3.a. Other Product Manufacture and Use – Medical applications (Anaesthesia)

N₂O emission from anaesthesiology was estimated based on country study: “Strategy of reduction of GHG emission until 2020 in the division into separate gases (N₂O, HFCs, PFCs and SF₆) and sectors” elaborated by the Institute of Environmental Protection [IOŚ 2001]. Due to lack of available data the value established in 2001 amounting to 0.4 kt is annually applied for entire series. Steps are undertaken to confirm or update this emission but data on N₂O medical use is scattered.

2.G.3.b. Propellant for pressure and aerosol products

The country study has been performed to develop methodology of estimating domestic N₂O emission from use as a propellant in aerosol products, primarily in food industry (2.G.3.b): “The methodology for estimating N₂O emissions in food industry (primarily as a propellant in aerosol products) for reporting to the national inventory of emissions and removals of greenhouse gases” (National Centre for Emission Management 2017, in Polish) [KOBIZE (2017)]. Based on this analysis it was assumed that the main product taken into consideration in emission calculations is whipped cream where entire propellant is released from container. The emission values related to this subcategory range from 0 kt N₂O in 1988 up to 0.06 kt N₂O in 2024.

5. Agriculture (CRT sector 3)

5.1. Overview of sector

The GHG emission sources in agricultural sector involve: enteric fermentation from domestic livestock (CH₄), manure related to livestock management (CH₄ and N₂O), agricultural soils (N₂O), liming, urea and other carbon containing fertilizers application (CO₂) as well as agricultural residue burning (CH₄ and N₂O). Emission categories like: rice cultivation and prescribed burning of savannas do not occur in Poland and are therefore not reported.

Following subcategories from sector 3 have been identified as key category (excluding LULUCF):

IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)		
3.A Enteric Fermentation	CH ₄	L	T	
3.B Manure Management	N ₂ O	L		
3.B Manure Management	CH ₄	L		
3.D.1 Direct N ₂ O Emissions From Managed Soils	N ₂ O	L	T	
3.D.2 Indirect N ₂ O Emissions From Managed Soils	N ₂ O	L		

Share of these subcategories in total Poland's GHG emissions amounts ca. 7.13%.

Total emissions of GHG in Agriculture sector amounted to 34.1 Mt CO₂eq. in 2024 and decreased since 1988 by about 32%. Strong decrease in emissions in Poland occurred after 1989 when economic transformation began shifting from centrally planned economy to the market one (Fig. 5.1.1). The cost-effectiveness of agricultural production deeply changed then – up to 1989 agricultural production was generally subsidised on the state level. Since 1990 the prices for agricultural products as well as for agricultural means of production (like mineral fertilisers or machines) became the market ones and the subsidies were cut off. Deterioration of macroeconomic conditions for agricultural production in early 1990-ties during the restructuring of the state economy triggered changes in structure of agricultural farms since 1989. The big state agricultural farms became economically ineffective in a new market conditions so they were constantly eliminated. Also production of many small family farms became cost-ineffective so for instance the process of leaving the animal production by small farms started. On the other hand – gradual development of private and collective farms breeding large livestock herds begun. In the total number of farms conducting agricultural activity in Poland maintains the dominance of small farms up to 5 ha of agricultural land [GUS R 2025].

Significant decrease of livestock population was observed after 1989 – the cattle population dropped almost by half – from over 10 million in 1988 to about 6 million presently. Since 2002, just before accessing Poland to the European Union (in 2004), population of dairy cattle stabilized when the limits of milk production were known in advance what stabilized the milk market. In the same time sheep population drop by 94% (from over 4 million in 1988 up to 0.3 million in 2024). Especially sheep breeding became unprofitable – the wool up to 1989 was highly subsidised so sheep farming was related mostly to wool production and over 70% of sheep farms' income was related to wool sale. Small domestic demand for sheep meat also caused retreat from sheep breeding.

Additional reasons for decreasing the agricultural production in 1990-ties were export limitation for Eastern markets, deterioration of relationship between prices for agricultural

products and prices for means of production as well as increased competition of imported food from Western Europe. Since 2004, when Poland joined the European Union, the key factor influencing the Polish agriculture and rural areas is the EU Common Agricultural Policy aiming at improvement of productivity through introducing technical progress and stabilisation of agricultural market.

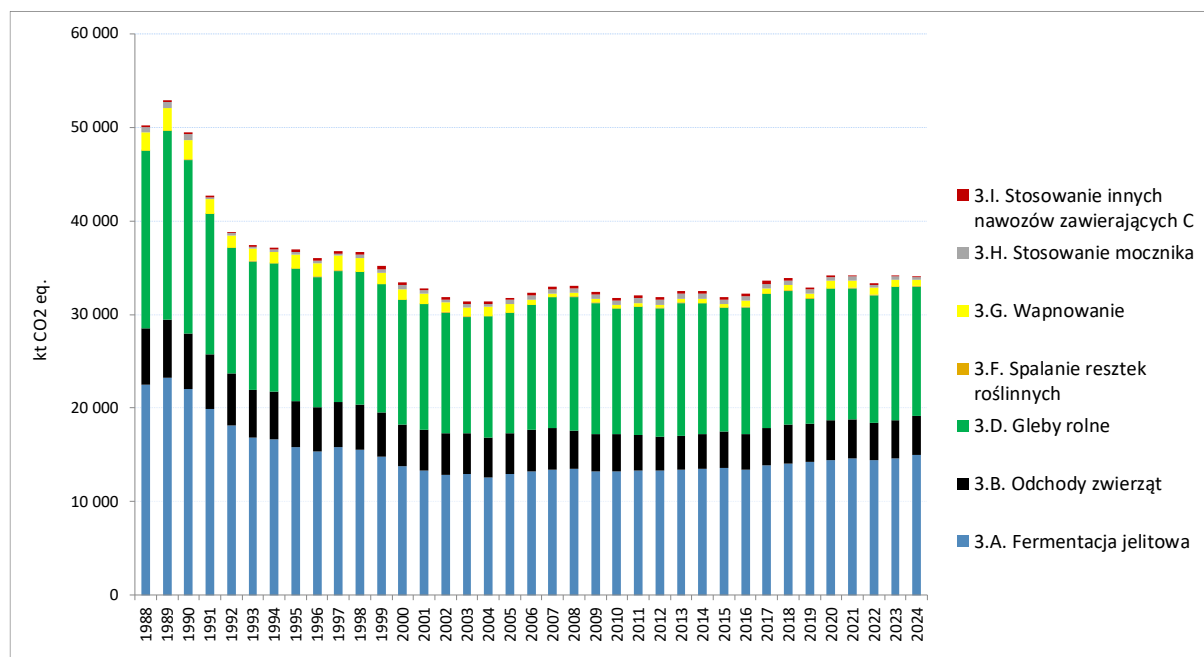


Figure 5.1.1. Total greenhouse gas emissions related to the Polish agriculture according to main source categories

The value of global agricultural production in 2024 (in current prices) compared to 2023 fell by 2.2% as a result of the decrease in crop production by 7.3%. In addition to changes in the volume of products of plant origin, the volume of global agricultural production was affected by changes in prices of agricultural products correlated with domestic supply and changes in prices occurring on foreign, primarily EU agricultural markets.

The sown area in 2024 was 11.1 million ha, which means a slight increase (by 0.4%) compared to the previous year. The sowing structure was dominated by cereals (64.0% of the total sown area), fodder crops (13.8%) and industrial crops (12.6%). Harvests and yields of the main agricultural crops in 2024 were lower. Comparing to the previous year, the decrease of harvests was recorded for total cereals, rape and turnip rape, fruit from fruit trees and bushes in orchards, as well as fruit from berry plantations. The harvests of sugar beets and potatoes were higher than a year ago. Vegetable harvests remained at a similar level compared to the previous year. Variable weather conditions during the growing season with uneven rainfall distribution, both temporally and territorially, were not favourable for crops in 2024.

The total cattle population amounted 6.3 million heads and was by slightly lower than in previous year. Decline in the number of cattle herd occurred in the group of cattle aged 2 years and more (by 3.7%). The pig population amounted 9.1 million heads and was 3.2% lower than a year ago. The number of all weight and use groups decreased over the year except sows. The largest decrease was observed in the number of piglets (by 5.5%). With the decrease in livestock purchasing prices, the profitability of pigs fattening declined compared to the previous year.

Year-over-year purchase prices of rape and turnip rape, most fruit, live cattle and cow's milk

increased. However, the prices of cereals, sugar beets, potatoes, most vegetables, live pig and poultry and chicken eggs decreased. In 2024, the procurement volume of basic crop products (most cereals, rape and turnip rape, fruits and vegetables) was lower in comparison to the previous year. The higher than the last year volumes were recorded for sugar beets and potatoes. In animal production, the procurement volumes increased for milk, poultry and beef as well as slightly for pork. Egg volumes decreased from the level of the previous year. On private farms, with the increase in prices of sold agricultural products per year by 0.4% accompanied by the rise in the prices of purchased goods and services acquired for current agricultural production and for consumption and investment by 4.9%, price relation („price gap”) of sold agricultural products to the prices of purchased goods and services was more favourable than the year before and amounted 95.8 [GUS R4 2025].

Contribution of Agriculture in national emissions excluding LULUCF is 9.8% in 2024. Among GHGs Agriculture has the highest contribution in national totals in N_2O – 80.2%, then in CH_4 – 44.0% and insignificant share in CO_2 – 0.4%. The biggest share in GHG Agricultural emissions have two sectors: Enteric fermentation – 43.8% and Agricultural soils – 40.6% while Manure management is responsible for about 12.3% of GHG emissions. Liming, urea and other carbon containing fertilizers application are responsible respectively for: 2.1%, 0.7% and 0.4% of GHG emissions. Share of CH_4 and N_2O emissions from Field burning of agricultural residues are minor – only about 0.1%.

The review of agricultural emission trends by gases and subsectors are given in Figures 5.1.2–5.1.4.

Carbon dioxide emissions in Agriculture sector come from liming, urea application as well as from other carbon containing fertilizers (i.e. calcium ammonium nitrate) amounted to 1081 kt CO_2 and were responsible for 66%, 23% and 11% respectively in 2024 (Fig. 5.1.2).

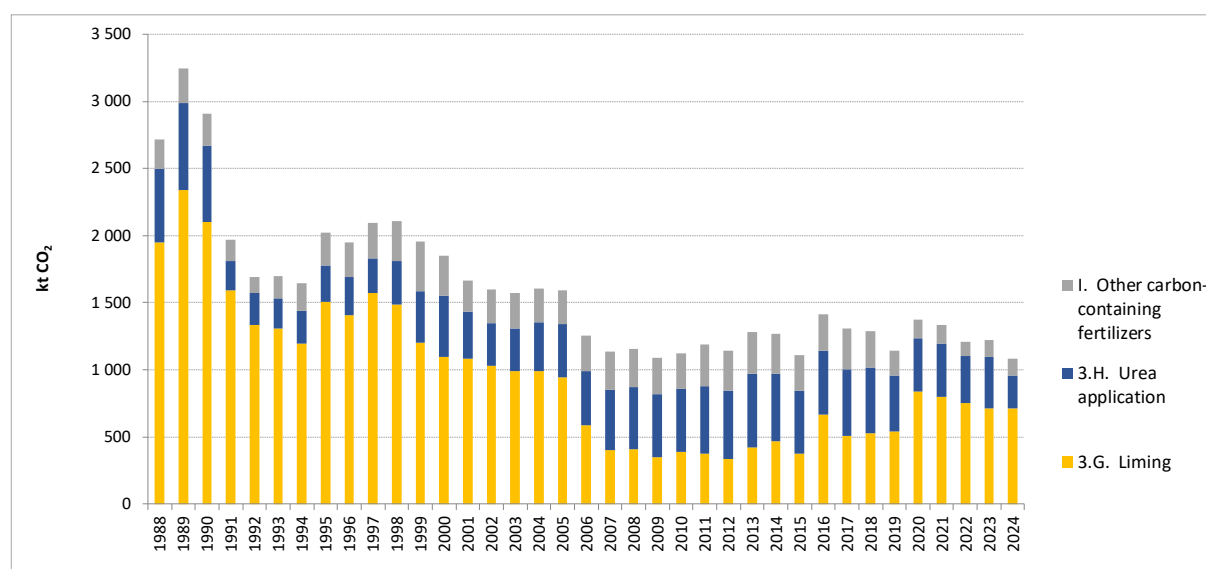


Figure 5.1.2. Carbon dioxide emissions from the Polish agriculture according to subcategories

As relates to methane emissions, they amounted to 593 kt CH_4 and most of them originated from enteric fermentation (90.1%) and 9.7% was related to manure management in 2024. Share of field burning of agricultural residues represent only 0.2% of emissions (Fig. 5.1.3).

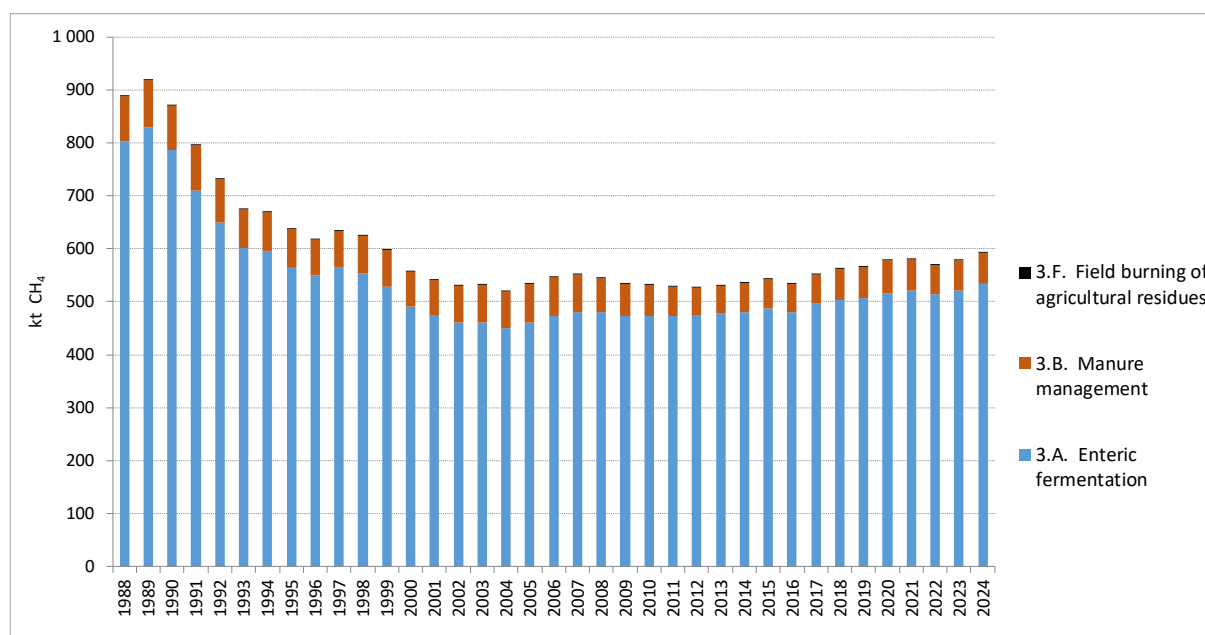


Figure 5.1.3. Methane emissions from the Polish agriculture according to subcategories

As concerns the nitrous oxide emissions, they amounted to 62 kt N₂O in 2024 and main source of emissions was the agricultural soils responsible for 84.3% while manure management – for 15.6%. Emissions from field burning of agricultural residues are negligible (0.06%) (Fig. 5.1.4).

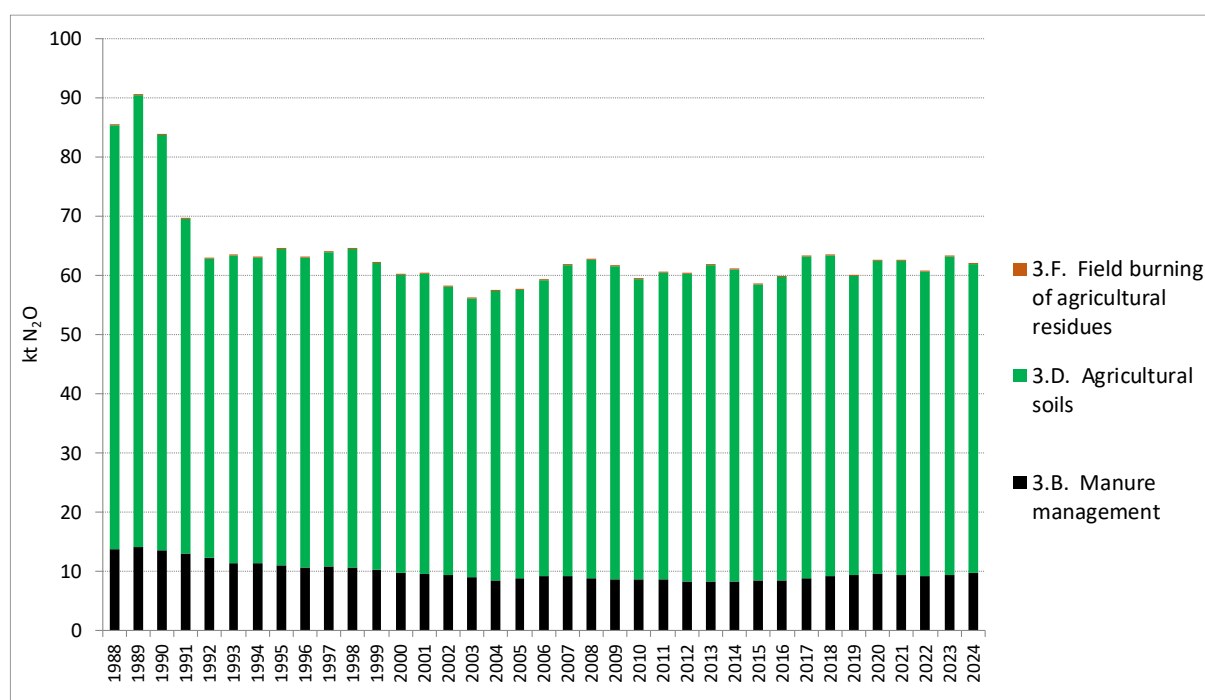


Figure 5.1.4. Nitrous oxide emissions from the Polish agriculture according to subcategories

5.2. Enteric Fermentation (CRT sector 3.A)

5.2.1. Source category description

CH₄ emissions from animals' enteric fermentation in 2024 amounted to almost 534 kt CH₄ and decreased since 1988 by 33.4%. Majority of CH₄ emissions in this subcategory, about 96%, are related to cattle breeding. The main driver influencing CH₄ emissions decline from enteric fermentation is the decrease of livestock population since 1988. The biggest change over time relates to the sheep breeding where cut of emissions amounts to 93% in 1988-2024. At the same time CH₄ emission reduction for dairy cattle amounts to 33% (table 5.2.1).

Table 5.2.1. Trends in CH₄ emissions from enteric fermentation kt CH₄

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Total
1988	462.28	255.64	35.02	0.90	18.92	29.41	802.16
1989	485.34	262.61	35.27	0.90	17.51	28.25	829.89
1990	471.20	234.49	33.27	0.90	16.94	29.20	786.00
1991	434.39	199.26	25.87	0.90	16.90	32.80	710.13
1992	400.56	183.23	14.96	0.90	16.20	33.13	648.97
1993	376.53	170.75	10.14	0.90	15.14	28.29	601.75
1994	367.76	179.57	6.96	0.90	11.20	29.20	595.59
1995	340.93	173.56	5.70	0.90	11.45	30.63	563.17
1996	334.80	172.55	4.42	0.90	10.24	26.95	549.85
1997	342.54	180.51	3.93	0.91	10.04	27.20	565.14
1998	349.42	160.76	3.62	0.93	10.10	28.75	553.58
1999	337.95	149.04	3.14	0.91	9.92	27.81	528.76
2000	309.96	142.41	2.90	0.88	9.89	25.68	491.73
2001	306.12	129.86	2.74	0.86	9.83	25.66	475.08
2002	294.47	127.86	2.76	0.97	5.94	27.94	459.94
2003	299.52	124.26	2.70	0.96	5.99	27.91	461.35
2004	292.64	123.06	2.54	0.88	5.78	25.48	450.39
2005	295.30	129.24	2.53	0.71	5.62	27.17	460.56
2006	300.24	135.97	2.41	0.65	5.53	28.32	473.12
2007	300.76	143.01	2.66	0.72	5.92	27.19	480.26
2008	303.25	145.02	2.59	0.68	5.86	23.14	480.54
2009	293.23	150.64	2.29	0.59	5.36	21.42	473.54
2010	290.25	153.62	2.06	0.54	4.75	22.30	473.53
2011	289.01	157.70	2.01	0.56	4.58	20.26	474.12
2012	289.33	162.17	2.13	0.45	4.00	17.37	475.46
2013	287.11	168.32	1.78	0.43	3.86	16.74	478.25
2014	284.47	173.15	1.61	0.41	3.73	17.59	480.96
2015	286.55	176.71	1.82	0.31	3.86	17.46	486.72
2016	276.63	180.78	1.91	0.27	3.73	16.30	479.61
2017	282.85	190.24	2.09	0.22	3.34	17.03	495.77
2018	288.56	191.45	2.21	0.24	3.17	17.74	503.37
2019	291.95	194.41	2.18	0.25	2.99	16.17	507.96
2020	297.05	196.74	2.30	0.27	2.82	17.15	516.33
2021	293.74	204.84	2.31	0.27	2.82	16.55	520.54
2022	279.22	215.02	2.32	0.30	2.82	14.42	514.10
2023	296.41	205.74	2.22	0.30	2.84	14.15	521.66
2024	310.16	204.54	2.39	0.32	2.84	13.70	533.94
<i>share [%] in 2024</i>	<i>58.09</i>	<i>38.31</i>	<i>0.45</i>	<i>0.06</i>	<i>0.53</i>	<i>2.57</i>	<i>100.00</i>
<i>change [%] 1988-2024</i>	<i>-32.91</i>	<i>-19.99</i>	<i>-93.18</i>	<i>-64.59</i>	<i>-85.00</i>	<i>-53.42</i>	<i>-33.44</i>

5.2.2. Methodological issues

Generally data on animal population is collected by Statistics Poland and is published on an annual basis in Statistical Yearbook of the Republic of Poland [GUS (1989-2025)] but also in

other agricultural statistical publications and the Local Bank Data in the Statistics Poland [GUS R1 2025]. Annual average population (AAP), as it is described in the [IPCC 2006, in Chapter 10.2.2 page 10.8], can be obtained as one-time animal inventory data, especially for static animal populations (like dairy cattle or breeding swine). It should be noted that in Poland the June sample survey is a common date for collecting data by national statistics on all main livestock numbers and covers entire trend since the base year 1988. The exception here is swine population for which data in 1998-2013 were collected also in summer but in July. It should be mentioned that for the last years sample surveys for cattle, sheep and poultry are performed twice a year (June, December) while for swine - three times a year (March, June and December) but the dates for additional sampling are not consistent and use to change since 1988. On the other hand population of horses and goats is collected once a year, in June, only. Additionally, for the first years of the inventoried series, only one annual number of livestock is available (June) for all main animal categories. In conclusion, application of the June survey results is justified and in fact the only one available to ensure time series consistency. Even more - comparison of differences in livestock population in the surveyed months performed for the same year indicated that summer populations are the highest in most of cases of the given year, thus use of summer statistical data should not lead to underestimation of the emission. The population data on livestock applied for GHG inventory correlates also with the numbers available in the FAO database what can be checked for consistency. Detail methodological information related to collecting data on livestock population by Statistics Poland is given in Annex 5.7.

Since 2022 poultry population is taken from GUS as of December because no data for June is available.

Trend of animal population (excluding cattle) in 1988–2024 is given in table 5.2.2. As relates to goats population some lack of data is noticed for 1988-1995 and 1997, so data for 1996 was taken for the period 1988–1995 and for 1997 the average value for 1996 and 1998 was calculated. Since 1998 up to 2013 goats population is available on an annual basis.

The goats and horses population, since 2013, has been collected every 3 years. Therefore repeated data for 2013–2015 were used only for the middle year like 2014 and the same data for 2016–2018 were used for 2017. For the years between interpolation was used (2015, 2016). In 2022 the results of Agricultural Census 2020 on livestock population were published so those data for goats and horses were employed for both years 2020 and 2021 (as no new data for horses and goats for 2021 in the national statistics appeared) so the interpolation was made for 2018 and 2019. Data on goats population was published again on an annual basis since 2022 [GUS R1 2025].

Table 5.2.2. Trends of selected livestock population

Years	Livestock population [thousands]						
	Sheep	Goats	Horses	Swine	Poultry	Rabbits	Fur-bearing animals
1988	4 377	179	1 051	19 605	241 518	1 091	483
1989	4 409	179	973	18 835	263 135	1 091	441
1990	4 159	179	941	19 464	224 866	1 091	399
1991	3 234	179	939	21 868	216 093	1 091	357
1992	1 870	179	900	22 086	199 135	1 091	314
1993	1 268	179	841	18 860	194 705	1 091	272
1994	870	179	622	19 466	201 396	1 091	230
1995	713	179	636	20 418	189 984	1 091	187
1996	552	179	569	17 964	207 480	1 091	145
1997	491	182	558	18 135	201 240	1 054	164
1998	453	186	561	19 168	201 363	1 017	183
1999	392	181	551	18 538	202 507	981	201

Years	Livestock population [thousands]						
	Sheep	Goats	Horses	Swine	Poultry	Rabbits	Fur-bearing animals
2000	362	177	550	17 122	198 337	944	220
2001	343	172	546	17 105	206 209	907	239
2002	345	193	330	18 629	198 783	870	257
2003	338	192	333	18 605	146 321	840	281
2004	318	176	321	16 988	131 142	811	305
2005	316	142	312	18 112	152 799	781	329
2006	301	130	307	18 881	141 808	751	353
2007	332	144	329	18 129	150 620	721	377
2008	324	136	325	15 425	145 496	691	401
2009	286	119	298	14 279	140 826	661	425
2010	258	108	264	14 865	132 196	632	449
2011	251	112	254	13 509	143 557	550	427
2012	267	90	222	11 581	130 596	468	404
2013	223	86	215	11 162	140 691	386	382
2014	201	82	207	11 724	146 770	374	601
2015	228	63	215	11 640	163 426	362	820
2016	239	54	207	10 865	187 775	350	1 039
2017	261	44	185	11 353	197 537	426	1 707
2018	277	47	176	11 828	206 228	502	2 375
2019	273	51	166	10 781	210 364	578	3 044
2020	288	54	157	11 433	214 987	654	3 712
2021	289	54	157	11 033	190 264	730	4 380
2022	290	60	157	9611	198 906	687	4 380
2023	278	61	158	9436	218 303	644	4 380
2024	299	63	158	9132	268 863	644	4 380

Data on rabbits and fur animals population is available in public statistics only for selected years like: 1983 [GUS R5 1987] and 1996 [GUS R6 1996], 2002 [GUS R7 2002], 2010 [GUS R8 2010], 2013 [GUS R9 2014] and 2016 [GUS R12 2017] as well as for 2021 [GUS R3 2022] when Agricultural Censuses were performed or other periodic studies were published containing required data. Those data from 2021 are repeated for 2022. Population of rabbits for 2023 was taken from national statistics [GUS R13 (2025)] and duplicated for 2024. Statistical data as referenced above related to rabbits covers female rabbits capable for reproduction. Fur-bearing animals include also female animals of: foxes, minks, polecats, nutrias, polecat-ferrets, chinchilla and yennots. No statistical information on deer population is available.

Trends of cattle population presented for specific subcategories is given in Table 5.2.3. In 1998 Statistics Poland introduced methodological changes in collecting statistical data on cattle population (apart from dairy cattle). This change triggered some inconsistency in population trend of other cattle. So in response to recommendations of the Expert Review Team (ERT 2013) the non-dairy cattle trend for 1988-1997 was unified based on average share in 1998-2007 of specific age groups in relation to all non-dairy cattle population.

Table 5.2.3. Trends of cattle population [thousands]

Years	Dairy cattle	Non-dairy cattle			
		young cattle <1 year	young cattle 1-2 years	heifers >2 years	bulls >2 years
1988	4 806	2 879	2 025	401	211
1989	4 994	2 996	2 107	417	219
1990	4 919	2 678	1 883	373	196
1991	4 577	2 227	1 567	310	163
1992	4 257	2 069	1 456	288	151
1993	3 983	1 910	1 344	266	140
1994	3 863	2 001	1 407	279	146
1995	3 579	1 946	1 368	271	142

Years	Dairy cattle	Non-dairy cattle			
		young cattle <1 year	young cattle 1-2 years	heifers >2 years	bulls >2 years
1996	3 461	1 919	1 349	267	140
1997	3 490	1 992	1 401	278	146
1998	3 542	1 799	1 235	280	99
1999	3 418	1 647	1 108	283	99
2000	3 098	1 572	1 101	231	81
2001	3 005	1 472	973	210	74
2002	2 873	1 384	1 084	142	50
2003	2 898	1 349	932	229	81
2004	2 796	1 309	916	246	86
2005	2 795	1 425	978	209	76
2006	2 824	1 428	1 040	224	90
2007	2 787	1 473	1 072	265	99
2008	2 806	1 502	1 102	263	83
2009	2 688	1 472	1 204	238	99
2010	2 656	1 457	1 244	276	92
2011	2 626	1 481	1 300	242	113
2012	2 578	1 469	1 344	239	147
2013	2 531	1 586	1 422	178	144
2014	2 479	1 609	1 433	259	141
2015	2 444	1 669	1 529	222	97
2016	2 332	1 728	1 576	215	87
2017	2 374	1 721	1 701	231	116
2018	2 429	1 686	1 734	228	124
2019	2 461	1 710	1 768	244	115
2020	2 468	1 709	1 812	241	113
2021	2 388	1 789	1 856	255	113
2022	2 208	1 916	1 674	490	157
2023	2 338	1 855	1 670	331	165
2024	2 336	1 882	1 641	306	172

In the estimation of CH₄ emissions from enteric fermentation two types of approaches were applied – in case of horses, sheep, goats and swine, the IPCC *Tier 1* method was applied using default CH₄ Emission Factors [IPCC 2006, table 10.10] as given in table 5.2.4.

Table 5.2.4. Methane emission factors related to enteric fermentation for horses, sheep, goats and swine

Animal	Emission Factors [kg CH ₄ /head/year] IPCC 2006 default vales for developed countries
Horses	18.0
Sheep	8.0
Goats	5.0
Swine	1.5

Emissions from enteric fermentation of poultry and fur animals were not estimated as the IPCC do not provide the guidelines.

More detailed, IPCC *Tier 2* method, was applied in calculation of methane emissions from enteric fermentation from cattle being the key category. Here country specific emission factors were calculated based on specific gross energy intake (GE) values estimated for selected cattle sub-categories [IPCC 2006, equation 10.21]:

$$EF = \left(GE * \frac{Y_m}{100} * 365 \frac{days}{yr} \right) / \left(55.65 \frac{MJ}{kg CH_4} \right)$$

where:

EF – emission factor, kg CH₄/head/yr

GE – gross energy intake, MJ/head/day

Y_m – methane conversion rate which is the fraction of gross energy in feed converted to methane, %.

Gross energy intake (GE) was calculated separately for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other mature cattle (divided for heifers and bulls over 2 years) using the equation 10.16 from [IPCC 2006]:

$$GE = \left[\frac{(NE_m + NE_a + NE_l + NE_{work} + NE_p)}{REM} + \frac{NE_g}{REG} \right] / \frac{DE\%}{100}$$

where:

GE – gross energy, MJ/day

NE_m – net energy required by the animal for maintenance, MJ/day

NE_a – net energy for animal activity, MJ/day

NE_l – net energy for lactation, MJ/day

NE_{work} = net energy for work, MJ/day (assumed zero)

NE_p – net energy required for pregnancy, MJ/day

REM = ratio of net energy available in a diet for maintenance to digestible energy consumed

NE_g – net energy needed for growth, MJ/day

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

Detail information on cattle parameters taken and/or calculated GE are given in tables 5.2.5–5.2.6. Parameters required for estimation of GE factor for dairy cattle like dairy cattle pregnancy [GUS R1 2025], milk production [GUS M 2025], percent of fat in milk [GUS R 2025] come from national statistics. Digestible energy (DE – expressed as a percent of gross energy) as well as mean mass and daily weight gain for cattle was updated by the National Research Institute of Animal Production [Walczak 2020, 2022, 2023] and relates to genetic as well as feeding improvements of cattle breeding throughout inventoried period. More detail parameters for cattle is given in Tables 5.2.7 – 5.2.9.

Table 5.2.5. Parameters and equations used to estimate GE and EF for mature dairy cattle

Parameters/unit	Source/reference	Values/comments
Body weight [kg]	National Research Institute of Animal Production [Walczak 2006, 2020, 2023]	Table 5.2.7
C Preganacy	Table 10.7 in 2006 IPCC GLs	0.1
C_{fi} [MJ/day/kg]	Table 10.4 in 2006 IPCC GLs	0.386
NE_m = net energy required by the animal for maintenance [MJ/day]	Equation 10.3 in 2006 IPCC GLs	Dependent on body weight
Ca	Table 10.5 of 2006 IPCC GLs	0 for stall 0.17 for pasture

Parameters/unit	Source/reference	Values/comments
NEa – net energy for animal activity [MJ/day]	Equation 10.4 in 2006 IPCC GLs	Calculated using share of grazing animals (table 5.3.2) and Ca parameters
NEl – net energy for lactation [MJ/day]	Equation 10.8 in 2006 IPCC GLs	Amount of milk produced and fat content of milk from national statistics
NEwork = net energy for work [MJ/day]	Equation 10.11 in 2006 IPCC GLs	Time spend for work assumed as zero
NEp – net energy required for pregnancy [MJ/day]	Equation 10.13	calculated
Digestible energy (DE) expressed as a percentage of gross energy [%]	National Research Institute of Animal Production [Walczak 2006, 2013, 2020, 2022, 2023]	Country Specific, see table 5.2.7
REM – ratio of net energy available in a diet for maintenance to digestible energy consumed	Equation 10.14 in 2006 IPCC GLs	calculated
NEg – net energy needed for growth [MJ/day]	Equation 10.6 in 2006 IPCC GLs	0
REG – ratio of net energy available for growth in a diet to digestible energy consumed	Equation 10.15 in 2006 IPCC GLs	calculated
Ym – CH₄ conversion factor [%]	Table 10.12 of 2006 IPCC GLs	6.5

Table 5.2.6. Parameters and equations used to estimate GE and EF for other cattle

Parameters/unit	Source	Values/comments
Body weight [kg]	National Research Institute of Animal Production [Walczak 2006, 2020, 2023]	Table 5.2.8
C Preganacy	Table 10.7 in IPCC 2006 GLs	0
Cfi [MJ/day/kg]	Table 10.4 in IPCC 2006 GLs	0.322
NEm = net energy required by the animal for maintenance [MJ/day]	Equation 10.3 in IPCC 2006 GLs	Dependent on body weight
Ca	Table 10.5 of IPCC 2006 GLs	0 for stall 0.17 for pasture
NEa – net energy for animal activity [MJ/day]	Equation 10.4 in IPCC 2006 GLs	Calculated using share of grazing animals (table 5.3.2) and Ca parameters
NEl – net energy for lactation [MJ/day]	Equation 10.8 in IPCC 2006 GLs	0
NEwork = net energy for work [MJ/day]	Equation 10.11 in IPCC 2006 GLs	Time spend for work assumed as zero
NEp – net energy required for pregnancy [MJ/day]	Equation 10.13	0
Digestible energy (DE) expressed as a percentage of gross energy [%]	National Research Institute of Animal Production	Country Specific, see table 5.2.9
REM – ratio of net energy available in a diet for maintenance to digestible energy consumed	Equation 10.14 in IPCC 2006 GLs	calculated
NEg – net energy needed for growth [MJ/day]	Equation 10.6 in IPCC 2006 GLs	Calculated for cattle < 2 years based on daily weight gain in Table 5.2.8, 0 for heifers and bulls > 2 years
REG – ratio of net energy available for growth in a diet to digestible energy consumed	Equation 10.15 in IPCC 2006 GLs	calculated
Ym – CH₄ conversion factor [%]	Table 10.12 of IPCC 2006 GLs	6.5

Methane emission factor for dairy cattle, established based on the above described methodology, vary from 96.2 CH₄/animal/year in 1988 up to 132.8 kg CH₄/animal/year in 2024, following GE changes (tab. 5.2.7). Specific methane emission factors for entire trend for non-dairy cattle are presented in table 5.2.10. Here the CS weighted mean values EFs for non-

dairy cattle vary from 46.3 kg CH₄/animal/year in 1988 up to 51.1 kg CH₄/animal/year in 2024.

Table 5.2.7. Body mass, digestible energy, milk yield and fat contain, gross energy intake and emission factors for dairy cattle

Years	Body mass	Digestible Energy	Average milk production	Fat content of milk	GE (gross energy intake)	Emission Factor
	[kg/head]	[%]	[litres/cow/yr]	[%]	[MJ/cow/day]	[kg CH ₄ /animal/year]
1988	500	63.8	3 165	3.99	225.62	96.19
1989	500	63.8	3 260	3.98	227.96	97.18
1990	500	64.0	3 151	4.04	224.69	95.79
1991	503	64.1	3 082	4.03	222.62	94.91
1992	505	64.2	3 015	4.01	220.71	94.09
1993	508	64.3	3 075	3.99	221.74	94.53
1994	510	64.4	3 121	4.02	223.31	95.20
1995	512	64.5	3 136	4.03	223.44	95.26
1996	515	64.6	3 249	4.07	226.90	96.73
1997	517	64.7	3 370	4.11	230.22	98.15
1998	520	64.8	3 491	4.12	231.40	98.65
1999	523	64.9	3 510	4.12	231.92	98.87
2000	526	65.2	3 668	4.12	234.69	100.05
2001	528	65.4	3 828	4.19	238.95	101.87
2002	531	65.6	3 902	4.19	240.41	102.49
2003	533	65.8	3 969	4.23	242.43	103.35
2004	540	66.0	4 082	4.22	245.50	104.66
2005	550	66.2	4 147	4.21	247.82	105.65
2006	560	66.4	4 200	4.18	249.38	106.32
2007	565	66.6	4 292	4.22	253.13	107.92
2008	570	66.8	4 351	4.14	253.50	108.07
2009	575	67.0	4 455	4.17	255.89	109.09
2010	580	67.2	4 487	4.18	256.36	109.29
2011	583	67.4	4 618	4.13	258.15	110.06
2012	585	67.6	4 845	4.15	263.25	112.23
2013	588	67.8	4 978	4.16	266.13	113.46
2014	590	68.0	5 164	4.08	269.16	114.75
2015	593	68.2	5 395	4.08	274.96	117.22
2016	595	68.6	5 563	4.09	278.22	118.61
2017	598	69.0	5 687	4.11	279.43	119.13
2018	600	69.4	5 747	4.08	278.63	118.79
2019	600	69.4	5 803	4.03	278.26	118.63
2020	600	69.4	5 946	4.07	282.32	120.36
2021	603	69.5	6 136	4.13	288.47	122.98
2022	605	70.1	6 647	4.07	296.67	126.48
2023	605	70.1	6 701	4.08	297.41	126.79
2024	605	70.1	7 312	4.08	311.49	132.80

Table 5.2.8. Body mass (BM), daily weight gain (DWG) and crude protein in diet (CP%) for non-dairy cattle

Years	Young cattle <1 year			Young cattle 1-2 years			Heifers >2 years		Bulls >2 years	
	BM [kg]	DWG [kg/day]	CP%	BM [kg]	DWG [kg/day]	CP%	BM [kg]	CP%	BM [kg]	CP%
1988	245	0.60	17.5	365	0.51	16.8	500	18.0	700	15.6
1989	245	0.61	17.5	345	0.52	16.8	500	18.0	700	15.6
1990	235	0.62	17.5	355	0.53	16.8	500	18.0	710	15.6
1991	245	0.63	17.5	360	0.54	16.8	503	18.0	720	15.6
1992	250	0.64	17.5	365	0.55	16.8	505	18.0	730	15.6
1993	255	0.65	17.5	367	0.56	16.8	508	18.0	740	15.6
1994	257	0.66	17.5	369	0.57	16.8	510	18.0	750	15.6
1995	250	0.67	17.5	371	0.58	16.6	512	18.0	760	15.6

Years	Young cattle <1 year			Young cattle 1-2 years			Heifers >2 years		Bulls >2 years	
	BM [kg]	DWG [kg/day]	CP%	BM [kg]	DWG [kg/day]	CP%	BM [kg]	CP%	BM [kg]	CP%
1996	253	0.68	17.5	375	0.59	16.4	515	17.9	770	15.6
1997	255	0.69	17.5	378	0.60	16.2	517	17.8	780	15.6
1998	257	0.70	17.5	380	0.61	16.0	520	17.5	790	15.6
1999	259	0.72	17.5	382	0.62	15.8	523	17.4	800	15.6
2000	261	0.73	17.5	385	0.63	15.6	526	17.3	810	15.6
2001	263	0.73	17.5	387	0.64	15.4	528	17.2	820	15.6
2002	265	0.74	17.4	390	0.64	15.2	531	17.1	830	15.5
2003	267	0.74	17.3	392	0.65	15.0	533	17.0	840	15.4
2004	269	0.74	17.2	395	0.65	14.9	540	16.9	850	15.3
2005	271	0.75	17.1	400	0.66	14.8	550	16.8	860	15.2
2006	274	0.75	17.0	410	0.67	14.7	560	16.7	870	15.1
2007	276	0.76	16.9	420	0.67	14.6	565	16.6	880	15.0
2008	279	0.76	16.8	425	0.68	14.5	570	16.5	890	14.9
2009	282	0.77	16.7	430	0.68	14.4	575	16.4	900	14.8
2010	284	0.77	16.6	433	0.69	14.3	580	16.3	910	14.7
2011	287	0.78	16.5	435	0.69	14.2	583	16.2	920	14.6
2012	290	0.78	16.4	437	0.70	14.1	585	16.1	930	14.5
2013	293	0.79	16.3	438	0.70	14.0	588	16.0	940	14.4
2014	295	0.79	16.2	440	0.70	13.9	590	16.0	950	14.3
2015	297	0.80	16.1	450	0.71	13.8	593	16.0	960	14.2
2016	299	0.80	16.0	450	0.71	13.8	595	16.0	970	14.1
2017	300	0.81	15.9	450	0.72	13.8	598	16.0	980	14.0
2018	305	0.83	15.8	450	0.72	13.8	600	16.0	990	13.9
2019	305	0.83	15.8	450	0.72	13.8	600	16.0	990	13.9
2020	305	0.83	15.8	450	0.72	13.8	600	16.0	990	13.9
2021	307	0.84	15.6	451	0.74	13.7	603	15.9	992	13.8
2022	308	0.85	15.6	451	0.75	13.7	605	16.2	993	13.9
2023	308	0.85	15.6	451	0.75	13.7	605	16.2	993	13.9
2024	308	0.85	15.6	451	0.75	13.7	605	16.2	993	13.9

Table 5.2.9. Parameters DE and GE for non-dairy cattle

Years	Young cattle <1 year		Young cattle 1-2 years		Heifers >2 years		Bulls >2 years	
	DE	GE	DE	GE	DE	GE	DE	GE
1988	68.60	88.10	62.40	130.84	63.80	107.92	59.10	178.94
1989	68.60	88.67	62.40	126.31	63.80	107.92	59.10	178.94
1990	68.70	86.06	62.40	129.62	64.00	107.36	59.10	180.73
1991	68.70	89.06	62.40	131.49	64.10	107.53	59.20	182.04
1992	68.70	88.21	62.50	129.56	64.20	107.53	59.30	183.34
1993	68.80	89.57	62.60	130.17	64.30	107.70	59.40	184.61
1994	69.00	89.94	62.70	130.81	64.40	107.70	59.50	185.88
1995	69.10	88.15	62.80	131.44	64.50	107.71	59.60	187.13
1996	69.20	88.97	62.90	132.56	64.60	107.87	59.70	188.36
1997	69.20	89.75	63.00	133.44	64.70	107.87	59.80	189.58
1998	69.30	90.30	63.10	134.03	64.80	108.03	59.90	190.79
1999	69.30	91.56	63.20	134.61	64.90	108.19	60.00	191.98
2000	69.40	91.85	63.30	135.44	65.20	107.87	60.20	192.67
2001	69.60	91.96	63.40	136.03	65.40	107.63	60.40	193.34
2002	69.80	92.04	63.50	136.14	65.60	107.55	60.60	194.01
2003	70.00	92.09	63.60	136.24	65.80	107.32	60.90	194.18
2004	70.20	91.96	63.70	136.57	66.00	107.46	61.20	194.50
2005	70.40	92.23	63.80	137.60	66.20	106.89	61.50	194.79
2006	70.60	92.38	64.00	139.33	66.40	109.43	61.70	195.54
2007	70.80	92.33	64.30	140.78	66.60	109.79	61.90	196.27
2008	71.00	92.65	64.50	141.31	66.80	110.04	62.10	197.00
2009	71.20	92.99	64.70	141.84	67.00	110.31	62.30	197.71
2010	71.40	93.09	65.00	141.50	67.20	110.56	62.50	198.42
2011	71.60	93.41	65.50	140.28	67.40	110.55	62.70	199.12
2012	72.00	93.41	65.90	139.45	67.60	110.38	62.90	199.80
2013	72.30	93.60	66.10	139.16	67.80	110.38	63.00	201.08

Years	Young cattle <1 year		Young cattle 1-2 years		Heifers >2 years		Bulls >2 years	
	DE	GE	DE	GE	DE	GE	DE	GE
2014	72.50	93.76	66.50	138.38	68.00	110.25	63.10	202.36
2015	72.70	93.90	66.80	139.72	68.20	110.25	63.20	203.62
2016	72.80	94.26	67.00	139.09	68.60	109.68	62.30	209.72
2017	73.00	94.39	67.50	137.60	69.00	109.25	62.40	210.99
2018	73.20	95.71	67.80	136.81	69.40	108.70	63.50	207.38
2019	73.30	95.75	67.80	136.91	69.40	108.73	63.50	207.52
2020	73.20	95.75	67.80	136.91	69.40	108.73	63.50	207.52
2021	73.30	96.63	67.90	138.10	69.50	108.92	63.30	208.79
2022	73.30	97.27	67.90	138.73	70.10	107.93	63.10	209.92
2023	73.30	97.27	67.90	138.73	70.10	107.93	63.10	209.92
2024	73.30	97.27	67.90	138.73	70.10	107.93	63.10	209.92

Table 5.2.10. Trends of emission factors from enteric fermentation for non-dairy cattle

Years	Non-dairy cattle weighted mean EF	Non-dairy cattle EF [kg CH ₄ /head/yr]			
		Young cattle <1 year	Young cattle 1-2 years	Heifers >2 years	Bulls >2 years
1988	46.35	37.56	55.78	46.01	76.29
1989	45.76	37.80	53.85	46.01	76.29
1990	45.71	36.69	55.26	45.77	77.05
1991	46.70	37.97	56.06	45.84	77.61
1992	46.22	37.60	55.23	45.84	78.16
1993	46.65	38.18	55.50	45.91	78.71
1994	46.85	38.34	55.77	45.92	79.24
1995	46.57	37.58	56.03	45.92	79.78
1996	46.95	37.93	56.51	45.99	80.30
1997	47.29	38.26	56.89	45.99	80.82
1998	47.10	38.50	57.14	46.06	81.34
1999	47.51	39.04	57.39	46.12	81.84
2000	47.71	39.16	57.74	45.99	82.14
2001	47.59	39.20	57.99	45.89	82.43
2002	48.07	39.24	58.04	45.85	82.71
2003	47.96	39.26	58.08	45.75	82.78
2004	48.13	39.21	58.22	45.81	82.92
2005	48.08	39.32	58.66	45.57	83.04
2006	48.88	39.39	59.40	46.65	83.36
2007	49.16	39.36	60.02	46.81	83.68
2008	49.16	39.50	60.25	46.91	83.99
2009	50.01	39.65	60.47	47.03	84.29
2010	50.07	39.69	60.33	47.14	84.59
2011	50.29	39.82	59.80	47.13	84.89
2012	50.70	39.82	59.45	47.06	85.18
2013	50.56	39.90	59.33	47.06	85.73
2014	50.32	39.97	58.99	47.00	86.27
2015	50.25	40.03	59.57	47.00	86.81
2016	50.12	40.18	59.30	46.76	89.41
2017	50.48	40.24	58.66	46.58	89.95
2018	50.75	40.80	58.33	46.34	88.41
2019	50.68	40.82	58.37	46.35	88.47
2020	50.76	40.82	58.37	46.35	88.47
2021	51.05	41.19	58.87	46.44	89.01
2022	50.76	41.47	59.14	46.01	89.49
2023	51.15	41.47	59.14	46.01	89.49
2024	51.13	41.47	59.14	46.01	89.49

As relates to dairy cattle breeding and impact on milk productivity, three main factors influence the most: feeding, genetic and environmental. Observed in Poland increased milk productivity, especially after joining the EU in 2004, is related to all three factors, but genetic progress (mostly selection and increasing share of HF cattle) influences here the littlest. Still

mean milk production in Poland is about 30% lower than, for instance, in Germany. The feeding factor has the highest impact on milk productivity improvement for country specific dairy cattle population based on research made by the National Research Institute of Animal Production. The feeding model reshaped into good quality maize silage used for forage at the milk market. Significant investments were made on farms with changing from tied to free-stall maintenance systems in parallel with modernisation of cowsheds for semi-open buildings with curtain ventilation. Also thermal stress has been eliminated in herds with increasing milk productivity for both: high and low temperatures (elimination of pasturage during heat waves and thermal modernisation of barns).

Genetic progress still remains the most expensive way of increasing milk productivity. As the income of milk farms is relatively low most of them decides to cross/mix existing cattle with Holstein- Friesian (KF) breed than to purchase pure breed cattle. Mean share of HF mix within these herds is about 70%. However the remaining 70% of domestic dairy cows population is based on the Polish Black-White breed, Simental and Jersey characterised with lower body mass than HF. In Poland small milky farms still dominate having 15-30 dairy cattle for which genetic progress is too expensive. Moreover Simental breed is maintained at the mountainous areas where fodder is much worse taking into account climatic conditions.

Some update of the breeding data took place in 2023, which also affected parameters in 2022. Here, a further decline in the number of farms keeping cattle had a strong impact, eliminating the least economically effective farms (low breeding value of animals, low quality of feed, low productivity, etc.). As a result, the overall statistics are increasingly influenced by the share of the HF dairy breed, which is also the basis for breeding beef cattle. The influence of this breed is most reflected in the results of milk production control. In mid-2022, there was already a crisis in milk production, continuing in 2023. The initial increase in production costs caused by the war in Ukraine was compensated by an increase in purchase prices, mainly of milk. Over time, small dairies stopped generating profits and the milk processing sector consolidated. Milk purchase prices began to decline, which continued in 2023. The need to reduce production costs resulted in a slower rate of improvement in nutrition (feed digestibility).

There is also a gradual increase in the weight of individual categories as the share of larger herds with higher production intensity with the PHF breed increases. In the last category of cattle, the average value is strongly influenced by the high culling of dairy cows (40%) for fattening (> 1000 kg). At the opposite extreme are meat breeds, slaughtered at a young age, weighing 350-450 kg, and producing relatively few carcasses. The average body weight gain in all cattle groups was characterized by a moderate, systematic increase, mainly due to the greater share of the medium PHF breed with a higher breeding value. The influence of breeding progress or nutrition quality should rather be ruled out.

Due to the increase in production costs, their largest component, which is nutrition, has not improved significantly. However, there was no decrease in digestibility as a result of feeding poorer quality fodder. Only for fattening animals such a small effect is observed.

In the case of dairy cows over 2 years of age and fattening animals, protein intake was slightly higher, mainly due to a slight decrease in the quality of nutrition resulting from the increase in the prices of concentrate feed.

5.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the year 2024 for IPCC sector 3. *Agriculture* was estimated with use of approach 1 described in IPCC 2006 Guidelines for National Greenhouse Gas Inventories. This approach is based on the assumptions that every value is independent and probability

distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in Annex 2.

Recalculation of data for years 1988-2023 ensured consistency for whole time-series.

Detailed table with assumptions for the uncertainty of activity data and emission factors is presented below. Combined uncertainty estimated using error propagation formulas (approach 1) are also presented in the table.

2023	CO ₂ [kt]	CH ₄ [kt]	N ₂ O [kt]	CO ₂ Emission uncertainty [%]	CH ₄ Emission uncertainty [%]	N ₂ O Emission uncertainty [%]
3. Agriculture	1 186.42	592.78	62.27	17.6%	28.8%	54.9%
A. Enteric fermentation	-	533.94	-	-	31.5%	-
B. Manure management	-	57.79	9.69	-	48.8%	34.4%
D. Agricultural soils	-	-	52.54	-	-	64.8%
F. Field burning of agricultural residues	-	1.06	0.04	-	17.2%	96.5%
G. Liming	714.79	-	-	24.5%	-	-
H. Urea application	349.06	-	-	30.4%	-	-
I. Other carbon-containing fertilizers	122.57	-	-	30.4%	-	-

Complementing data presented in Annex 2 on AD, EFs and combined uncertainty assessment for Agricultural sector some additional information is given below.

The primary source of activity data used for GHG emission calculation, relating number of livestock and corresponding parameters as well as crop production and nitrogen fertilizers use, is the national statistical office – Statistics Poland (GUS) which is also a substantial data provider to the Eurostat and other international bodies. The main rural publications are prepared by the GUS's Agricultural Department and cover yearbooks on:

- Farm animals,
- Production of agricultural and horticultural crops,
- Means of production in agriculture,
- Agricultural Statistical Yearbooks.

Yearly data published by GUS are based on representative samples and verified with data collected during the General Agricultural Censuses performed every 10 years on average (the last ones occurred in 2011 and 2020). Therefore relatively low uncertainty (5%) is attributed to AD in agricultural sector as relates to livestock population or crop production. The electronic database is also developed by GUS allowing to import and cross-check data in trends back to 1999 or 2004 depending on range of data. Detail method of elaboration of livestock population on a yearly basis is presented in Annex 5.7. Higher uncertainty (30%) relates to AD for field burning of agricultural residues where amount of crop waste is assessed based on case study. The same range of uncertainty covers urea application where data come from international database on fertilizers (IFASTAT).

Uncertainties related to emission factors are noticeably higher than those for the activity data. Application of Tier 2 methodologies involving country specific parameters instead of IPCC default EFs, also diminishes the uncertainty EFs ranges. Uncertainty accompanying CH₄ implied emission factors reaches 50% as they rely partially on experts analysis covering animal waste management systems. Even higher uncertainty concerns the EFs for nitrous oxide, reaching 100–150%, what influence the combined uncertainty as % of particular GHG emissions. The highest combined uncertainties characterise soil related N₂O emissions

(reaching 70%), especially indirect ones, what is caused among others by natural variability, spatial data aggregation as well as rare measurements.

5.2.4. Source-specific QA/QC and verification

Activity data related to livestock population and any additional parameters like milk productivity or cattle pregnancy come from national statistics prepared by the Statistics Poland (GUS). Data like livestock population, crop production, nitrogen fertilizers use and others are available in several publications as well as GUS electronic database that were cross-checked. Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Also emphasis on comparison and consistency is checked with the input data applied in the UNECE CLRTAP and NECD reporting in Agriculture sector. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency.

Generally QC procedures follow QA/QC plan presented in Annex 4.

As a part of verification specific data related to livestock breeding are compared with other European countries (tab. 5.2.11). As the National Inventory Documents are elaborated by Parties in the same time, only data related to emission factors and other characteristics can be compared from previous reporting year. Cross-check for dairy cattle generally indicates that Polish parameters do not deviate from neighbouring countries.

When comparing to IPCC default CH₄ emission factor for dairy cattle the country specific one is higher (89 kg CH₄/animal/year for Eastern Europe with average milk production 2550 kg/head/yr) due to increasing intensification of dairy cattle production, characterised among others, with growing milk production (tab. 5.2.7).

Non-dairy IEF for Poland is lower than the IPCC default (58 kg CH₄/animal/year for Eastern Europe) what relates to high share of youngest cattle (< 1 year) among this category (53% in 1998 and 47% in 2023) (table 5.2.3). Also the Polish CH₄ CS EF for non-dairy cattle is at lower level of the EFs reported by other European countries (tab. 5.2.11).

Table 5.2.11. Comparison of parameters and Implied Emission Factors related to methane emissions from enteric fermentation for cattle in 2023

Country	Dairy cattle			Non-dairy cattle
	Milk yield [kg/head/yr]	GE intake [MJ/day]	IEF [kg CH ₄ /head/yr]	IEF [kg CH ₄ /head/yr]
Austria	17.34	232.73	94.51	50.81 (pasture)
Czechia	26.34	373.59	150.70	70.92
Germany	18.06	296.42	130.54	45.55
Lithuania	19.32	317.62	135.41	70.10
Poland	20.63	311.49	132.80	51.13
Slovakia	23.00	306.80	123.13	58.35
IPCC default value	–	–	109 (Western Europe) 89 (Eastern Europe)	57 (Western Europe) 58 (Eastern Europe)

5.2.5. Source-specific recalculations

- Update of fat content in milk for dairy cattle influencing Gross Energy and EF for 2021–2023
- Update of rabbit population based on national statistics since 2022

- Update of horses population based on national statistics for 2023

Table 5.2.12. Changes in CH₄ emissions from enteric fermentation due to recalculations

Change	1988	1989	1990	1991	1992	1993	1994
kt	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%
Change	1995	1996	1997	1998	1999	2000	2001
kt	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%
Change	2002	2003	2004	2005	2006	2007	2008
kt	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%
Change	2009	2010	2011	2012	2013	2014	2015
kt	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
Change	2016	2017	2018	2019	2020	2021	2022
kt	0.00	0.00	0.00	0.00	0.00	-1.15	1.14
%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.22%	0.22%
Change	2023						
kt	1.00						
%	0.19%						

5.2.6. Source-specific planned improvements

Presently no further improvements are planned.

5.3. Manure Management (CRT sector 3.B)

5.3.1. Source category description

CH₄ emissions related to animal manure management in 2024 amounted to 57.8 kt and decreased since 1988 by about 33.3%. Most of CH₄ emissions come from manure generated by cattle (46%) and swine (36%).

Table 5.3.1. Trends in CH₄ emissions from manure management according to livestock categories [kt CH₄]

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Fur animals	Total
1988	28.028	12.207	0.832	0.023	1.640	36.657	6.076	0.416	85.878
1989	29.506	13.899	0.838	0.023	1.518	35.271	6.853	0.387	88.296
1990	28.316	10.048	0.790	0.023	1.468	36.504	5.995	0.359	83.503
1991	26.170	9.609	0.614	0.023	1.465	41.075	5.712	0.330	84.998
1992	23.896	8.792	0.355	0.023	1.404	41.547	5.374	0.301	81.692
1993	22.133	7.909	0.241	0.023	1.312	35.532	5.321	0.272	72.745
1994	21.674	8.203	0.165	0.023	0.970	36.729	5.673	0.243	73.681
1995	20.143	7.719	0.135	0.023	0.992	38.583	5.256	0.215	73.067
1996	19.504	7.483	0.105	0.023	0.888	33.997	5.195	0.186	67.381
1997	20.367	7.640	0.093	0.024	0.870	34.372	5.072	0.196	68.635
1998	20.389	6.934	0.086	0.024	0.875	36.573	5.272	0.205	70.358
1999	21.374	6.583	0.074	0.024	0.860	35.335	5.338	0.215	69.803
2000	19.965	6.394	0.069	0.023	0.858	32.632	5.340	0.225	65.505
2001	19.693	5.884	0.065	0.022	0.852	32.745	5.502	0.235	64.997
2002	22.540	5.839	0.066	0.025	0.515	35.720	5.300	0.245	70.250
2003	25.021	5.690	0.064	0.025	0.519	35.652	3.680	0.259	70.910
2004	26.471	5.457	0.060	0.023	0.501	32.544	3.365	0.272	68.694
2005	26.710	5.735	0.060	0.018	0.487	35.529	4.104	0.286	72.929
2006	26.232	5.802	0.057	0.017	0.479	35.977	3.881	0.300	72.745
2007	26.102	6.090	0.063	0.019	0.513	33.665	4.069	0.314	70.835
2008	25.839	6.029	0.061	0.018	0.507	27.395	3.959	0.328	64.137
2009	24.249	6.138	0.054	0.015	0.465	24.928	3.875	0.342	60.068
2010	22.775	6.194	0.049	0.014	0.412	25.018	3.649	0.356	58.467
2011	21.928	5.833	0.048	0.015	0.397	21.729	3.934	0.334	54.218
2012	21.749	5.916	0.051	0.012	0.347	18.348	3.834	0.312	50.568
2013	21.650	6.098	0.042	0.011	0.335	19.273	3.876	0.290	51.576
2014	21.513	6.228	0.038	0.011	0.323	21.865	4.015	0.438	54.432
2015	21.186	6.200	0.043	0.008	0.335	22.754	4.447	0.587	55.560
2016	19.785	6.201	0.045	0.007	0.323	21.989	5.046	0.735	54.130
2017	19.647	6.390	0.050	0.006	0.289	23.802	5.308	1.195	56.687
2018	19.370	6.258	0.053	0.006	0.274	25.335	5.656	1.655	58.608
2019	19.149	6.232	0.052	0.007	0.259	23.487	5.845	2.116	57.147
2020	19.688	6.329	0.055	0.007	0.244	26.314	6.002	2.576	61.215
2021	19.412	6.563	0.055	0.007	0.244	25.346	5.341	3.037	60.004
2022	18.132	6.865	0.055	0.008	0.244	22.030	5.467	3.033	55.838
2023	19.185	6.571	0.053	0.008	0.246	21.516	5.915	3.030	56.523
2024	20.032	6.522	0.057	0.008	0.246	20.857	7.036	3.030	57.788
<i>share [%] in 2024</i>	<i>34.67</i>	<i>11.29</i>	<i>0.10</i>	<i>0.01</i>	<i>0.43</i>	<i>36.09</i>	<i>12.18</i>	<i>5.24</i>	<i>100.00</i>
<i>change [%] 1988-2024</i>	<i>-28.53</i>	<i>-46.57</i>	<i>-93.18</i>	<i>-64.59</i>	<i>-85.00</i>	<i>-43.10</i>	<i>15.79</i>	<i>628.27</i>	<i>-32.71</i>

Generally decreasing trend is observed in CH₄ emissions from manure management for all livestock sub-categories, where the biggest drop over time occurred to sheep breeding where CH₄ emissions dropped by 93% in 1988-2024 (tab. 5.3.1). The main reason for decreasing emissions are diminishing livestock populations, implemented abatement measures and conditions described in previous chapter.

N₂O emissions from manure management amounted to 9.7 kt in 2024 and drop since 1988 by 29.9% what is associated mostly with the diminishing livestock population. Direct emissions are responsible for about 48% and indirect for 52% of N₂O emissions in this category in 2024 (fig. 5.3.1).

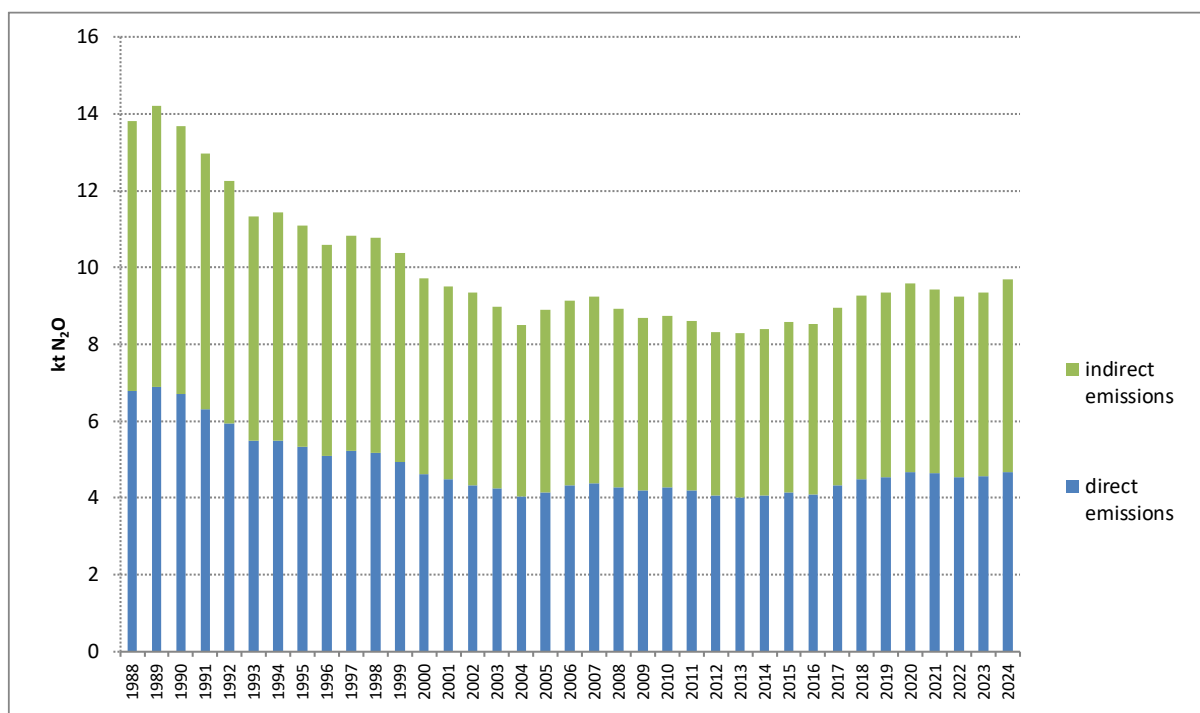


Figure 5.3.1. Trend of N₂O emissions (in division for direct and indirect) from manure management

5.3.2. Methodological issues

The source of activity data i.e. animal population was taken from the public statistics as described in chapter 5.2.2 (tab. 5.2.2, 5.2.3).

Country specific data on the animal waste management systems (AWMS) come from [Walczak 2006, 2009, 2011, 2012, 2013]. The fractions of manure managed in given AWMS for cattle were assessed on an annual basis for periods 1988-2002 and 2004-2012, data for 2003 was interpolated between 2002 and 2004. The share of pastures and solid storage were assessed for the key years: 1988-1989 and for 2004-2012 and the values in-between were interpolated (tab. 5.3.2). As concerns swine manure management systems the share of liquid and solid storage was estimated based on AWMS shares and pigs population for age categories for 1988 [Walczak 2006]. Data for 2004-2012 was taken from [Walczak 2011, 2012, 2013]. Data for years between 1988 and 2004 interpolation was made.

The data on AWMS shares for livestock has been prepared by the Institute of Animal Production where the database has been established. The database covers livestock population together with their waste management systems (solid, liquid) to determine impact of animal production on natural environment. This database covers animal breeding according

to groups (technological and age) for Poland and has been constructed based on livestock monitoring on farms across country in frames of Multiannual Program: "Protection and management of national genetic resources of livestock in the sustainable use conditions" in 2011-2015. Based on Agricultural Census 2020 Institute of Animal Production elaborated AWMS data for cattle and swine, that were initially applied in calculations. For the years between 2012 and 2020 interpolation was used while for years 2021–2022 – data from 2020 were used. For swine significantly growing share of liquid systems is observed while in case of cattle – slight changes are visible.

For other animals permanent shares of AWMS for entire inventoried period were assumed based on data assessed for 2004–2012: for sheep - 40% on pastures and 60% solid storage, for goats: 44% on pastures and 56% on solid storage and for horses: 22% and 78% respectively. For poultry the following AWMS shares were established: 11% on litter-free systems and 89% on solid storage [Walczak 2011, 2012, 2013].

According to the results of the Agricultural Census (PSR 2020), published in late 2022, the number of farms in June 2020 was 1,317.4 thousand. Out of this number, 99.4% (1,309.9 thousand) were individual farms, which owned 91.3% of the total agricultural land and 90.8% of the total conversion units of large livestock on farms. In 2020, the trend of a decrease in the number of farms with a simultaneous increase in their average area, recorded for many years, continued. Compared to Agricultural Census results from 2010, the number of farms decreased by approx. 192 thousand. (by 12.7%). This was caused by a decrease in the number of farms in the area groups of agricultural land (AL) from 1 to 20 ha. The deepest decrease concerned the area group of 1–2 ha of AL (by over ¼) and 5–10 ha of AL (by over 16%). The smallest number of farms decreased in the group of 2–3 ha of agricultural land. It should be noted that generally in Poland prevail small farms where 52% farms have up to 5 ha and 74% below 10 ha, and only 3% above 50 ha in 2020.

In the 2010-2020 decade, the number of the smallest farms with an area of up to 1 ha of agricultural land increased (by 1.6%) and the largest farms belonging to the area groups of 20 ha and more of agricultural land. The largest number of farms was added in the area group of 50 ha and more AL (over 50%). The observed trend of a decrease in the number of farms was reflected in an increase in the average area of agricultural land per farm - from 9.85 ha in 2010 to 11.35 ha in 2020. This increase was mainly due to the increase in the average area in farms with an area of 20–50 ha of agricultural land.

Among all farms, 1,311.9 thous. (99.6%) had agricultural land and 582.1 thous. (approx. 44%) kept livestock. On average in the country, one farm keeping livestock had: 23 head of cattle, 131 head of swine, 4.4 head of horses, 7.2 head of goats, 30.9 head of sheep and 615.5 poultry birds.

Solid manure was used by 482.8 thous. farms, slurry – 139.4 thousand as well as 110.6 thous. farms used poultry manure for fertilization. Natural fertilization was used mainly by farms specializing in field crops, while and slurry was used by farms specializing in rearing animals fed with roughage. It follows the proportion of solid and liquid systems of livestock maintenance where solid one prevail [GUS R3 2022].

Based on new data for cattle and swine developed on the basis of Agricultural Census 2020, updated information for liquid and solid management systems were elaborated for 2020 and repeated in the following years. The interpolation was used for period between 2012 and 2020 (see Table 5.3.2).

Table 5.3.2. Fractions of manure management systems for cattle and swine [%]

Year	Dairy cattle			Other cattle			swine		
	liquid	solid	pasture	liquid	solid	pasture	liquid	solid	pasture
1988	2.8	75.2	22.0	4.9	77.1	18.0	22.3	77.7	0.0
1989	2.8	75.2	22.0	6.8	75.2	18.0	22.4	77.6	0.0
1990	2.7	76.1	21.2	3.2	79.2	17.6	22.4	77.6	0.0
1991	2.7	76.9	20.4	5.1	77.7	17.2	22.5	77.5	0.0
1992	2.5	77.9	19.6	5.0	78.2	16.8	22.5	77.5	0.0
1993	2.3	78.9	18.8	4.4	79.2	16.4	22.6	77.4	0.0
1994	2.3	79.7	18.0	4.2	79.8	16.0	22.6	77.4	0.0
1995	2.3	80.4	17.2	3.8	80.6	15.6	22.7	77.3	0.0
1996	2.1	81.5	16.4	3.4	81.4	15.2	22.7	77.3	0.0
1997	2.4	82.0	15.6	3.0	82.2	14.8	22.8	77.2	0.0
1998	2.1	83.1	14.8	3.4	82.2	14.4	22.8	77.2	0.0
1999	3.3	82.7	14.0	3.7	82.3	14.0	22.9	77.1	0.0
2000	3.7	83.1	13.2	4.0	82.4	13.6	23.0	77.0	0.0
2001	3.7	83.9	12.4	4.3	82.6	13.2	23.0	77.0	0.0
2002	6.8	81.6	11.6	4.4	82.8	12.8	23.1	76.9	0.0
2003	8.6	80.5	10.8	4.5	83.1	12.4	23.1	76.9	0.0
2004	10.5	79.5	10.0	5.2	83.0	11.8	23.2	76.8	0.0
2005	10.6	79.4	10.0	5.2	82.8	12.0	24.0	76.0	0.0
2006	10.3	79.7	10.0	5.2	83.1	11.7	24.4	75.6	0.0
2007	10.7	79.2	10.0	4.8	83.1	12.0	25.0	75.0	0.0
2008	10.9	79.1	10.0	4.9	83.1	11.9	24.9	75.1	0.0
2009	10.8	79.2	10.0	4.8	83.1	12.0	25.9	74.1	0.0
2010	10.1	79.6	10.3	5.1	82.9	12.1	25.5	74.5	0.0
2011	10.6	79.1	10.3	5.2	82.9	11.9	24.9	75.1	0.0
2012	10.5	79.2	10.3	5.1	82.9	12.0	24.3	75.7	0.0
2013	10.8	79.2	10.0	5.2	82.3	12.5	28.7	71.3	0.0
2014	11.0	79.2	9.8	5.4	81.6	13.0	33.2	66.8	0.0
2015	11.3	79.2	9.5	5.6	81.0	13.4	37.6	62.4	0.0
2016	11.6	79.2	9.2	5.7	80.4	13.9	42.0	58.0	0.0
2017	11.8	79.2	9.0	5.9	79.7	14.4	46.4	53.6	0.0
2018	12.1	79.2	8.7	6.1	79.1	14.9	50.9	49.1	0.0
2019	12.3	79.2	8.4	6.2	78.4	15.4	55.3	44.7	0.0
Since 2020	12.6	79.3	8.2	6.4	77.8	15.9	59.7	40.3	0.0

5.3.2.1. Estimation of CH₄ emissions from manure management

The *Tier 1* methodology was used for estimation of CH₄ emissions from manure management of horses, sheep, goats, swine, poultry, rabbits and fur animals [IPCC 2006] (tab. 5.3.3).

Table 5.3.3. CH₄ Emission factors applied for selected livestock where Tier 1 methodology was used based on IPCC 2006 GLs

Livestock	EF [kg CH ₄ /animal/year]
Sheep	0.19
Goats	0.13
Horses	1.56
Poultry:	
Layers (dry)	0.03
Broilers	0.02
Turkeys	0.09
Ducks	0.02
Rabbits	0.08
Fur-bearing animals	0.68

The *Tier 2* methodology was used to establish domestic CH₄ emission factors for cattle applying equation 10.23 from [IPCC 2006]:

$$EF = Vs * 365 \frac{\text{days}}{\text{year}} * B_o * 0.67 \frac{\text{kg}}{\text{m}^3} * \sum MCF * MS$$

where:

- EF – emission factor (kg CH₄/animal/year),
- Vs – average daily volatile excreted solids,
- B_o – maximum CH₄ production capacity for manure produced by animal,
- MCF – methane conversion factors for each manure management system for cool climate [IPCC 2006, tab. 10.17],
- MS – fraction of livestock category manure in given AWMS (table 5.3.2).

Detail information on parameters used in methane emissions estimation from manure management for cattle is given in table 5.3.4. The CS methane EFs for dairy cattle range from above 6 kg CH₄/animal/year in early 1990-ties to more than 9 kg CH₄/animal/year in 2004–2009 (tab. 5.3.5) and slowly decreasing to about 8 kg CH₄/animal/year where cover of tanks with slurry were used following legal obligations (table 5.3.11). EFs for years for mid 2000 are close to the IPCC default ones (11 kg CH₄/animal/year for cool climate ≤10°C). More data on comparison of CH₄ EFs from manure management with other countries is presented in chapter 5.3.4.

Table 5.3.4. Parameters used for calculation of CH₄ emissions from manure management for cattle

Parameters/unit	Source/reference	Values/comments
Volatile solids (Vs) [kg DM/head/day]	equation 10.24 in IPCC 2006 GLs	Calculated with the use of specific GE and DE parameters
Urinary energy expressed as fraction of GE	IPCC 2006 GLs	0.04
ASH content	IPCC 2006 GLs	0.08
Maximum CH₄ producing capacity (B_o) [m³ CH₄/kg Vs]	IPCC 2006 GLs	0.24 for dairy cattle 0.17 for non-dairy cattle

Table 5.3.5. Volatile excreted solids and CS CH₄ EFs for cattle

Years	Dairy cattle		Non-dairy cattle	
	Vs [kg DM/head/day]	CH ₄ EF [kg/head/yr]	Vs [kg DM/head/day]	CH ₄ EF [kg/head/yr]
1988	4.52	5.83	2.08	2.21
1989	4.57	5.91	2.05	2.42
1990	4.48	5.76	2.05	1.96
1991	4.43	5.72	2.09	2.25
1992	4.38	5.61	2.07	2.22
1993	4.39	5.56	2.08	2.16
1994	4.41	5.61	2.08	2.14
1995	4.40	5.63	2.06	2.07
1996	4.46	5.64	2.08	2.04
1997	4.51	5.84	2.09	2.00
1998	4.52	5.76	2.07	2.03
1999	4.52	6.25	2.09	2.10
2000	4.54	6.44	2.09	2.14
2001	4.60	6.55	2.07	2.16
2002	4.60	7.85	2.09	2.20
2003	4.62	8.63	2.07	2.20
2004	4.65	9.47	1.89	2.13
2005	4.67	9.56	1.87	2.13
2006	4.68	9.29	1.90	2.09

Years	Dairy cattle		Non-dairy cattle	
	Vs [kg DM/head/day]	CH ₄ EF [kg/head/yr]	Vs [kg DM/head/day]	CH ₄ EF [kg/head/yr]
2007	4.72	9.37	1.90	2.09
2008	4.70	9.21	1.88	2.04
2009	4.72	9.02	1.92	2.04
2010	4.70	8.58	1.91	2.02
2011	4.71	8.35	1.90	1.86
2012	4.78	8.44	1.90	1.85
2013	4.80	8.56	1.88	1.83
2014	4.83	8.68	1.85	1.81
2015	4.91	8.67	1.83	1.76
2016	4.91	8.48	1.81	1.72
2017	4.88	8.27	1.81	1.70
2018	4.81	7.97	1.81	1.66
2019	4.80	7.78	1.80	1.62
2020	4.87	7.98	1.81	1.63
2021	4.96	8.13	1.81	1.64
2022	5.01	8.21	1.79	1.62
2023	5.03	8.21	1.81	1.63
2024	5.27	8.58	1.81	1.63

The rising trend of Polish EFs for dairy cattle is mostly related to increasing share of liquid systems since 1988. On the other hand the methane CS EFs for non-dairy cattle is less than 2 kg CH₄/animal/year in entire period and is lower than the IPCC default EF (6 kg CH₄/animal/year) due to relatively small share of liquid systems applied and moderate level of GE (see also table 5.3.2).

For calculation of methane emissions from manure management from swine bred also the equation 10.23 from [IPCC 2006] was used but the default values for Vs, B₀ and MCF were applied [IPCC 2006]. The weighted mean CH₄ EF calculated for 2024, as described above, for market swine is 2.2 kg CH₄/animal/year and for breeding swine 3.7 kg CH₄/animal/year and both EFs are close to the IPCC default EFs (3 kg CH₄/animal/year for market swine and 4 kg CH₄/animal/year for breeding swine). These EFs decrease after 2005 when abatement measures are gradually endorsed with slurry tanks covering (table 5.3.11).

Table 5.3.6. Methane-producing potential (B₀), volatile solids excreted (Vs) and CH₄ emission factors for manure management for swine

Livestock	EF Emission Factor [kg CH ₄ /animal/year]	Vs Volatile Solids Excreted [kg d.m./animal/day]	B ₀ Methane-producing potential [m ³ CH ₄ /kg Vs]
Market swine	2.28	0.30	0.45
Breeding swine	3.73	0.50	

Methane conversion factors (MFCs) for all systems were taken from the table 10.17 of the IPCC 2006 Guidelines for cool climate ≤ 10°C (see table 5.3.5). As relates to liquid/slurry animal manure storage the reduction measures are taken since 2006 directed to cover slurry tanks (tab 5.3.11). The same reduction measures are taken into account for estimation of NH₃ and NO_x emissions under NECD and UNECE CLRTAP reporting based on case study [Walczak 2016. 2022]. Therefore CH₄ MCF values characterised as “with natural crust cover” for the part of slurry under cover were applied and the ones “without natural crust cover” (tab. 5.3.7) for the rest of slurry and period before 2006 (Chapter 5.3.2.2). Data between years 2005–2010–2014–2019 were interpolated. Since 2019 100% of tanks with liquid slurry are obliged to be covered.

Table 5.3.7. MCF values for manure management applied in CH₄ emissions [IPCC 2006 GLs table 10.17]

System	MCF for cool climate ≤ 10°C
pasture/range/paddock	1%
solid storage	2%
liquid/slurry systems with cover	10%
liquid/slurry systems without cover	17%
Anaerobic digestion	1.84%

Methane combusted in biogas plants, including agriculture biogas plants, is included in energy sector. Separation of methane emissions from anaerobic digesters in manure management category (recommendation A.4 from FCCC/ARR/2020/POL) has been elaborated within this Submission influencing CH₄ and N₂O emissions.

Data on inputs (including manure) used in agricultural biogas plants are collected for 2011–2024 from the National Centre for Agricultural Support (KOWR). Additional information was also gained from the national statistics which started to publish data on manure applied on soils for last single years. Here the share of manure used in biogas plants could be assessed. As the IPCC 2006 GLs do not provide MCFs for anaerobic digester therefore the new IPCC 2019 Refinement GLs were employed as presented in Table 10-17 where MCFs for anaerobic digesters are divided for groups depending on leakage and digestate management. Based on information from the National Centre for Agricultural Support it is assumed that only low leakage installations are operating in Poland but digestate is stored both: in gastight tanks or in the open air. Information on types of agricultural biogas plants operating in Poland was seek through questionnaire sent in January 2022. Data collected from the query covered about 30% biogas installations. Here weighted mean MCF was assigned which accounted for 1.84% (Table 5.3.7). Shortage in the data still exists and relates to differentiation of manure used in anaerobic digesters in relation to livestock so the simplified method was used to assign the same share of liquid or solid manure used in biogas from cattle or swine. The share of manure used in agriculture anaerobic digesters is presented in Table 5.3.8. Including agricultural biogas plants (anaerobic digesters) using livestock manure since 2011 slightly reduced CH₄ emissions.

Table 5.3.8. Share of manure used in anaerobic digestion facilities

Manure	2011	2012	2013	2014	2015	2016	2017	2018
Slurry	0.01207	0.01532	0.02053	0.02561	0.02678	0.03617	0.03158	0.03477
Solid	0.00024	0.00060	0.00080	0.00102	0.00126	0.00215	0.00198	0.00240
Manure	2019	2020	2021	2022	2023	2024		
Slurry	0.03454	0.03070	0.03085	0.03078	0.03972	0.04558		
Solid	0.00238	0.00301	0.00291	0.00296	0.00394	0.00421		

5.3.2.2. Estimation of direct N₂O emissions from manure management

Direct nitrous oxide emissions from manure management were estimated based on recommended IPCC methodology [IPCC 2006, equation 10.25] using the same AWMS data as for CH₄ emissions (chapter 5.3.2.1):

$$N_2O_{D(mm)} = \left[\sum_S \left[\sum_T (N_{(T)} * Nex_{(T)} * MS_{(T,S)}) \right] * EF_{3(S)} \right] * \frac{44}{28}$$

where:

N₂O_{D(mm)} – direct N₂O emissions from manure management in the country (kg

- $\text{N}_2\text{O}/\text{year}$),
- $N_{(T)}$ – livestock population in given category T in the country,
- $N_{ex(T)}$ – annual average N excretion per head of livestock category T in country (kg N/animal/year),
- $MS_{(T,S)}$ – fraction of total annual nitrogen excretion for each livestock category T managed in manure management system S ,
- $EF_{3(S)}$ – emission factor for direct N_2O emissions from manure management system S (kg $\text{N}_2\text{O}-\text{N}/\text{kg N}$),
- S – manure management system,
- T – livestock category,
- 44/28 – conversion of $(\text{N}_2\text{O}-\text{N})_{(mm)}$ emissions to $\text{N}_2\text{O}_{(mm)}$ emissions.

Data on animals' nitrogen excretion rates (N_{ex} , kg N/head/year) are mostly country specific ones [IUNG 2014, Pastuszak, Igras 2012], except of rabbits and fur bearing animals which were taken from on IPCC 2006 GLs (Table 5.3.10). Following the ERT 2018 recommendation (FCCC/ARR/2020/POL A.6,7) N_{ex} for cattle and poultry were updated. Cattle N_{ex} parameters (Table 5.3.9) were based on the IPCC 2006 GLs methodology (equations 10.31 and 10.32) with gross energy (GE) as presented in Chapter 5.2.2 and percent of crude protein in diet (CP%) based on country study [Walczak 2020] (presented in Tables 5.2.7 and 5.2.8). Fraction of N intake that is retained by animal ($N_{retention}$) are taken from Table 10.10 of the IPCC 2006 GLs: 0.2 for dairy cows and 0.07 for other cattle.

The same N_{ex} parameters are used in CLRTAP-NECD inventory. N_{ex} for poultry comes from publication summarizing international project concerning emissions of nitrogen and phosphorus from Polish territory to the Baltic Sea [Pastuszak, Igras 2012] and are presented in Table 5.3.10.

Country specific N_{ex} values are generally in line with parameters published by EMEP/EEA for most livestock categories. The basis for assessment of Nitrogen excretion rates (N_{ex}) by [IUNG 2014, Pastuszak, Igras 2012] constitutes the standard amounts of nitrogen in faeces and urine determined for different groups of livestock animals grounded on standard quantity, sort and digestibility of fodder applied.

Table 5.3.9. Country specific Nitrogen excretion rates (N_{ex}) in manure for cattle and swine [kg N/animal]

Livestock categories	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Dairy cattle > 2 years	102.42	101.85	102.81	105.43	105.81	111.40	114.38	116.15	121.70	122.01	127.78
Young cattle <1 year	44.34	45.41	47.32	46.43	45.49	44.51	44.53	44.37	44.67	44.67	44.67
Young cattle 1-2 years	64.11	64.23	62.20	59.95	59.57	56.76	55.62	55.69	55.95	55.95	55.95
Heifers > 2 years	56.89	57.07	54.93	52.86	53.05	51.93	51.21	50.98	51.47	51.47	51.47
Bulls > 2 years	83.00	85.93	88.48	87.16	85.86	85.12	84.91	84.82	85.89	85.89	85.89
Other cattle (weighted mean)	53.98	54.71	54.51	53.00	53.08	51.42	51.31	51.17	51.44	51.60	51.59
Swine (weighted mean)	9.97	9.97	10.03	9.86	10.07	10.43	10.91	10.93	10.95	10.84	10.99

Table 5.3.10. Nitrogen excretion rates (Nex) for other livestock and swine subcategories used in emission calculations in 1990–2024 [kg N/animal]

Livestock categories	Nex	Reference
Swine:		
Piglets (< 20 kg)	2.6	CS [IUNG, 2014]
Piglets (20-50 kg)	9.0	
Fattening pigs (> 50 kg)	15.0	
Butcher hogs	18.0	
Sows	20.0	
Sheep	9.5	CS [IUNG, 2014]
Horses	55.0	CS [IUNG, 2014]
Goats	8.0	CS [IUNG, 2014]
Hens	0.725	CS [Pastuszak, Igras 2012]
Broilers	0.435	CS [Pastuszak, Igras 2012]
Turkeys	1.554	CS [Pastuszak, Igras 2012]
Ducks	1.381	CS [Pastuszak, Igras 2012]
Geese	1.640	CS [Pastuszak, Igras 2012]
Rabbits	8.10	D [IPCC 2006 table 10.19]
Minks and polecats	4.59	D [IPCC 2006 table 10.19]
Foxes, racoons	12.09	D [IPCC 2006 table 10.19]

The exemptions are sheep and goats where Nex values for Poland are among group of countries with lower factor then the default ones in IPCC 2006 GLs. The country specific Nex values were established based on livestock categories raised in Poland as well as country specific conditions and international literature and research. Sheep (as well as goats) in Poland are fed on pastures for around half a year and housed for another half. Sheep and goats are fed mostly on roughage from extensive pastures and meadows. Winter feeding cover hay, straw and root crops. Additional protein fodder is not widely applied among sheep and goats, if applied it is limited to lambs. It should be mentioned here that Nex is established for entire group of sheep of which about 30% are lambs and other immature animals.

Table 5.3.11. Population of fur-bearing animals in 1983 according to species

Fur-bearing females	1983
Foxes	164 403
Minks	40 948
Nutrias	464 039
Polecats and polecats-ferrets	20 695
Chinchillas	4 242
Yenots	596

For rabbits and other fur-bearing animals the *Tier 1* method and default Nex values were used from [IPCC 2006, table 10.19] where Nex for rabbits amounts to 8.1 kg N/head/yr. As the detail disaggregation of fur-bearing animals listed in national statistics was given only up to 1983 (tab. 5.3.11) the share from 1983 was used to establish the weighted mean Nex value (6.36 kg N/head/yr) for all fur-bearing animals using default Nex values: 12.09 for foxes and 4.59 kg N/head/yr for minks, polecats and others. The next available data on rabbits and fur-bearing animals (but without disaggregation for species) was published by Statistics Poland in 1996 in frames of national agricultural census. Since that time data on fur-bearing animals are published periodically (see Chapter 5.2.2).

Table 5.3.12. Abatement techniques related to cover the slurry tanks

NH ₃ abatement techniques	% of animal population covered in years			
	2005	2010	2014	Since 2019
Cattle slurry under cover	0.0	43.5	44.8	100
Swine slurry under cover	0.0	61.8	67.2	100

Table 5.3.13 Emission factors for calculating N₂O emissions from manure management [IPCC 2006]

Animal Waste Management Systems	Emission factor (EF ₃) [kg N ₂ O-N/kg N]
Liquid/slurry with natural crust cover	0.005
Liquid/slurry without natural crust cover	0.000
Solid storage	0.005
Pit storage below animal confinements	0.002
Poultry manure with litter	0.001
Poultry manure without litter	0.001
Anaerobic digester	0.000

Default values of N₂O emission factors for given management systems from [IPCC 2006, table 10.21] were applied (table 5.3.13). Anaerobic digesters have been taken into account within this Submission where EF for N₂O is zero based on [IPCC 2006, table 10.21] (table 5.3.13). The share of manure applied in agricultural biogas plants is given in the Table 5.3.8.

As relates to liquid/slurry animal manure storage the reduction measures are taken after 2005 directed to cover such tanks in part of farms (tab. 5.3.12). The same reduction measures are taken into account for estimation of NH₃ and NO_x emissions under NECD and UNECE CLRTAP reporting and are based on case study [Walczak 2016, 2022]. Therefore N₂O EFs characterised as “with natural crust cover” for the part of slurry under cover were applied and “without natural crust cover” (tab. 5.3.13) for the rest of slurry and period before 2006. Data between years 2005–2010–2014–2019 were interpolated.

5.3.2.3. Indirect N₂O emission from manure management

Following IPCC 2006 Guidelines the indirect N₂O emissions from manure management were estimated based on equations: 10.27 (N volatilisation) and 10.29 (N leaching) as well as nitrogen excretion rates (N_{ex}) and manure management systems shares (MS) described in previous subchapters related to GHG emissions from manure management. Emission factor for calculation of N₂O emissions from atmospheric nitrogen deposition was assumed as 0.01 kg N₂O–N while emission factor for N₂O emissions from nitrogen leaching and runoff was adopted as 0.0075 kg N₂O–N (default EFs from IPCC 2006).

Nitrogen losses related to volatilisation from manure management were calculated based on equation 10.26 [IPCC 2006] where fractions of managed manure nitrogen for given livestock category that volatilises as NH₃ and NO_x in given manure system (Frac_{GAS}) are taken from [IPCC 2006 table 10.22]. Nitrogen losses due to leaching from manure management were estimated based on equation 10.28 [IPCC 2006] applying fraction of managed manure nitrogen losses for livestock categories due to runoff and leaching during manure storage as the difference between Nitrogen loss from manure management Frac_{LossM} [IPCC 2006 Table 10.23] and Nitrogen loss due to volatilisation of NH₃ and NO_x from manure management Frac_{GAS}MS [IPCC 2006 Table 10.22].

Here recommendation A.18 from review report FCCC/ARR/2020/POL was also implemented where updated N_{ex} parameters for cattle and poultry were applied.

5.3.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 5.2.3.

5.3.4. Source-specific QA/QC and verification

Activity data related to livestock population come from national statistics prepared by the Statistics Poland (GUS). Data on Animal Waste Management Systems are elaborated by the National Research Institute of Animal Production which develops activities aiming at obtaining representative data on the production of main livestock categories. Collection of this data is based on appointing a suitable monitoring for various institutions like statistical office, Farmers Chambers, Centres for Agricultural Advice and Veterinary Inspection. Partially monitoring is covered also by Institute's employees.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Also emphasis on comparison and consistency is checked with the data applied in the UNECE CLRTAP and NECD reporting in Agriculture sector. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 4.

As a part of verification specific data related to livestock breeding are compared with other European countries (tab. 5.3.13). As the National Inventory Documents are elaborated by Parties in the same time, only data related to emission factors and other characteristics can be compared from previous reporting year. Cross-check for dairy cattle generally indicates that Polish characteristics corresponds to neighbouring countries where milk production influence N excretion rates (Table 5.3.14).

Methane IEF for cattle in Poland is in lower range due to specific cattle breeding conditions, including relatively small share of liquid AWMS (described in Chapter 5.2.2 and 5.3.2) as well as growing share manure treated anaerobic digestion facilities. The range of CH₄ EFs for manure management for swine in compared countries varies significantly depending, among others, on climatic conditions and AWMS share: from 1.5 in Austria in to even 4.6 kg CH₄/animal/year in Germany.

Table 5.3.14. Comparison of CH₄ Implied Emission Factors related to manure management and Nitrogen excretion rates resulting in N₂O emissions for cattle and swine in 2023

Country	Dairy cattle		Non-dairy cattle		Swine	
	CH ₄ IEF [kg/head/yr]	Nex [kg N/head/yr]	CH ₄ IEF [kg/head/yr]	Nex [kg N/head/yr]	CH ₄ IEF [kg/head/yr]	Nex [kg N/head/yr]
Austria	13.86	125.43	4.65	34.91 (pasture)	1.52	12.17
Czechia	12.19	119.30	3.64	59.22	1.76	10.76
Germany	21.71	108.16	7.55	41.12	4.60	13.05
Lithuania	13.66	112.98	8.90	45.70	0.30	11.91
Poland	8.77	122.42	1.70	51.60	2.29	11.15
Slovakia	10.78	119.91	2.20	39.07	2.69 (market)	9.65 (market)
IPCC default value	11.0	70	6.0	50	3 (market swine) 4 (breeding swine)	9.86 (market swine)

5.3.5. Source-specific recalculations

- Update of fat content in milk for dairy cattle influencing Gross Energy, EF and Nex for 2021–2023

- Update of rabbit population based on national statistics since 2022 based on national statistics
- Update of horses population based on national statistics for 2023 based on national statistics

Table 5.3.15. Changes in CH₄ emissions from manure management due to recalculations

Change	1988	1989	1990	1991	1992	1993	1994
kt	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%
Change	1995	1996	1997	1998	1999	2000	2001
kt	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%
Change	2002	2003	2004	2005	2006	2007	2008
kt	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%
Change	2009	2010	2011	2012	2013	2014	2015
kt	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
Change	2016	2017	2018	2019	2020	2021	2022
kt	0.00	0.00	0.00	0.00	0.00	-0.08	0.08
%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.13%	0.14%
Change	2023						
kt	1.71						
%	3.02%						

Table 5.3.16. Changes in N₂O emissions from manure management due to recalculations

Change	1988	1989	1990	1991	1992	1993	1994
kt	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%
Change	1995	1996	1997	1998	1999	2000	2001
kt	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%
Change	2002	2003	2004	2005	2006	2007	2008
kt	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%
Change	2009	2010	2011	2012	2013	2014	2015
kt	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%
Change	2016	2017	2018	2019	2020	2021	2022
kt	0.00	0.00	0.00	0.00	0.00	-0.01	0.02
%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.15%	0.17%
Change	2024						
kt	0.04						
%	0.40%						

5.3.6. Source-specific planned improvements

Presently no further improvements are planned.

5.4. Agricultural Soils (CRT sector 3.D)

5.4.1. Source category description

Nitrous oxide emissions from agricultural soils amounted to 52.3 kt N₂O in 2024 and significantly decreased since base year by about 26% (Fig. 5.4.1). Since 1993 emissions stabilised with few percent changes between years. There are several main driving forces influencing emissions variability during entire inventoried period: nitrogen mineral and organic fertilizers use and crops production.

As a result of economic transformation of the Polish economy in 1989 significant changes were observed in relation to crop production and usage of agricultural land. For instance the decrease of agricultural land of which share in total country area changed from 59.2% in 1989 up to 54% in 1996 and 52% in 2020. Between 1990 and 2002 the decrease of sown area by 3.5 million hectares occurred, but in recent years rise again. Also the decrease of mineral fertilisers' use drop from 164 kg per 1 ha of agricultural land in 1989/90 to 93 kg in 2001/02 and increased again to 132.9 kg in 2019/2020. Since 1988 production of certain crops in Poland changed noteworthy – potatoes cultivation dropped by over 80% up to 2024 while maize production increased more than 40-fold (table 5.4.1). Activity data on crop production in 2024 comes from public statistics [GUS R10 2025].

Table 5.4.1. Main crops production in Poland [kt]

Year	wheat	barley	maize	oats	rye	triticale	cereal mixed	millet & buckwheat	pulses edible	potatoes	rape & agrimony	All vegetables	All fruits
1988	7582	3804	204	2222	5501	1731	3387	73	565	34707	1199	5179	2168
1989	8462	3909	244	2185	6216	2404	3466	72	615	34390	1586	5067	2078
1990	9026	4217	290	2119	6044	2721	3554	43	609	36313	1206	5259	1416
1991	9270	4257	340	1873	5900	2449	3683	39	680	29038	1043	5637	1873
1992	7368	2819	206	1229	3981	1711	2612	36	380	23388	758	4518	2385
1993	8243	3255	290	1493	4992	1894	3200	50	411	36270	594	5823	2705
1994	7658	2686	189	1243	5300	1631	3026	30	215	23058	756	5198	2109
1995	8668	3278	239	1495	6288	2048	3844	45	268	24891	1377	5746	2115
1996	8576	3437	350	1581	5653	2130	3520	51	277	27217	449	5253	2781
1997	8193	3866	416	1630	5299	1841	4105	49	260	20776	595	5136	2887
1998	9537	3612	497	1460	5663	2058	4274	58	289	25949	1099	6096	2517
1999	9051	3401	599	1447	5181	2097	3914	60	317	19927	1132	5457	2387
2000	8503	2783	923	1070	4003	1901	3084	74	264	24232	958	5721	2247
2001	9283	3330	1362	1305	4864	2698	4060	58	211	19379	1064	5428	3413
2002	9304	3370	1962	1486	3831	3048	3608	40	229	15524	953	4537	3018
2003	7858	2831	1884	1182	3172	2812	2812	44	238	13731	793	4870	3309
2004	9892	3571	2344	1430	4281	3723	4322	72	270	13999	1633	5283	3521
2005	8771	3582	1945	1324	3404	3903	3916	83	253	10369	1450	5220	2923
2006	7060	3161	1261	1035	2622	3197	3379	59	206	8982	1652	4919	3212
2007	8317	4008	1722	1462	3126	4147	4257	96	286	11791	2130	5475	1694
2008	9275	3619	1844	1262	3449	4460	3673	82	235	10462	2106	5023	3843
2009	9790	3984	1706	1415	3713	5234	3884	93	272	9703	2497	5601	3749
2010	9408	3397	1994	1516	2852	4576	3339	146	356	8188	2229	4878	2826
2011	9339	3326	2392	1382	2601	4235	3373	109	335	9362	1862	5575	3414
2012	8608	4180	3996	1468	2888	3349	3920	128	482	9041	1866	5431	3838
2013	9485	2934	4040	1190	3359	4273	3021	135	375	7290	2678	4986	4128
2014	11629	3275	4468	1459	2793	5247	2922	135	467	7689	3276	5607	4189
2015	10958	2961	3156	1220	2013	5339	2250	99	715	6314	2701	4795	4100
2016	10828	3441	4343	1358	2200	5102	2415	160	653	8872	2219	5610	4644
2017	11666	3793	4022	1465	2674	5312	2847	144	630	9172	2697	5705	3151
2018	9820	3048	3864	1166	2167	4086	2506	116	501	7478	2202	5271	5072

Year	wheat	barley	maize	oats	rye	triticale	cereal mixed	millet & buckwheat	pulses edible	potatoes	rape & agrimony	All vegetables	All fruits
2019	11012	3374	3734	1233	2461	4583	2472	118	499	6599	2373	5019	3933
2020	12669	3001	6822	1658	2960	6195	2080	118	695	8008	3125	5087	4491
2021	12119	3018	7461	1656	2520	5451	2232	178	768	7081	3191	5279	5059
2022	13445	2835	8503	1529	2381	5543	1191	216	984	6031	3647	1994	5299
2023	13178	2905	9152	1532	2581	5383	923	192	987	5590	3739	5165	5363
2024	12415	3016	9398	1648	2439	5052	833	185	1253	5920	3268	5276	4213
2024/ 1988	63.7	-20.7	4506.9	-25.9	-55.7	191.9	-75.4	153.9	121.7	-82.9	172.5	1.9	94.3

Within agricultural soils, 81% of N₂O emissions are related to direct soil cultivation, while about 19% are generated in indirect emission processes. The main sources of N₂O emissions estimated relate to direct soil cultivation covering:

- Inorganic N fertilizers use,
- Organic N fertilizers use: animal manure and sewage sludge,
- Urine and dung deposited by grazing animals,
- Crop residues,
- Mineralisation/immobilisation associated with loss/gain of soil organic matter,
- Cultivation of organic soils (i.e. histosols).

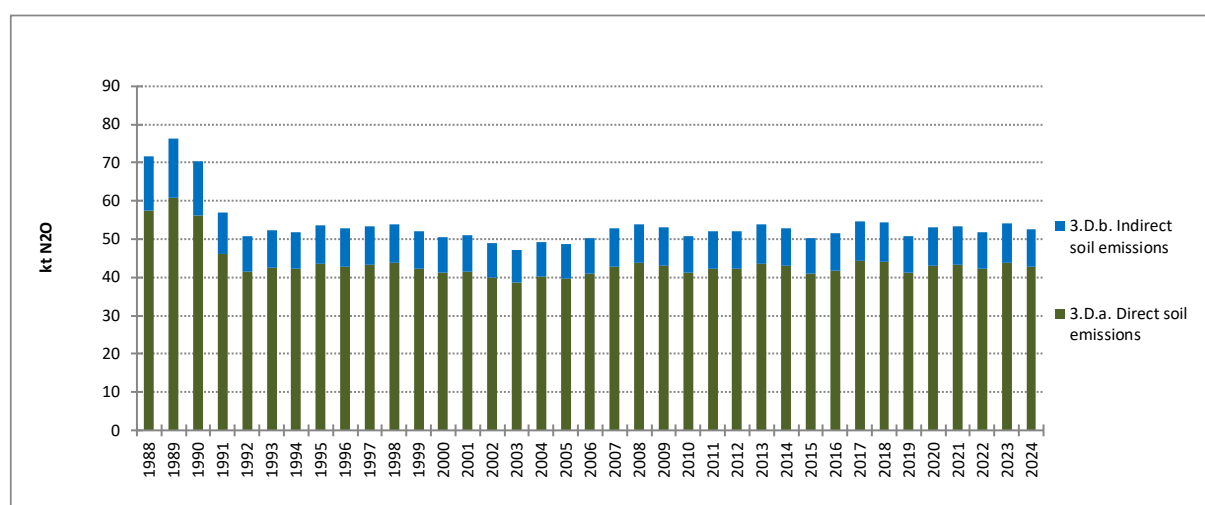


Figure 5.4.1. N₂O emissions from agricultural soils

5.4.2. Methodological issues

5.4.2.1. Direct N₂O emissions from managed soils (CRT sector 3.D.a)

Direct N₂O emissions from managed soils has been estimated based on equation 11.1 from the IPCC 2006:

$$N_{2}O_{Direct} - N = (F_{SN} + F_{ON} + F_{CR} + F_{SOM})EF_1 + F_{OS} * EF_2 + F_{PRP} * EF_{3PRP}$$

where:

N₂O_{Direct}-N = annual direct N₂O-N emissions produced from managed soils (kg N₂O-N/year),

F_{SN} = annual amount of synthetic fertiliser N applied to soils (kg N/year),

F_{ON} = annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils (kg N/year),

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 (kg N/year),

F_{SOM} = annual amount of N in mineral soils that is mineralised, in association with loss of soil C from soil organic matter as a result of changes of land use or management (kg N/year),

F_{OS} = annual area of managed/drained organic soils (ha),

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N/year),

EF_1 = emission factor for N_2O emissions from N inputs (kg N_2O-N /kg N input),

EF_2 = emission factor for N_2O emissions from drained/managed organic soils (kg N_2O-N /ha/year),

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).

The following default values of N_2O emission factors to estimate direct emissions from managed soils were applied [IPCC 2006, table 11.1]:

$EF_1 = 0.01$ kg N_2O-N /kg N input,

$EF_2 = 8$ kg N_2O-N /ha/year (for temperate organic crop and grassland soils),

$EF_{3PRP} = 0.02$ for cattle, swine and poultry, 0.01 for sheep, goats and horses.

In 2024 about 37% of direct N_2O emissions come from the use of synthetic nitrogen fertilizers (3.D.a.1), about 26% relates to management of organic soils, 15% to organic fertilizers applied to soils and 16% to crop residues. Only 4% of direct N_2O emissions comes from urine and dung left by grazing animals on pastures (fig. 5.4.2). N_2O emissions related to mineralisation of soils as a result of changes of land use or management are insignificant (0.9%).

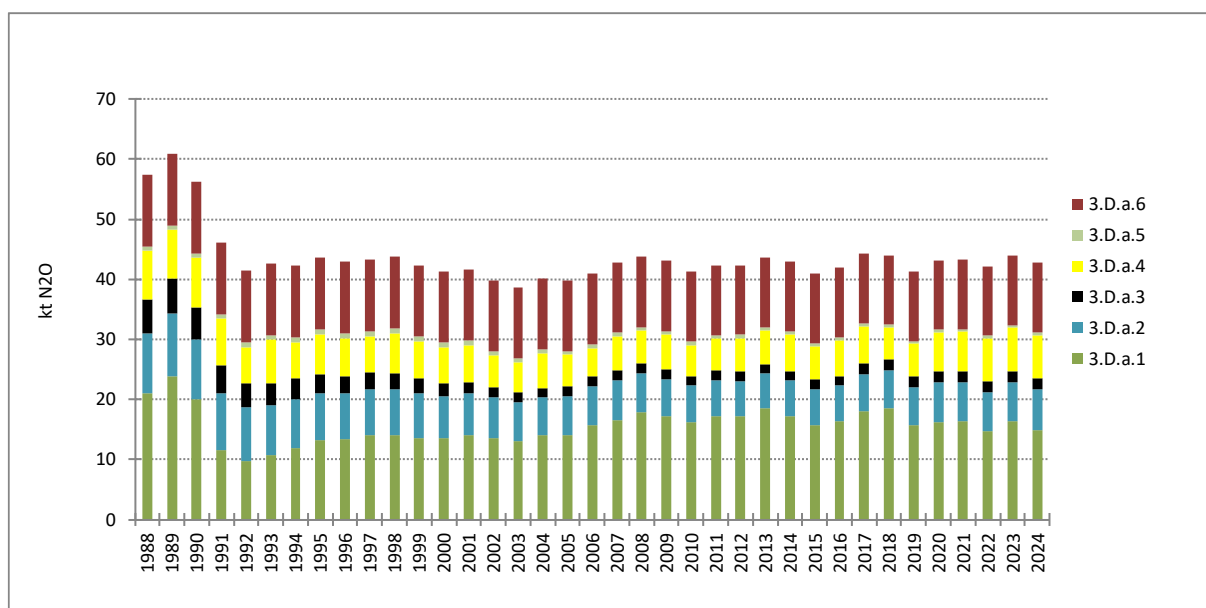


Figure 5.4.2. Direct N_2O emissions from specific subcategories

Synthetic nitrogen fertilizers (F_{SN}) (CRT sector 3.D.a.1)

N_2O emission from synthetic fertilizers was estimated based on the amount of nitrogen synthetic fertilizer applied to soils come generally from national statistics.

Data regarding consumption of mineral fertilizers is developed by Statistics Poland (GUS) on the basis of reporting and sample surveys, ie. regular surveys on the structure of agricultural holdings (R-SGR) carried out every three years and the June Agricultural Surveys (R-CzBR) conducted between research R- SGR. The data based on information collected in sample surveys include:

- generalized results of the sample survey conducted in individual farms,
- information obtained from the whole population of agricultural farms of legal persons and organizational units without legal personality.

As the data on fertilizer use does not cover the calendar year but the farming year (covering period since 1 July year x-1 up to 30 June year x), data for 2020 is established for farming year 2019/2020 etc. For farming year 2009/10 the data on fertilizers and tractors was compiled on the basis of the results of the Agricultural Census of 2010. The survey results are presented according to the seat of the farm user.

Since 2020 Statistics Poland started to publish data on mineral fertilizers use every 3 years [GUS R2 (2024)], therefore data for 2021, 2022 and 2024 were taken from [IFASTAT database] where historical data are, in general, in line with national statistics.

Present level of fertilizing is still lower than it was in 1988–1989. The drop of nitrogen fertilizers use in 1989–1992 amounted to 41% and gradually increased up to 2007 when exceeded 1 million tons. The year 2019 was the first year since 2007 when usage of mineral fertilizers drop below 1 million tons but again, in 2020 and 2021, slight increase above 1 million tons occurred. In 2022 certain decrease in N fertilizers use was observed, but in 2023 again N fertilizers use exceeded 1 million tons. Then in 2024 drop below 1 million tons of N fertilisers was noted (table 5.4.2).

As part of the Act on Fertilisers and Fertilisation, *inter alia*, the following measures are introduced: limitation of the natural fertiliser dose to 170 kg N/ha/year, a ban on the use of natural fertilisers from the end of November to the beginning of March and mandatory training for fertilizer service providers [NC8/BR5 POL 2022].

Table 5.4.2. Nitrogen fertilizers use (F_{SN}) in Poland [kt N]

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1 335	1 520	1 274	735	619	683	758	836	852	890	891	862
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
861	895	862	832	895	895	996	1 056	1 142	1095	1028	1091
2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1095	1179	1098	1004	1043	1151	1179	994	1034	1038	940	1040
2024											
949											

Nitrous oxide emissions amounted in 2024 about 14.9 kt N_2O . Generally trend in N_2O emissions follow nitrogen fertilizers use and range from the highest emissions with 23.9 kt N_2O in 1989 to the lowest emissions with 9.7 kt N in 1992.

Organic nitrogen fertilizers (F_{ON}) (CRT sector 3.D.a.2)

Organic nitrogen fertilisers cover both animal manure as well as sewage sludge applied to fields. The amount of nitrogen in **animal manure applied to soils** is calculated according to the method described in chapter 5.3.2.2. Following guidelines given in chapter 10.5.4 and using equation 10.34 [IPCC 2006], all nitrogen excreted on pasture, range and paddock as well as all nitrogen volatilised prior to final application to managed soils is subtracted from the total excreted manure. The amount of managed manure nitrogen that is lost in the manure management system is taken from table 10.23 [IPCC 2006] for particular livestock categories. Nitrogen from bedding material was taken into account in total Nitrogen applied to soils. Data related to Nitrogen added in straw was calculated in line with Ammonia emissions from manure management for straw based systems and amounts to: dairy cattle; 6 kg N/animal/yr., other cattle 2 kg N/animal/yr., fattening pigs: 0.8 kg N/animal/yr., sows 2.4 kg N/animal/yr., sheep and goats 0.08 kg N/animal/yr., horses 2 kg N/animal/yr. The fractions of animal manure burned for fuel, used for feed and fuel were neglected because these activities are not reported in Poland.

Here recommendation A.18 from review report FCCC/ARR/2020/POL was also implemented where updated Nex parameters for cattle and poultry were applied.

Nitrous oxide emissions from animal manure applied to soils in 2024 was about 6.4 kt N_2O . Trend of emissions is driven by trend of livestock population, mainly cattle and sheep after 1989, and changes in AWMS share. Here ERT 2018 and 2020 recommendation on update cattle and poultry Nex parameters for entire trend was implemented increasing N_2O emissions in this subsector.

Activity data on the amount of **sewage sludge applied on the fields** were taken from national statistics [GUS 2025d] and regards both - industrial and municipal sewage sludge applied in cultivation of all crops marketed, including crops designed to produce fodder as well as this applied in cultivation of plants intended for compost production. As the consistent reporting of data concerning application of sewage sludge in agriculture in the public statistics starts in 2003, the activities since 1988 were supplemented based on annual mean changes of AD in 2003–2009 where constant increasing trend was noted (fig. 5.4.3). Diminishing trend back to 1988 corresponds to the percentage of people using sewage treatment plants that ranges from 29% in 1988, through 50% in 1998, and 64% in 2009 and the number of municipal sewage treatment plants, which increased from 558 in 1988 up to 1923 in 1998 and 3153 in 2009 [GUS 2010d]. The growth of usage of sewage sludge for agriculture purposes stopped and stabilized after 2009 due to legal limitations and precise determination of parameters for sewage sludge used for specific purposes.

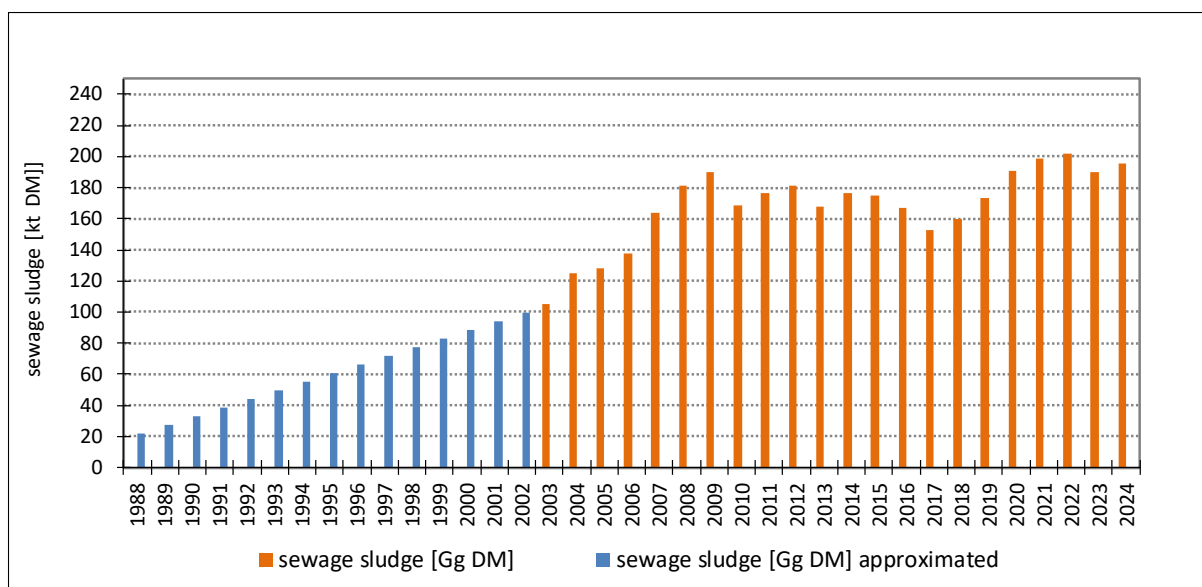


Figure 5.4.3. Amounts of sewage sludge applied in agriculture [kt DM]

The mean content of nitrogen in sewage sludge was taken as 2.61% from publication [Siebielec, Stuczyński 2008] where analysis of nitrogen content in domestic sewage sludge applied in agriculture was made. The study covered a group of 60 biosolids collected in 2001–2004 from 43 municipal sewage treatment plants. The same N content was assumed for both – municipal and industrial sewage sludge because majority of it applied in agriculture (about 76%) come from municipal treatment plants.

In Poland application of sewage sludge as fertilizer is relatively small, after increasing trend 2003–2009, certain stabilisation was noticed up 2017 and further growth thereafter. Emissions of N_2O for this subcategory amount to 0.08 kt N_2O in 2024.

No other organic fertilizers are reported in Statistics Poland to be used on soils, therefore notation key NO is applied in the category 3.D.1.b.iii in the CRT table 3.D.

Urine and dung deposited by grazing animals (F_{PRP}) (CRT sector 3.D.a.3)

Emission of N_2O resulting from animal urine and dung deposited on pastures by grazing livestock is calculated based on equation 11.5 [IPCC 2006] using: animal population (tables 5.2.2, 5.2.3), total amount of nitrogen in animal excreta (N_{ex}) estimated based on country specific parameters presented in tables 5.3.8 and 5.3.9 as well as data on fraction of manure related to grazing animals (table 5.3.2).

Here recommendation A.18 from review report FCCC/ARR/2020/POL was also implemented where updated N_{ex} parameters for cattle and poultry were applied.

Emissions in 2024 from pasture, range and paddock manure were 1.8 kt N_2O and stabilized since 2002. This value is much lower than in 1988 by about 68% what was caused by decreasing livestock population as well as decreasing percentage of livestock grazed.

Crop Residues (F_{CR}) (CRT sector 3.D.a.4)

N_2O emission from crop residue returned to soils was generally estimated based on modified equation 11.6 from [Corrigenda for the IPCC 2006 GLs]:

$$F_{CR} = \sum_T \{Crop_{(T)} * Area_{(T)} * Frac_{Renew(T)} * [R_{AG(T)} * N_{AG(T)} * (1 - Frac_{Burn(T)} - Frac_{Remove(T)}) + R_{BG(T)} * N_{BG(T)}]\}$$

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

$Crop_{(T)}$ = harvested annual dry matter yield for crop T , kg d.m./ha

$Area_{(T)}$ = total annual area harvested of crop T , ha/yr

$Frac_{Renew(T)}$ = fraction of total area under crop T that is renewed annually.

$R_{AG(T)}$ = ratio of above-ground residues dry matter ($AG_{DM(T)}$) to harvested yield for crop T ($Crop_{(T)}$), kg d.m./kg d.m.,

$N_{AG(T)}$ = N content of above-ground residues for crop T , kg N/kg d.m.,

$Frac_{Burn(T)}$ - fraction of crop residues burned as indicated in sector 3.F

$Frac_{Remove(T)}$ = fraction of above-ground residues of crop T removed annually for purposes such as feed, bedding and construction, kg N/kg crop-N

$R_{BG(T)}$ = ratio of below-ground residues to harvested yield for crop T , kg d.m./kg d.m.

$N_{BG(T)}$ = N content of below-ground residues for crop T , kg N/kg d.m.

T = crop or forage type

$R_{BG(T)}$ is calculated by multiplying R_{BG-BIO} in Table 11.2 by the ratio of total above-ground biomass to crop yield ($= [(AG_{DM(T)} * 1000 + Crop_{(T)}) / Crop_{(T)}]$), calculating $AG_{DM(T)}$ from the information in Table 11.2. Values of nitrogen content in below-ground residues for specific crops $N_{BG(T)}$ were taken from table 11.2 [IPCC 2006]. For permanent pastures and meadows, which are renewed on average every 20 years, $Frac_{Renew} = 1/20$. For annual crops $Frac_{Renew}$ was taken as 1.

Data on N content in the above-ground residues, ratio of above-ground residues in dry matter to harvested yield for crops, fraction of crops burned come from country studies [Łoboda 1994, IUNG 2012] where experimental and literature data as well as default emission factors were used and are given in table 5.5.1. Fraction of total above-ground crop biomass that is removed from the field as a crop product ($Frac_R$) were consulted with the Institute of Soil Science and Plant Cultivation – State Research Institute and is presented in table 5.4.3.

Table 5.4.3. Fraction of total above-ground crop biomass that is removed from the field as a crop product ($Frac_{Remove}$) according to crops/group of crops

crop	$Frac_{Remove}$	crop	$Frac_{Remove}$
wheat	0.70	sugar beet	0.25
rye	0.70	rape	0.10
barley	0.70	other oil-bearing	0.10
oats	0.70	flux straw	0.90
triticale	0.70	tobacco	0.65
cereal mixed	0.70	hop	0.01
millet & buckwheat	0.70	hey from pastures and meadows	0.95
maize	0.10	hey from pulses	0.95
pulses edible	0.10	hey from legumes	0.95
pulses feed	0.10	vegetables	0.10
potatoes	0.01		

Activity data concerning crop production for 2024 was taken from national statistics [GUS R10 2025] (table 5.4.1). The default emission factor of 0.01 kgN₂O-N/kg N [IPCC 2006, table 11.1] multiplied by 44/28 was used for estimating the N₂O emissions from N inputs from crop residues.

Emission from above- and belowground crop residues in 2024 was 7.2 kt N₂O and is lower by about 12% than in 1988 due to drop in area sown and crop production.

Mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM}) (CRT sector 3.D.a.5)

In response to question obtained during ERT 2020 the additional analysis was made for this subcategory resulting in preparation of N₂O emission calculation for mineralization/immobilization processes associated with loss/gain of soil organic matter for cropland remaining cropland.

As there are no relevant country specific EFs on nitrogen mineralized in mineral soils on cropland as a result of loss of soil C through change in land use or management practices the reported assessment is based on application of default EF and relevant country specific activity data on cropland remaining cropland area reported in 4B category. For the purpose of the assessment, default value of 10 for C:N ratio has been used in this particular situation to estimate potential emissions. Furthermore, the value of 0.01 kg N₂O-N/kg N has been applied for EF1 for N mineralised from mineral soil as a result of loss of soil carbon [IPCC 2006, Tab. 11.1].

N₂O emissions associated with mineralization process taking place in mineral soils related to loss of soil C from soil organic matter are insignificant – from 0.5 kt (1988) to 0.2 kt (2024).

Cultivation of organic soils (F_{OS}) (CRT sector 3.D.a.6)

Following recommendation A.19 from the review report FCCC/ARR/2018/POL the area of cultivated organic soils was updated and unified [Wależak et al, 2020]. The main basis for establishing histosols area under this Submission was the project *Spatial Information System on Wetlands in Poland* (GIS Mokradla) elaborated in 2004–2006 by the Institute of Technology and Life Sciences. Here vector layers were identified with organic soils and associated with Corine Land Cover maps published for: 1990, 2000, 2006, 2012 and 2018. The land cover classes were divided into IPCC classification where cropland and grassland in Agriculture sector were taken into account. Data between years covered by CLC were interpolated, data for 1988-1989 were extrapolated based on changes after 1990. Generally organic soils area under agricultural use decreases: cropland by 1% and grassland by 4% in 1988–2024 (fig. 5.4.4).

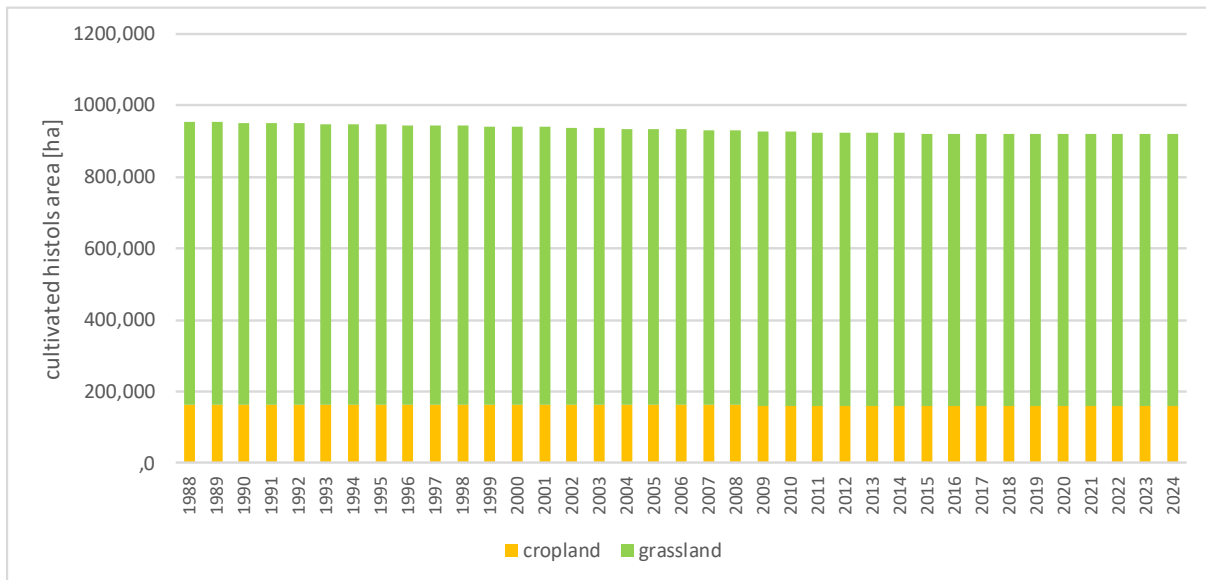


Figure 5.4.4. Area of cultivated histosols under cropland and grassland

The default emission factor of 8 kgN₂O-N/kg N [IPCC 2006, Chapter 11, table 11.1] is applied. Nitrous oxide emissions from cultivated histosols for agricultural purposes in Poland in 2024 was about 11.6 kt N₂O and fell since 1988 by 3.5% because of continuous drop in usage of histosols for agricultural purposes.

5.4.2.2. Indirect N₂O emissions from managed soils (CRT sector 3.D.b)

Atmospheric deposition (CRT sector 3.D.b.1)

Indirect emissions of N₂O from atmospheric deposition of N volatilised were assessed using equation 11.9 [IPCC 2006]:

$$N_{2O(ATD)} - N = [(F_{SN} * Frac_{GASF}) + ((F_{ON} + F_{PRP}) * Frac_{GASM})] * EF_4$$

where:

N_{2O(ATD)}-N – annual amount of N₂O-N produced from atmospheric deposition of N volatilised from managed soils (kg N₂O-N/year),

F_{SN} - annual amount of synthetic N fertilizer applied to soils (kg N/year),

F_{ON} - annual amount of organic N fertilizer applied to soils (animal manure and sewage sludge nitrogen) (kg N/year),

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N/year),

Frac_{GASF} - fraction of synthetic fertilizer that volatilises as NH₃ and NO_x (kg of N applied),

Frac_{GASM} - fraction of organic fertilizer materials that volatilises as NH₃ and NO_x (kg of N applied),

EF₄ - emission factor for N₂O emissions from atmospheric deposition of N on soils and water surfaces (kg N-N₂O).

Nitrogen amounts from synthetic fertilizers as well as from organic additions to soils (livestock manure and sewage sludge) correspond to values presented in chapter 5.4.2.1. Parameters characterising Frac_{GASF} and Frac_{GASM} are taken from table 11.3 [IPCC 2006] and amount respectively: 0.1 kg NH₃-N+NO_x-N/kg N applied and 0.2 kg NH₃-N+NO_x-N/kg N applied. Also the default emission factor EF₄ [IPCC 2006, table 11.3] is used amounting to 0.01 kg N₂O-N (kg

NH₃-N+NO_x-N volatilised).

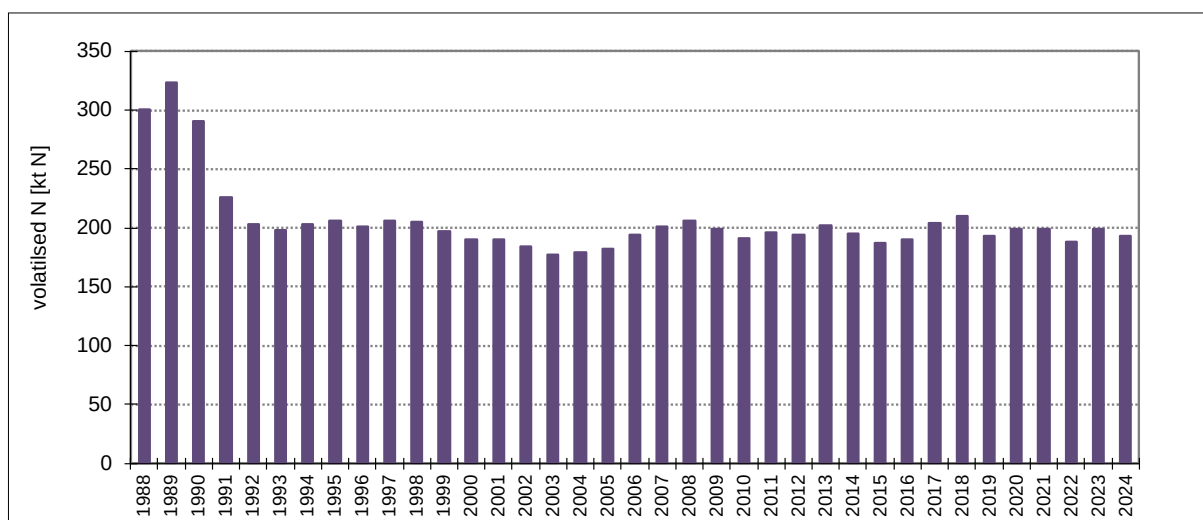


Figure 5.4.5. Volatized nitrogen from synthetic and organic fertilizers applied to soils

Trend of volatilised Nitrogen since 1988 is given at Figure 5.4.5. Here recommendation A.18 from review report FCCC/ARR/2020/POL was also implemented where updated Nex parameters for cattle and poultry were applied.

Nitrogen leaching and run-off (CRT sector 3.D.b.2)

Indirect emissions of N₂O from leaching and runoff of N from soils were assessed using equation 11.10 [IPCC 2006]:

$$N_2O_{(L)-N} = (F_{SN} + F_{ON} + F_{PRP} + F_{CR} + F_{SOM}) * Fra_{CLEACH-(H)} * EF_5$$

where:

N₂O_{(L)-N} – annual amount of N₂O-N produced from leaching and runoff of N additions to managed soils (kg N₂O-N/year),

F_{SN} = annual amount of synthetic fertiliser N applied to soils (kg N/year),

F_{ON} = annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils (kg N/year),

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N/year),

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 (kg N/year),

F_{SOM} = annual amount of N in mineral soils that is mineralised, in association with loss of soil C from soil organic matter as a result of changes of land use or management (kg N/year),

Fra_{CLEACH-(H)} - fraction of all N added to/mineralised in managed soils (kg N / kg of N additions),

EF₅ – emission factor for N₂O emissions from N leaching and runoff (kg N₂O-N).

Nitrogen additions to soils correspond to values presented in chapter 5.4.2.1. Fra_{CLEACH-(H)} equals 0.3 kg N/kg N added and is the default value taken from [IPCC 2006, table 11.3]. The default emission factor EF₅ equal 0.0075 kg N₂O-N/kg N leached and runoff was used for

calculation of N_2O -N emissions produced from leaching and runoff of N [IPCC 2006, table 11.3].

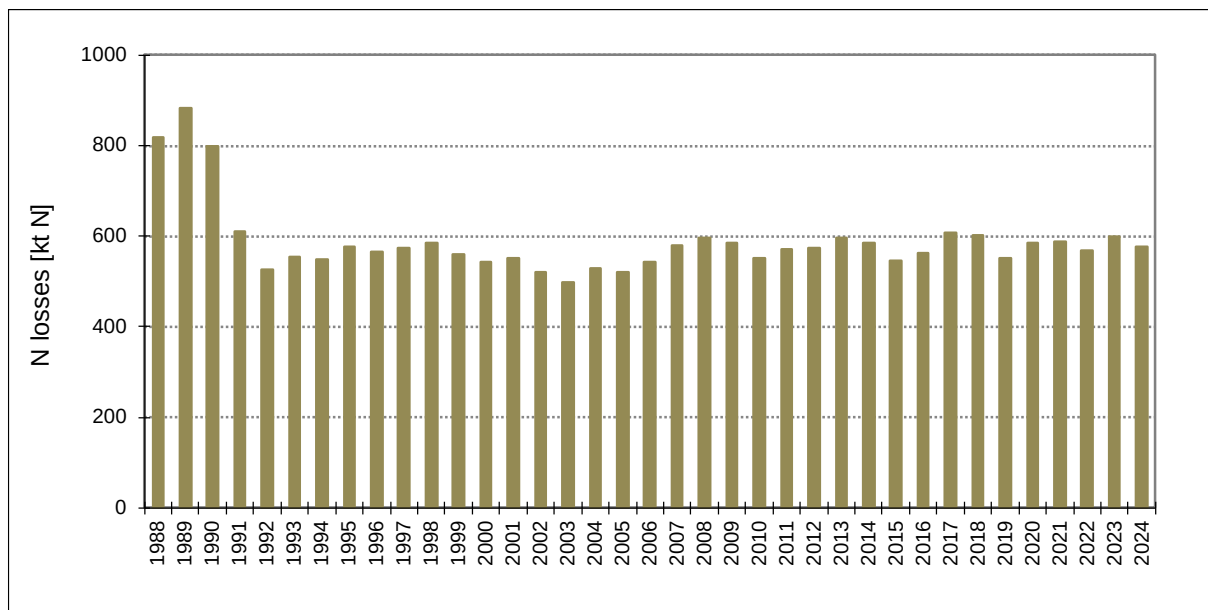


Figure 5.4.6. Nitrogen losses through leaching and runoff from nitrogen added to soils

Trend of Nitrogen losses through leaching and runoff since 1988 is given at Figure 5.4.6. Here recommendation A.7 from review report FCCC/ARR/2020/POL was also implemented where updated Nex parameters for cattle and poultry were applied.

Indirect emissions related to atmospheric deposition of nitrogen volatilised from managed soils amounted to 3.0 kt N_2O while those related to nitrogen leaching and runoff from managed soils amounted to 6.8 kt N_2O in 2024. The emissions trend since 1992 is rather stable after significant drop in 1989-1992 accompanying serious decrease in mineral fertilisers use as well as in animal population.

5.4.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 5.2.3.

5.4.4. Source-specific QA/QC and verification

Activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Statistics Poland (GUS). Overall final estimation of cereals and potatoes output was verified by means of simulative calculation of crops quantity according to the distribution of output between: sale, sowing/planting, fodder and self-consumption. Final estimation of sugar beets, rape and turnip rape, and some species of industrial crops were verified with procurement data for these crops. Estimation of fodder crops output in private farms, conducted by local experts of Statistics Poland, was additionally verified by the calculation of fodder crops according to the directions of their use. Total area of fodder crops comprises the area of meadows, pastures and field crops for fodder. This area does not include the area of cereals, potatoes, and other agricultural crops, a part of which was directly or indirectly used for fodder.

Emphasis was put on data consistency between sub-categories and between sectors using

agricultural data. Also emphasis on comparison and consistency is checked with the data applied in the UNECE CLRTAP and NECD reporting in Agriculture sector. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 4.

As a part of verification specific data related to agricultural soils are compared with other European countries. As the National Inventory Reports are elaborated by Parties in the same time, only data related to emission factors and other characteristics can be compared from previous reporting year.

Comparison of N₂O EFs among EU countries indicate that only Ireland, Netherlands and UK use country specific factors from inorganic and organic N fertilizers while rest of EU countries, including Poland, apply IPCC 2006 GLs default EFs.

5.4.5. Source-specific recalculations

- Update of fat content in milk for dairy cattle influencing Gross Energy, EF and Nex for 2021–2023
- Update of rabbit population based on national statistics since 2022 based on national statistics
- Update of horses population based on national statistics for 2023 based on national statistics
- AD update for certain crops for 2003–2023 based on national statistics
- Correction of cropland area used in N₂O emission assessment related to mineralisation/immobilization associated with loss/gain of soil organic matter for entire period (recommendation from EU review process in 2025)

Table 5.4.7. Changes in N₂O emissions from agricultural soils resulting from recalculations

Change	1988	1989	1990	1991	1992	1993	1994
kt	0.53	0.56	0.59	0.62	0.64	0.67	0.69
%	0.75%	0.74%	0.85%	1.10%	1.28%	1.30%	1.36%
Change	1995	1996	1997	1998	1999	2000	2001
kt	0.72	0.74	0.73	0.72	0.72	0.73	0.68
%	1.36%	1.43%	1.40%	1.37%	1.40%	1.47%	1.35%
Change	2002	2003	2004	2005	2006	2007	2008
kt	0.62	0.56	0.50	0.45	0.42	0.39	0.36
%	1.29%	1.20%	1.04%	0.92%	0.84%	0.74%	0.67%
Change	2009	2010	2011	2012	2013	2014	2015
kt	0.33	0.30	0.28	0.25	0.23	0.21	0.20
%	0.63%	0.60%	0.54%	0.49%	0.44%	0.41%	0.40%
Change	2016	2017	2018	2019	2020	2021	2022
kt	0.19	0.18	0.16	0.14	0.02	0.04	0.00
%	0.37%	0.33%	0.29%	0.28%	0.03%	0.08%	-0.01%
Change	2023						
kt	0.02						
%	0.04%						

5.4.6. Source-specific planned improvements

Presently no improvements are planned.

5.5. Field Burning of Agricultural Residues (CRT sector 3.F)

5.5.1. Source category description

Greenhouse gas emissions in 2024 from field burning of agricultural residues amounted to 1.06 kt CH₄ and 0.04 kt N₂O. The share of GHG emissions from field burning of agricultural residues in total agricultural emissions is 0.1%. The trend of GHG emissions within this category is presented on figure 5.5.1 and fluctuates following the annual crop production.

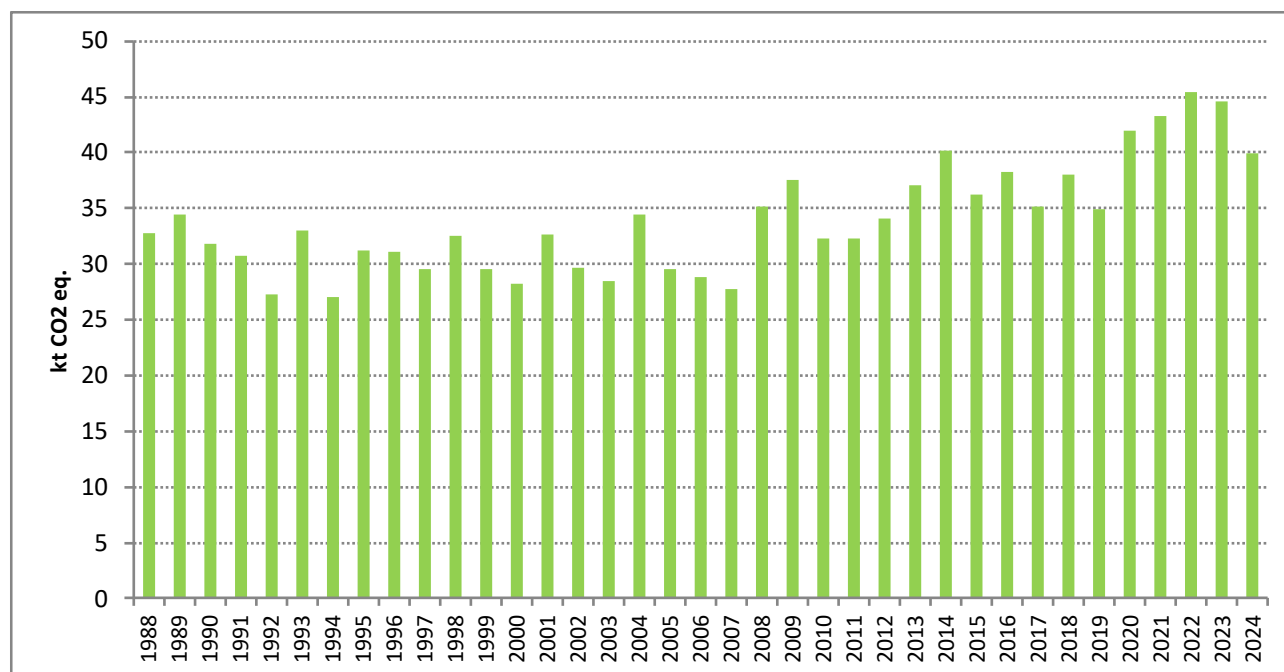


Figure 5.5.1. CH₄ and N₂O emissions from field burning of agricultural residues presented as CO₂ equivalent

5.5.2. Methodological issues

While estimating GHG emissions in this subcategory only methane and nitrous oxide are taken into account assuming that carbon dioxide released during burning of crop residues is reabsorbed back by plants.

Estimation of CH₄ and N₂O emissions from burning of agricultural residues in fields is still based on the IPCC methodology as published in 1997. This method is more detail and covers specific crops burned, than the method described in IPCC 2006 GLs (Chapters 2.4 and 5.2.4). These parameters and emissions are also consistent with calculations made for category 3.1.a.4 Crop residues retained to soils.

For domestic purposes 43 crops were selected for which residues can potentially be burned [Łoboda et al 1994]. Within this group certain plants were excluded for which residues can be composted or used as forage. So finally there were selected 38 crops which were then aggregated into 32 groups containing cereals, pulses, tuber and root, oil-bearing plants, vegetables and fruits potentially could be burned on fields.

Activity data on crop production comes from public statistics [GUS R10 2025]. Factors applied for emissions calculation were taken from country studies [Łoboda 1994, IUNG 2012] where experimental and literature data as well as default emission factors were used. Production of main crops is presented in the table 5.4.1.

Table 5.5.1. Selected crop residue statistics employed in GHG estimation from field burning of agriculture residues (3.F) and direct soil emissions related to crop residues returned to soils (3.D.a.4)

Crops	Residue to crop ratio	Dry matter fraction	Fraction burned in fields	Fraction oxidized	Carbon fraction of residue	Nitrogen fraction of residue
winter wheat	0.90	0.85	0.005	0.90	0.4853	0.0068
spring wheat	0.85	0.85	0.005	0.90	0.4853	0.0068
rye	1.40	0.86	0.005	0.90	0.4800	0.0053
spring barley	0.80	0.86	0.005	0.90	0.4567	0.0069
oats	1.10	0.86	0.004	0.90	0.4700	0.0075
triticale	1.10	0.86	0.005	0.90	0.4853	0.0063
cereal mixed	0.90	0.86	0.004	0.90	0.4730	0.0071
buckwheat & millet	1.70	0.86	0.002	0.90	0.4500	0.0090
maize	1.30	0.52	0.002	0.90	0.4709	0.0094
edible pulses	0.90	0.86	0.001	0.90	0.4500	0.0180
feed pulses	1.30	0.85	0.001	0.90	0.4500	0.0203
potatoes	0.10	0.25	0.100	0.85	0.4226	0.0203
rape	1.20	0.87	0.030	0.90	0.4500	0.0068
other oil-bearing crops	3.50	0.87	0.030	0.90	0.4500	0.0068
flax straw	0.25	0.86	0.001	0.90	0.4500	0.0072
tobacco	1.25	0.50	0.002	0.85	0.4500	0.0180
hop	4.00	0.25	0.020	0.90	0.4500	0.0158
hay from greenland	0.05	0.23	0.001	0.90	0.4500	0.0198
hay from pulses	0.05	0.23	0.001	0.90	0.4500	0.0203
hay from clover and lucerne	0.05	0.23	0.001	0.90	0.4500	0.0275
tomatoes	0.60	0.16	0.050	0.85	0.4500	0.0225
other ground vegetables	0.35	0.15	0.010	0.90	0.4500	0.0248
vegetables under cover	0.40	0.35	0.010	0.90	0.4500	0.0270
apples	1.50	0.35	0.050	0.90	0.4500	0.0275
pears and other fruits	1.50	0.35	0.070	0.90	0.4500	0.0149
plums	1.50	0.35	0.100	0.90	0.4500	0.0149
cherries	1.50	0.35	0.100	0.90	0.4500	0.0149
sweet cherries	1.50	0.35	0.100	0.90	0.4500	0.0149
strawberries	0.50	0.18	0.010	0.90	0.4500	0.0149
raspberries	1.20	0.30	0.250	0.90	0.4500	0.0248
currants	1.20	0.30	0.250	0.90	0.4500	0.0149
gooseberries and other berries	1.20	0.30	0.250	0.90	0.4500	0.0149

5.5.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 5.2.3.

5.5.4. Source-specific QA/QC and verification

Activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Statistics Poland (GUS). Overall final estimation of cereals and potatoes output was verified by means of simulative calculation of crops quantity according to the distribution of output between: sale, sowing/planting, fodder and self consumption. Final estimation of sugar beets, rape and turnip rape, and some species of industrial crops were verified with procurement data for these crops. Estimation of fodder crops output in private farms, conducted by local experts of Statistics Poland (GUS), was additionally verified by the calculation of fodder crops according to the directions of their use. Total area of fodder crops comprises the area of meadows, pastures and field crops for fodder. This area does not include the area of cereals, potatoes, and other agricultural crops, a part of which was directly or indirectly used for fodder.

Emphasis was put on data consistency between sub-categories and between sectors using

agricultural data. Also emphasis on comparison and consistency is checked with the data applied in the UNECE CLRTAP and NECD reporting in Agriculture sector. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 4.

Field burning of agricultural residues is reported only by few European countries, in most of countries legal ban is introduced. In Poland also certain legal limitations are obligatory related to areas and time of residues burning but some potential activity can occur.

5.5.5. Source-specific recalculations

Insignificant recalculations were made resulting from AD update for certain crops for 2003–2023 based on national statistics

5.5.6. Source-specific planned improvements

No improvements are planned presently.

5.6. CO₂ emissions from liming, urea and other carbon-content fertilizers use (CRT sectors 3.G–3.I)

5.6.1. Liming (CRT sector 3.G)

Emissions of carbon dioxide from limestone (CaCO₃) and dolomite (CaMg(CO₃)₂) application to agricultural soils in 2024 amounted to 553 kt CO₂ and 162 kt CO₂ respectively. Trend in CO₂ emissions of both fertilizers drop since 1988, in line with fertilizers use (Fig. 5.6.1), due to significant changes of agricultural farms after 1989 (see chapter 5.1) as well as current economic situation at rural market (prices of means of production vs. prices of agricultural goods).

The annual carbon emission from agricultural lime application is calculated with Tier 1 method using equation 11.12 and the default emission factors for carbon conversion of 0.12 and 0.13 for limestone and dolomite respectively [IPCC 2006]:

$$\text{CO}_2\text{-C Emission} = (M_{\text{limestone}} * EF_{\text{limestone}}) + (M_{\text{dolomite}} * EF_{\text{dolomite}})$$

where:

CO₂-C Emission – annual C emissions from lime application; t C/year

M_{limestone} – annual amount of calcic limestone (CaCO₃); t / year

M_{dolomite} – annual amount of dolomite (CaMg(CO₃)₂); t / year

EF_{limestone} – emission factor for limestone – 0.12 t C / t limestone

EF_{dolomite} – emission factor for dolomite – 0.13 t C / t dolomite

Activity data on use of lime fertilizers, in division for calcic limestone and dolomite, is generally available in national statistics on an annual basis in pure nutrient (CaO, CaO+MgO). As Statistics Poland started to report fertilizers use every 3 years since 2020, data from national statistics was used for 2020 and 2023 while data between those years were interpolated [GUS R2 2024]. As no data for 2024 were available, the same data were used as for 2023.

Based on country study [Radwański 2006b] it was established that application of oxides of lime occurs in Poland in limited amount, carbonate limes dominate (respectively 12% and 88%). As the oxides of lime do not contain inorganic carbon they are not included in calculations for CO₂ estimation from application to soils [Chapter 11.3.1 IPCC 2006].

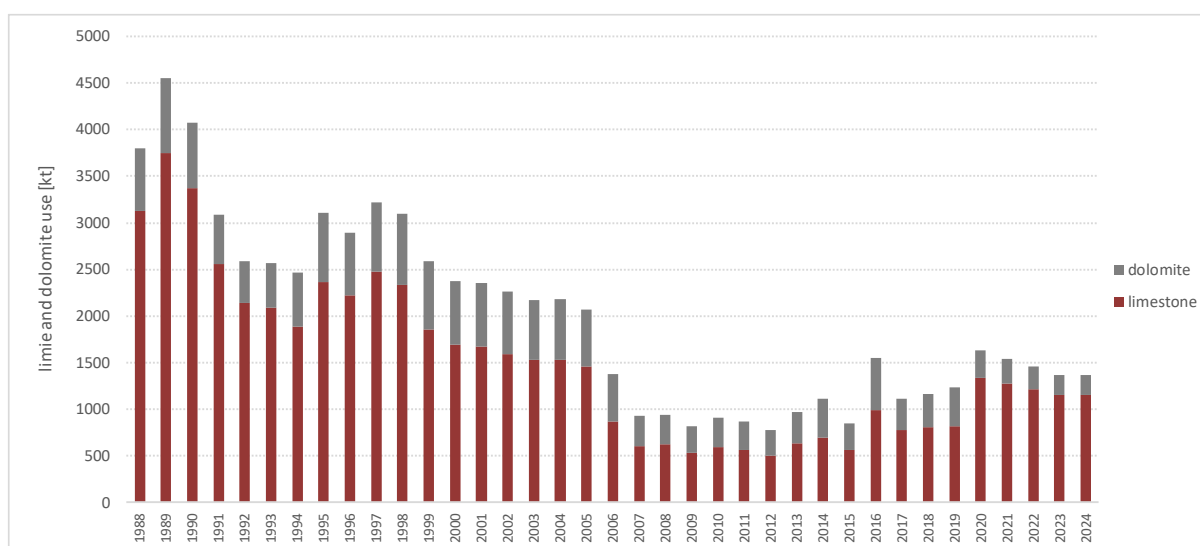


Fig. 5.6.1. Limestone and dolomite use in Poland

5.6.2. Urea fertilization (CRT sector 3.H)

Adding urea to soils during fertilisation leads to a loss of CO₂ that was fixed in the industrial production fertilizer process. Emissions related to this process in Poland amounted to 349 kt CO₂ in 2024 and drop since 1988 by 36%.

The annual carbon emission from urea application is calculated Tier 1 method using equation 11.13 [IPCC 2006]:

$$\text{CO}_2\text{-C Emission} = M * EF$$

where:

CO₂-C Emission – annual C emissions from urea application; t C/year

M – annual amount of urea fertilization; t urea/year

EF – emission factor; t C/t urea

Annual amount of urea used for application to soils is derived from IFA database (Tab. 5.6.1). Emission factor is the default one from the IPCC 2006 GLs: 0.20 t C/ t urea.

Table 5.6.1. Urea share in N fertilizers used in Poland

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
26.2%	27.1%	28.5%	18.9%	24.3%	21.1%	20.4%	20.9%	21.1%	18.7%	23.0%	28.7%
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
33.8%	24.8%	23.2%	24.1%	25.8%	28.0%	26.1%	27.0%	25.8%	27.1%	28.9%	29.1%
2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
29.4%	29.6%	29.1%	29.9%	29.1%	27.8%	26.6%	26.6%	24.5%	24.5%	23.4%	23.4%
2024											
16.3%											

It should be noted here that data for Poland published in the IFA database are shifted by one year comparing to the data published in Eurostat and used in the inventory what is related to the fact that fertilizers are published in national statistics for farming years. It means that in the IFA database amount of N fertilizer published as 2019 are those published by national statistics for 2019/2020 farming year while in Eurostat data assigned for 2019 are those from 2018/2019.

5.6.3. Other carbon-containing fertilizers (CRT sector 3.I)

CO₂ emissions from calcium ammonium nitrate (CAN) use amounted to about 123 kt CO₂ in 2024 and were lower by about 44% than in 1988.

The use of CAN in Poland is based on data published at [IFA database] and presented in the Table 5.6.2. It has been confirmed that data on CAN use is collected and reported separately from other carbonate fertilizers in the national statistics.

The annual carbon emission from CAN use is calculated with Tier 1 method using equation 11.12 and the default emission factor based on carbonate carbon contents of CaCO₃ as 12% (the same as for limestone) according to [IPCC 2006, Chapter 11.3.1]:

$$\text{CO}_2\text{-C Emission} = M * EF$$

where:

CO₂-C Emission – annual C emissions from CAN application; t C/year

M – annual amount of CAN expressed in CaCO₃; t/year

EF – emission factor as for limestone – 0.12 t C/t CaCO₃

Table 5.6.2. CAN use in Poland [kt N]

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
138.3	165.4	150.3	98.4	78.2	104.0	131.0	153.0	165.0	166.3	191.5	234.3
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
188.9	147.7	160.7	170.0	161.5	160.5	165.0	182.0	180.0	172.1	167.0	200.2
2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
189.9	200.8	190.1	167.9	174.0	189.9	170.0	117.0	90.0	90.3	70.0	77.4
2024											
78.0											

5.6.4. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 5.2.3.

5.6.5. Source-specific QA/QC and verification

Description is given in Chapter 5.2.4.

5.6.6. Source-specific recalculations

- No recalculations were made in this category

5.6.7. Source-specific planned improvements

Presently no improvements are planned.

6. Land use, land use change and forestry (CRT sector 4)

6.1. Overview of sector

The greenhouse gas inventory of the Land Use, Land Use Change and Forestry (LULUCF) sector covers all CO₂ emissions and removals related to gains and losses in the relevant carbon pools of the predefined six land-use categories, as well as non-CO₂ emissions from biomass burning and disturbance associated with land-use conversions. It should be noted that a number of factors used in the estimations of GHG's assumes default values (recommended by the IPCC). Those factors are subject to modification on the basis of in-country analysis.

According to the report of IPCC meeting report (Expert Meeting on Revisiting the Use of Managed Land as a Proxy for Estimating National Anthropogenic Emissions and Removals, 5-7 May 2009, Sao Paulo, Brazil), there are currently no scientifically sound methods to separate out indirect and natural GHG emissions and removal (IPCC, 2010). On the other hand, this is not necessarily needed if appropriate proxies are used. The above mentioned meeting, among others, stated that, although not perfect, the currently applied proxy, i.e. the so called "managed land" proxy is one that approximates the effects of direct human induced activities. We also note that this separation is taken care of by the various steps of the accounting, thus, no additional separation is necessary, and we have indeed not have done any.

Data included in this inventory is based on statistical data presented in statistical journals published by the Statistics Poland. The data relating to the land area by the type of land use (in accordance with the methodology recommended by IPCC 2006) is based on data on the condition and changes in the registered the Minister of Agriculture and Food Economy 17 December 1996 on intended use of land were developed on the basis of annual reports on land, introduced in the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of register of land and buildings (O. J. No. 158, item 813), from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454) from 2021 of the Minister of Development, Labour and technology of 30 July 2021 on register of land and buildings (O. J. No. 2021, item 1390).

Amendments to the regulations introduced changes in land classifications. Subsequent changes were implemented inter alia due to adoption of the international standards. Beginning with data for 1997 on, the registers of land were prepared by the Head Office of Geodesy and Cartography as well as voivodship branches of geodesy and land management. The data are presented, taking into consideration of cadastral units area. Available activity data and methodologies did not allow the exclusions of indirect and natural GHG emissions from the present estimation of anthropogenic GHG emissions for the relevant activities.

6.1.1. The greenhouse gas inventory overview of the Land Use, Land-Use Change and Forestry (LULUCF) sector

The greenhouse gas inventory of LULUCF sector comprises emissions and removals of CO₂ due to overall carbon gains or losses in the relevant carbon pools of the predefined six land-use categories. These activities in 2024 altogether resulted in net removals estimated to be equal to 24 623 kt of CO₂ equivalent. The description of the methodological details in the

subsequent sections follows the structure of the national inventory reports as outlined in the Appendix to Annex I (Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories) of Decision 24/CP.19 (Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention).

In estimating emissions and removals, the IPCC 2006 Guidelines have been applied as a methodological basis since 2016 inventory. In general, we apply Tier 2 methodology with country specific data where relevant data became accessible. We also apply “best estimates”, i.e. we have made use of all data and information that exist within the country in relation to the forest GHG inventory. In all other cases, we refer to the source of the data applied (i.e., the 2006 IPCC GL).

Table 6.1. Sectoral estimates for LULUCF

Greenhouse gas source and sink categories	Net CO ₂ emissions/removals	CH ₄	N ₂ O
	(kt)		
LULUCF total	-27 627.82	0.40	11.30
A. Forest land	-35 447.94	0.36	0.57
1. Forest land remaining forest land	-32 019.58	0.35	0.02
2. Land converted to forest land	-3 428.36	0.01	0.55
B. Cropland	-3 290.71	NA,NO	0.11
1. Cropland remaining cropland	-4 040.80	NA,NO	NO
2. Land converted to cropland	750.09	NA,NO	0.11
C. Grassland	783.46	0.04	0.00
1. Grassland remaining grassland	1 019.41	0.04	0.00
2. Land converted to grassland	-235.96	NA,NO	NA,NO
D. Wetlands	1 332.96	NA,NO	0.02
1. Wetlands remaining wetlands	13.93	NA,NO	0.02
2. Land converted to wetlands	1 319.03	NA,NO	NA,NO
E. Settlements	12 778.59	NO	8.37
1. Settlements remaining settlements	-177.79	NO	NO
2. Land converted to settlements	12 956.38	NO	8.37
F. Other land	NA,NO	NO	NO
1. Other land remaining other land	NA	NA	NA
2. Land converted to other land	NA	NA	NA
G. Harvested wood products	-3 784.17	NA	NA
H. Other	NA	NA	NA
(I). Indirect N ₂ O	NA	NA	2.22

The most important category recognised to be the main source of CO₂ removals is 4.A *Forest land*. This situation is, to some extent, related to the recorded growth of timber resources. It shall be noted that the recorded growth is the result of timber harvest carried out in accordance with the forest sustainability principle and furthermore persistent enlargement of the forest area. Most removals are generated by biomass increment in the *Forest Land remaining Forest Land* and the *Land converted to Forest Land* categories. The net sink in these categories is mainly due to the fact that the gross increment of the growing stock in forest lands has always been observed to exceed the annual harvest.

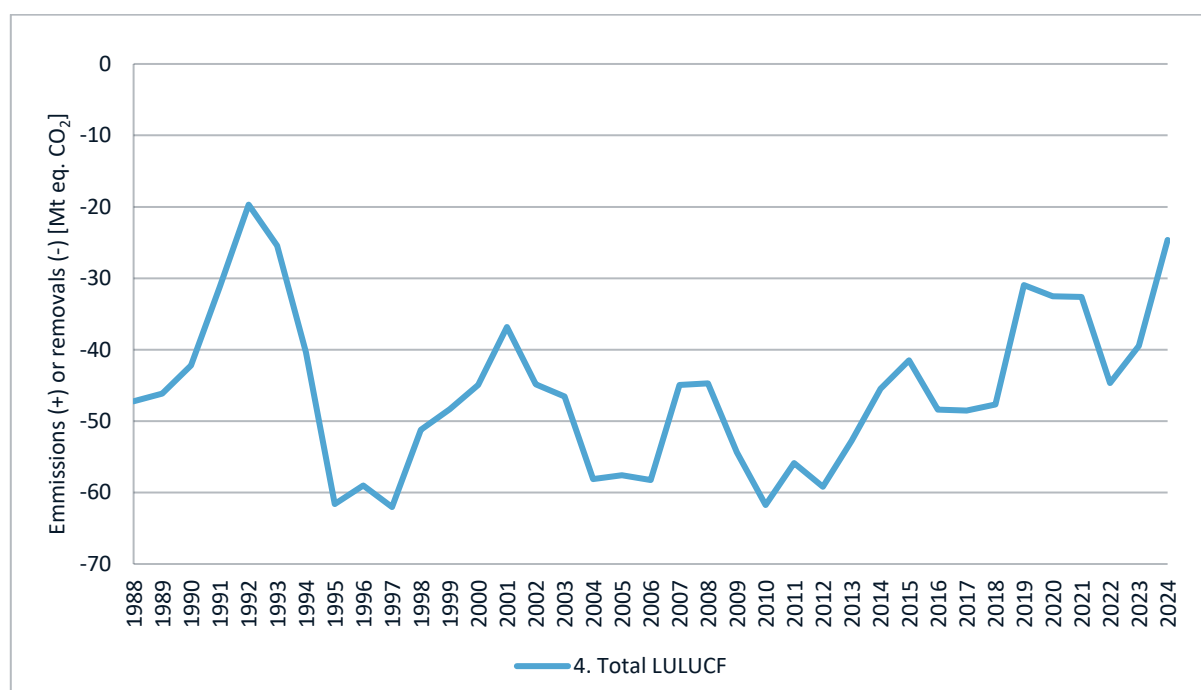


Figure 6.1. Trends in emissions/removals from the LULUCF sector by land-use

In this submission, Poland reports on carbon stock changes as well as greenhouse gas emissions and removals from *Forest Land* (CRT 4.A), *Cropland* (CRT 4.B), *Grassland* (CRT 4.C), *Wetland* (CRT 4.D) and *Settlements* (CRT 4.E). N₂O emissions from N in mineral soils that is mineralized/immobilized in association with loss of soil C are reported in CRT Table 3.D for Cropland remaining Croplands. CRT Table 4(III) reports N₂O emissions for all other land use and land use change categories associated with gain of organic matter resulting from change of land use or management of mineral soils. N₂O emissions from fertilization in Wetlands (CRT 4(I)) do not occur in Poland; N₂O emissions from fertilization in other land use categories, where relevant, are reported under the *Agriculture* sector (CRT 3). In addition, CO₂ emissions from liming are reported in CRT table 3G, whereas CO, CH₄, N₂O and NO_x emissions from biomass burning are reported in CRT table 4(V).

6.1.2. Country area balance

Table 6.2. Country area balance in 2024

Greenhouse gas source and sink categories	Area [ha]
4. Total land-use categories	31 393 298
4.A. forest land	9 471 605
4.A.1. forest land remaining forest land	9 052 046
4.A.2. land converted to forest land	419 559
total organic soils on forest land, of which:	342 094
on forest land remaining forest land	316 337
on land converted to forest land	25 758
4.B. cropland	13 710 326
4.B.1. cropland remaining cropland	13 536 632
4.B.2. land converted to cropland	173 694
total organic soils on cropland, of which:	342 094
on cropland remaining cropland	316 337
on land converted to cropland	25 758
4.C. grassland	4 208 423
4.C.1. grassland remaining grassland	3 861 231
4.C.2. land converted to grassland	347 192
total organic soils on grassland, of which:	787 233

Greenhouse gas source and sink categories	Area [ha]
on grassland remaining grassland	760 740
on land converted to grassland	26 493
4.D. wetlands	1 472 320
4.D.1. wetlands remaining wetlands	1 429 046
4.D.2. land converted to wetlands	43 274
total organic soils on wetland, of which:	56 310
on wetlands remaining wetlands	13 036
on land converted to wetlands	43 274
4.E. settlements	2 446 039
4.E.1. settlements remaining settlements	1 926 427
4.E.2. land converted to settlements	519 612
total organic soils on settlements, of which:	12 881
on settlements remaining settlements	9 135
on land converted to settlements	3 747
4.F. other land	84 585
4.F.1. other land remaining other land	NO
4.F.2. land converted to other land	84 585
total organic soils on other land, of which:	NO
on other land remaining other land	NO
on land converted to other land	NO
Country area balance	31 393 298

Land-use transition matrices (implementing approach 2 methodological assumptions) are included in the Annex 5.8. LUC matrices have been resolved to minimise inconsistencies as far as they can with the available datasets. Because several different data sources have been combined it has not been possible to reduce all inconsistencies to zero, but the variation is very small difference between the sum of all changes and the overall category totals to ensure that the sum of categories consistently adds up to the recently reported total area of Poland.

6.1.3. Land uses classification for representing LULUCF areas

For the reporting purposes to the United Nations Framework Convention on Climate Change it is recommended to assign national land-use categories (as specified in the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings (*Journal of Laws 2013 pos. 1551*)) to the appropriate categories of land use consistently to the IPCC guidelines (Chapter 3.3.1. of IPCC 2006 Guidelines of the Volume 4). Considering this good practice, the available data were summarized based on the assessment provided in Table 6.3.

Table 6.3. Land use classification

IPCC category	National Land Identification System
4.A Forest land	forest land
4.B Cropland	arable land, orchards
4.C Grassland	permanent meadows and pastures; woody and bushy land
4.D Wetland	land under waters (marine internal, surface stands); land under ponds; land under ditches; ecological arable land; wasteland
4.E Settlements	agricultural build-up areas; build-up and urbanized areas
4.F Other land	miscellaneous land

Domestic land statistics are covered with the statistical surveys program of official statistics (more information is available at: <https://bip.stat.gov.pl/dzialalnosc-statystyki-publicznej/program-badan-statystycznych/pbssp-2023/>). Land statistics are characterized mainly by the PBSSS statistical survey No 1.01.02(002) Resources and changes in land use, land threats and protection. As a matter of the scope land statistics covers full land use assessment

taking into consideration cadastral (geodesic) area of the country by land use in particular years. We would like to note that the reported total area of all land use categories is equal to the total official land area of Poland as published by the annual land-use statistics (i.e. 31,393, 298ha). To avoid any inconsistencies in the reported times series, the latest of the annually published total area is reported for each inventory year in the GHG inventory. Furthermore, land statistics covers also net losses or gains in the area of specific land-use categories/activities and what these conversions represent (i.e., changes both from and to a category).

These conversions, such as data on agricultural land designated for non-agricultural uses and forest land designated for non-forest and non-agricultural purposes, are used to prepare the LULUCF matrix. Annual land use and land use change data for Poland incorporate elements of all available approaches (Approaches 1, 2, and 3). The identification of IPCC land-use categories—derived from Polish statistical categories and primary data sources (including the corresponding Approach)—is presented in the following table.

Table 6.4. Approaches applied in preparation of LUC matrix

IPCC category	Data source	Associated IPCC approach
4.A Forest land	Land-use statistics, Land and Building Register (EGiB), Forest data bank, Spatial Information System on Wetlands in Poland (complemented by CLC-change 1990-2000; CLC-change 2000-2006, CLC-change 2006-2012; CLC change 2012-2018)	Approach 2/3
4.B Cropland	Land-use statistics; Land and Building Register (EGiB), Land and Parcel Identification System (LPIS); Spatial Information System on Wetlands in Poland (complemented by CLC-change 1990-2000; CLC-change 2000-2006, CLC-change 2006-2012; CLC change 2012-2018)	Approach 2/3
4.C Grassland	Land-use statistics; Land and Building Register (EGiB), Land and Parcel Identification System (LPIS); Spatial Information System on Wetlands in Poland (complemented by CLC-change 1990-2000; CLC-change 2000-2006, CLC-change 2006-2012; CLC change 2012-2018)	Approach 2/3
4.D Wetland	Land-use statistics; Land and Building Register (EGiB), Spatial Information System on Wetlands in Poland (complemented by CLC-change 1990-2000; CLC-change 2000-2006, CLC-change 2006-2012; CLC change 2012-2018)	Approach 2/3
4.E Settlements	Land-use statistics; Land and Building Register (EGiB), Spatial Information System on Wetlands in Poland (complemented by CLC-change 1990-2000; CLC-change 2000-2006, CLC-change 2006-2012; CLC change 2012-2018)	Approach 1/2/3
4.F Other land	Land-use statistics ; Land and Building Register (EGiB), Spatial Information System on Wetlands in Poland (complemented by CLC-change 1990-2000; CLC-change 2000-2006, CLC-change 2006-2012; CLC change 2012-2018)	Approach 1/2/3

In order to develop the most accurate overall area estimates for the entire AFOLU sector, the statistical sources on the various land use/change categories/activities were treated hierarchically during the compilation of land use change matrices. Since the land statistics are regarded as the most accurate and are the most important for the overall accuracy in the LULUCF sector, the hierarchy of the available sources was established as follows:

- 1) land-use statistics;
- 2) domestic spatial data (Land and building register (EGiB))
- 3) forestry statistics;
- 4) Land and Parcel Identification System (LPIS);
- 5) external spatial data (e.g. CLC. BDOT 10k).

In terms of land use change matrices development starting with 1988, first, annual land use

changes were addressed based on available statistics (i.e. available information on LUC areas, such as data on areas of agricultural land designated for non-agricultural purposes and forest land designated for non-forest purposes). Land use changes statistics were assessed taking into account the land use status in Land and Building Register (EGIB). A hierarchical wall-to-wall land use layer was developed for this purpose.

Data from Statistics Poland (GUS) on land use is limited for 1968–1989. For Land Use Change (LUC) matrices, the latest available data was applied retroactively from 1968. Since late 2018, the Head Office of Geodesy and Cartography (GUGiK) has published land and building register data from poviats resources via public web services for use in state and commercial IT systems. The services concerned are:

1. KIEG - (National Integration of Land Records) a service providing the ability to generate a relevant layers of land and building records for any area of the country.
2. ULDK - (Cadastral Plot Location Service) a service for locating cadastral plots. It allows spatial location of the indicated plot based on its identifier, precinct name and plot number, or based on the X, Y coordinates of any point inside.

All technical details related to services can be found on the pages of these services, i.e.

- <https://integracja.gugik.gov.pl/cgi-bin/KrajowaIntegracjaEwidencjiGruntow>
- <https://uldk.gugik.gov.pl>

These land statistics are generally characterized by the PBSSP statistical survey No 1.01.02(002) Resources and changes in land use, land threats and protection.

Additionally, the CLC data sets, including statistics on land cover and spatial data from Spatial Information System on Wetlands (GIS Mokradła Polski) in Poland, had been compiled and applied to expand relevant activity data to the extend possible. For organic soils assessment, relevant areas were assigned to specific land uses when developing land use change matrices from 1988 onward. Initial periodic land use changes (covering 1992–2000, 2000–2006, 2006–2012, and 2012–2018) were estimated using CLC databases. Annual land use change values for organic soils were derived from periodic values via interpolation (up to 2018). For 1988 and 1989, values calculated for the 1990–2000 period were applied. Areas in land use change categories were determined assuming a default 20-year transition period for all outflows from remaining categories, during which converted areas undergo no further transitions. This approach allows assigning the area of organic soils (taken from GIS Mokradła Polski) to the relevant land use and land use change categories. Contextually, the judgement was based, mostly on Corine Land Cover (CLC) vector maps (with a scale of 1:100,000, a minimum cartographic unit (MCU) of 25 ha and Map of Wetlands and Grasslands and the Map of Poland's Hydrographic Division (both with a scale of 1:100,000). Therefore, the mapping homogeneous landscape patterns was possible. Also, in terms of CLC nomenclature a 3-level hierarchical classification system (44 classes) was utilised. For this judgement CLC land-cover categories were classified into IPCC land-use categories (forest land: 311, 312, 313, 324; cropland 211, 212, 213, 221, 222; grassland: 231, 321; settlements: 111, 112, 121, 122, 123, 124, 131, 132, 133, 141, 142; wetlands: 411, 412, 511, 512; other land: 331, 332, 333).

It should be noted that CLC land cover change data has not been used to assess land use changes. Recent attention has focused on the requirements in Part 3 of Annex V to EU Regulation 2018/1999 regarding its potential inclusion in GHG inventories.

6.1.4. Key categories

Key category assessment for LULUCF categories is included in annex 1.

6.2. Forest Land (CRT sector 4.A)

6.2.1. Source category description

Estimations for this subcategory were based on the IPCC methodology outlined in Chapter 4 of the IPCC 2006 Guidelines, Volume 4. As of 2024, the greenhouse gas (GHG) balance in this category is a net CO₂ sink, estimated to be equal to 35 287 CO₂ equivalent (CO₂ eq). The overall trend during the reporting period is illustrated in the graph below. Fluctuations and Trends

Considerable fluctuations observed in the early 1990s are attributed to natural disturbances, which significantly impacted the consistently increasing wood resources. Notably, data from 2019 to 2021 indicate a significant change in the dynamics of forest resource growth. This shift is driven by several factors, including:

- tree stand ageing affecting tree size, shape, biomass allocation, and consequently alters allometric relationships.
- the effects of natural disasters such as prolonged droughts since 2014 and hurricane winds in 2017 have had a considerable impact on carbon accumulation levels in forests.
- significant changes in the decomposition dynamics of dead wood have also influenced the annual levels of carbon accumulation.

The decomposition levels and overall structure of dead wood resources have been reflected in the estimation of carbon stock changes (CSC) within relevant carbon reservoirs. The methodology utilized for these estimations adheres to the principles established in the IPCC 2006 Guidelines, which emphasize accuracy and consistency in GHG inventory reporting. The guidelines provide comprehensive methods for estimating sources and sinks of GHGs across various land use categories, ensuring that countries can produce reliable estimates regardless of their resources or experience level.

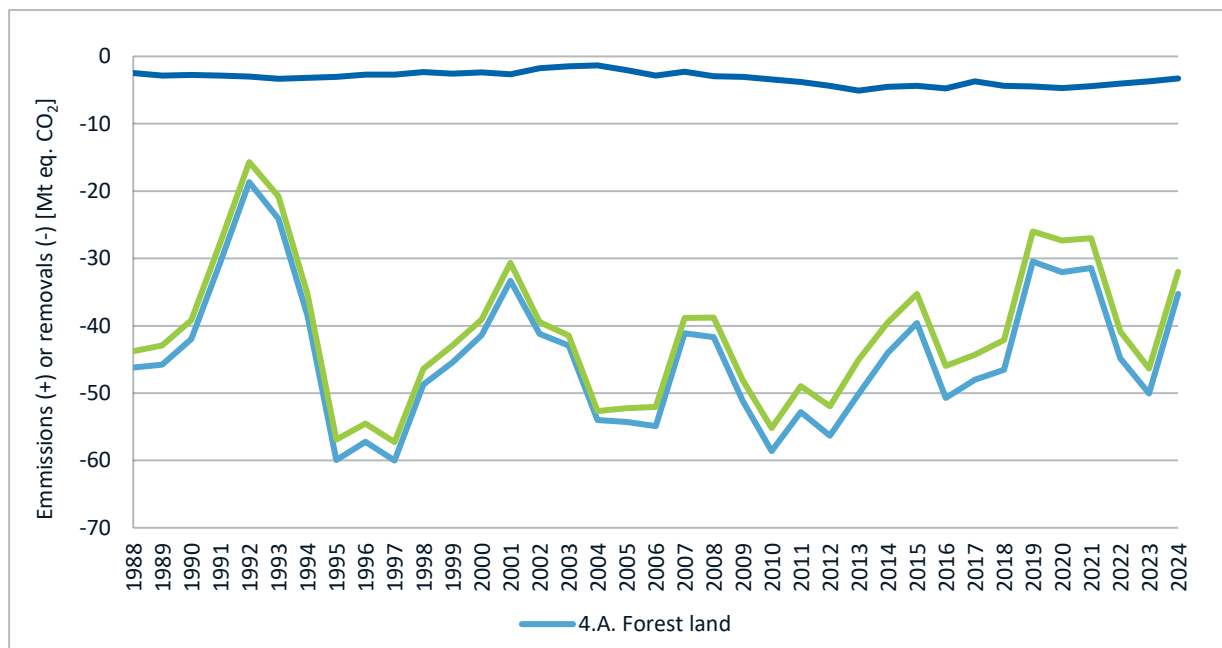


Figure 6.2. Trends in emissions/removals for the category 4.A. *Forest land*

Most removals are generated by biomass gains in the category *forest land remaining forest land (FL_FL)* and the *land converted to forest land (L-FL)* categories. The net sink in this category is mainly due to the fact that the forest area is continuously increasing, and that the

total increment of the growing stock in forest land has always been larger than the annual harvest for the last decades.

6.2.1.1. Area of forest land in Poland in year 2024

Forest land reported under subcategory 4.A is classified as a “forest” according to Art. 3 of *Act on Forests of 28 Sep 1991 (Journal of Law of 1991 No 101 item 444, as amended)*. This assessment is in line with internationally adopted standard which takes into account the forest land associated with forest management. Forest land area in Poland, as of 1 January 2024, was equal to 9,471,605 ha (*Statistics Poland; Environmental protection 2025*).

Table 6.5 Forest land (cadastral) area by provinces as of the 1st Jan (1/4)

No.	Voivodship	Unit	2008	2009	2010	2011	2012
1.	Dolnośląskie	[ha]	606 104	607 327	608 387	609 279	610 583
2.	Kujawsko-pomorskie	[ha]	425 207	426 170	427 147	427 843	428 254
3.	Lubelskie	[ha]	568 601	572 620	576 420	579 237	581 002
4.	Lubuskie	[ha]	706 788	707 583	708 201	709 002	709 881
5.	Łódzkie	[ha]	386 172	387 711	388 597	389 350	390 358
6.	Małopolskie	[ha]	439 126	438 280	439 765	440 114	440 432
7.	Mazowieckie	[ha]	802 158	804 912	808 810	812 973	817 869
8.	Opolskie	[ha]	257 858	258 170	258 246	258 399	258 570
9.	Podkarpackie	[ha]	671 363	674 450	677 953	680 166	683 371
10.	Podlaskie	[ha]	621 718	624 856	626 532	627 235	628 678
11.	Pomorskie	[ha]	676 165	677 673	678 226	679 898	681 014
12.	Śląskie	[ha]	400 709	399 592	399 954	401 747	402 014
13.	Świętokrzyskie	[ha]	331 492	332 089	332 487	332 980	402 364
14.	Warmińsko-mazurskie	[ha]	752 146	755 050	760 064	763 567	334 385
15.	Wielkopolskie	[ha]	778 863	780 795	783 340	784 649	785 648
16.	Zachodniopomorskie	[ha]	826 934	828 508	830 633	832 735	834 009
Total		[ha]	9 251 404	9 275 786	9 304 762	9 329 174	9 353 731

Table 6.5 Forest land area by provinces as of the end of inventory year (2/4)

No.	Voivodship	Unit	2013	2014	2015	2017	2018
1.	Dolnośląskie	[ha]	610 968	611 562	611 919	612 305	612 893
2.	Kujawsko-pomorskie	[ha]	428 491	428 772	429 045	429 605	429 953
3.	Lubelskie	[ha]	582 307	583 447	584 477	573 550	586 630
4.	Lubuskie	[ha]	710 350	710 858	711 077	711 424	711 666
5.	Łódzkie	[ha]	390 950	391 259	391 722	372 238	392 880
6.	Małopolskie	[ha]	440 664	440 672	440 683	440 846	440 942
7.	Mazowieckie	[ha]	824 660	828 607	835 112	836 080	836 789
8.	Opolskie	[ha]	258 846	258 982	259 139	258 932	259 270
9.	Podkarpackie	[ha]	683 462	685 002	686 848	687 992	689 055
10.	Podlaskie	[ha]	629 184	630 047	630 622	631 277	632 106
11.	Pomorskie	[ha]	681 537	682 244	682 783	683 461	684 089
12.	Śląskie	[ha]	402 307	402 989	403 341	403 765	404 096
13.	Świętokrzyskie	[ha]	334 796	335 083	335 277	335 770	336 315
14.	Warmińsko-mazurskie	[ha]	769 824	771 463	774 906	777 517	780 690
15.	Wielkopolskie	[ha]	785 998	786 497	786 015	786 783	787 065
16.	Zachodniopomorskie	[ha]	834 760	835 094	833 205	840 435	841 291
Total		[ha]	9 369 403	9 382 578	9 395 171	9 381 979	9 425 730

Table 6.5 Forest land area by provinces as of the end of inventory year (3/4)

No.	Voivodship	Unit	2019	2020	2021	2022	2023
1.	Dolnośląskie	[ha]	612977	612793	612728	615249	615169
2.	Kujawsko-pomorskie	[ha]	430009	430075	430182	430254	430365
3.	Lubelskie	[ha]	586396	587070	587886	588134	588668
4.	Lubuskie	[ha]	712013	712196	712234	712593	712943

No.	Voivodship	Unit	2019	2020	2021	2022	2023
5.	Łódzkie	[ha]	393164	393197	393350	391931	393712
6.	Małopolskie	[ha]	441054	441156	441128	441279	440740
7.	Mazowieckie	[ha]	837674	837796	837936	838091	838715
8.	Opolskie	[ha]	259284	259286	259409	259189	259300
9.	Podkarpackie	[ha]	689972	690359	690499	691244	691566
10.	Podlaskie	[ha]	633635	633929	633873	634966	639985
11.	Pomorskie	[ha]	684212	684132	684315	684810	687996
12.	Śląskie	[ha]	404583	404760	404277	404596	404845
13.	Świętokrzyskie	[ha]	336772	337233	337441	337815	338136
14.	Warmińsko-mazurskie	[ha]	783616	785399	786956	787857	788933
15.	Wielkopolskie	[ha]	786809	787353	787495	788463	788679
16.	Zachodniopomorskie	[ha]	841908	842387	843165	843641	844311
Total		[ha]	9 434 078	9 439 123	9 442 874	9 450 112	9 464 063

Table 6.5 Forest land area by provinces as of the end of inventory year (4/4)

No.	Voivodship	Unit	2024	2025
1.	Dolnośląskie	[ha]	615697	616276
2.	Kujawsko-pomorskie	[ha]	430483	430485
3.	Lubelskie	[ha]	588954	589335
4.	Lubuskie	[ha]	681493	713402
5.	Łódzkie	[ha]	393681	393841
6.	Małopolskie	[ha]	440901	441306
7.	Mazowieckie	[ha]	838814	839099
8.	Opolskie	[ha]	259314	259546
9.	Podkarpackie	[ha]	691813	692376
10.	Podlaskie	[ha]	640793	641258
11.	Pomorskie	[ha]	685296	685720
12.	Śląskie	[ha]	405017	404908
13.	Świętokrzyskie	[ha]	338269	338434
14.	Warmińsko-mazurskie	[ha]	790139	790623
15.	Wielkopolskie	[ha]	789121	789487
16.	Zachodniopomorskie	[ha]	845147	845510
Total		[ha]	9 434 932	9 471 605

6.2.1.2. Habitat structure

The diversity of growing conditions for forests in Poland is closely linked to the allocation of natural forest habitats, as detailed in Table 6.6. Predominantly, Poland has retained forests on poorer soils, which is reflected in the structure of its forest habitat types. Mixed coniferous habitats prevail, accounting for 29.0% of the total forest area (Statistics Poland; Forestry 2025). In contrast, pure coniferous habitats have slightly decreased compared to the previous year, now estimated at 20.2% of the forest area. Meanwhile, mixed deciduous habitats have seen a slight increase, now estimated at 27,1%. Finally, pure deciduous habitats are estimated to comprise 23.7% of the forest area. Each habitat type is further categorized into lowland, upland, and mountain habitats, reflecting the geographical diversity of Poland's forests. This classification highlights the ecological significance of various forest types and their adaptation to specific soil conditions and climatic influences across different regions of the country.

Table 6.6. General characteristic of forest habitat structure [%]

Specification	Habitats in percent										
	Lowland				Upland				Mountain		
	coniferous forests	coniferous forests mixed	mixed forests	forests (decid.)	coniferous forests mixed	mixed forests	forests (decid.)	coniferous forests	coniferous forests mixed	mixed forests	Forests (decid.)
Total	20	27.8	23.5	13.5	0.7	1.5	4.5	0.2	0.5	2.1	5.7

Source: Statistics Poland; Forestry 2025

6.2.1.3. Species composition

The geographical distribution of habitats is, to a great extent, reflected in the spatial structure of dominant tree species. Apart from the mountain regions where spruce (west) and spruce and beech (east) are the main species in stand composition, and a few other locations where stands have diversified species structure, in most of the country stands with pine prevail as the dominant species. In terms of forest area, coniferous species dominate in Polish forests, accounting for 67.4% of the total forest area. Poland offers optimal climatic and site conditions for pine within its Euro-Asiatic natural range, which resulted in development of a number of important ecotypes. Pine accounts for 58.8% of the area of forests in all ownership categories, for 61.0% in the State Forests and for 55.9% in the privately-owned forests.

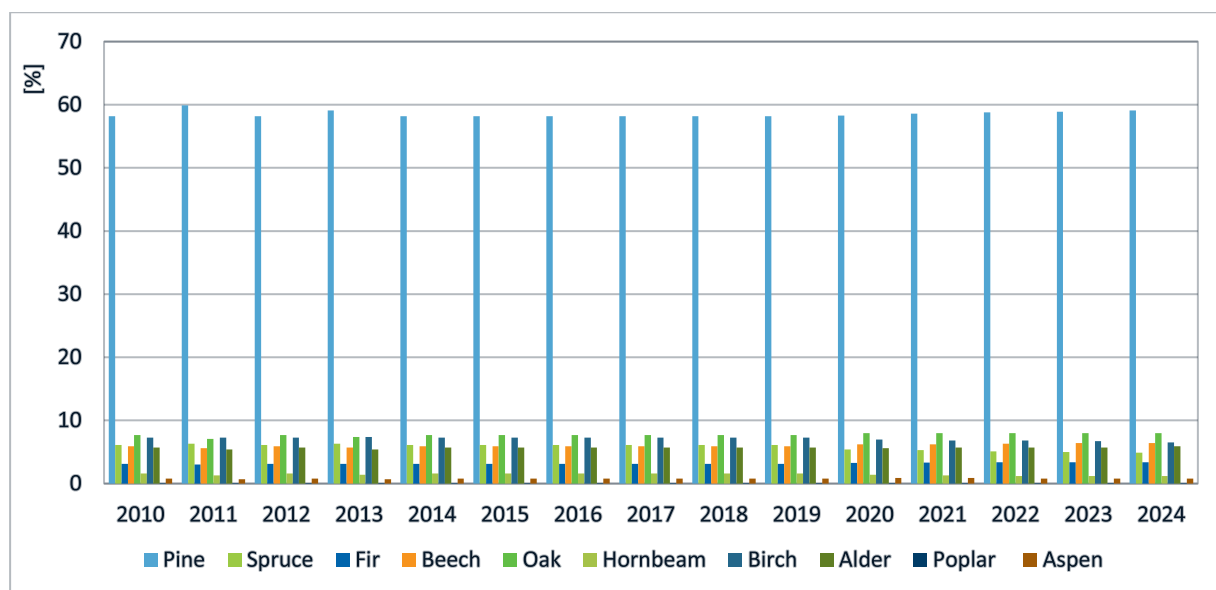


Figure 6.3. Structure of forest area by dominant tree species (as of 1 January 2024)

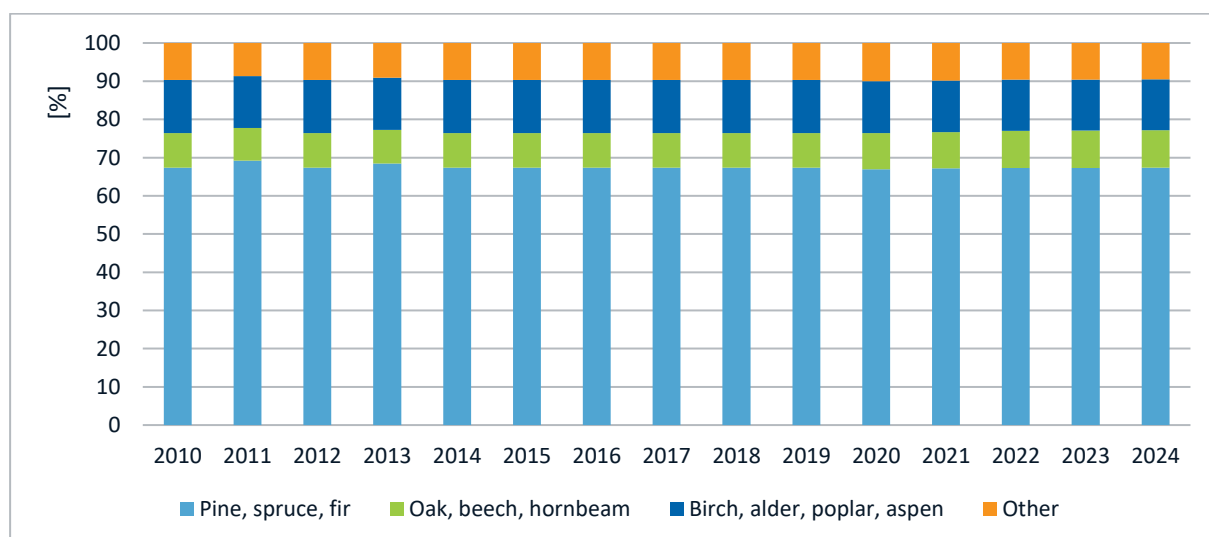


Figure 6.4. Structure of forest area by aggregated groups of dominant tree species (as of 1 January 2024)

Since 1945, there have been noteworthy changes in the species structure of forests, notably marked by an increased proportion of stands occupied by deciduous trees. This phenomenon is observable, particularly in state forests, where annual updates on forest land area and timber resources allow for tracking these changes. The total area covered by deciduous stands in state forests has risen significantly, growing from 13% to 32.6%. Despite this considerable

increase in the area covered by deciduous forests, their overall share remains below their potential contribution, as dictated by the inherent structure of forest habitats. This underscores that, despite the notable expansion, there is still room for further development of deciduous stands to align with the potential capacity dictated by the broader structure of forest habitats.

6.2.1.4. Age structure

Stands aged 41–80 years, representing age classes III and IV prevail in the age structure of standing wood and forest area. Notably representing 18,5% and 29.2% of standing wood resources and 20.7% and 22.2% of the forest area respectively. Moreover, stands aged 41–80 years are dominating in total forests area, with their total share equal to nearly 42.4%. Stands over 80 years old, including stands in the restocking classes, account for 30.3% of the total forest area.

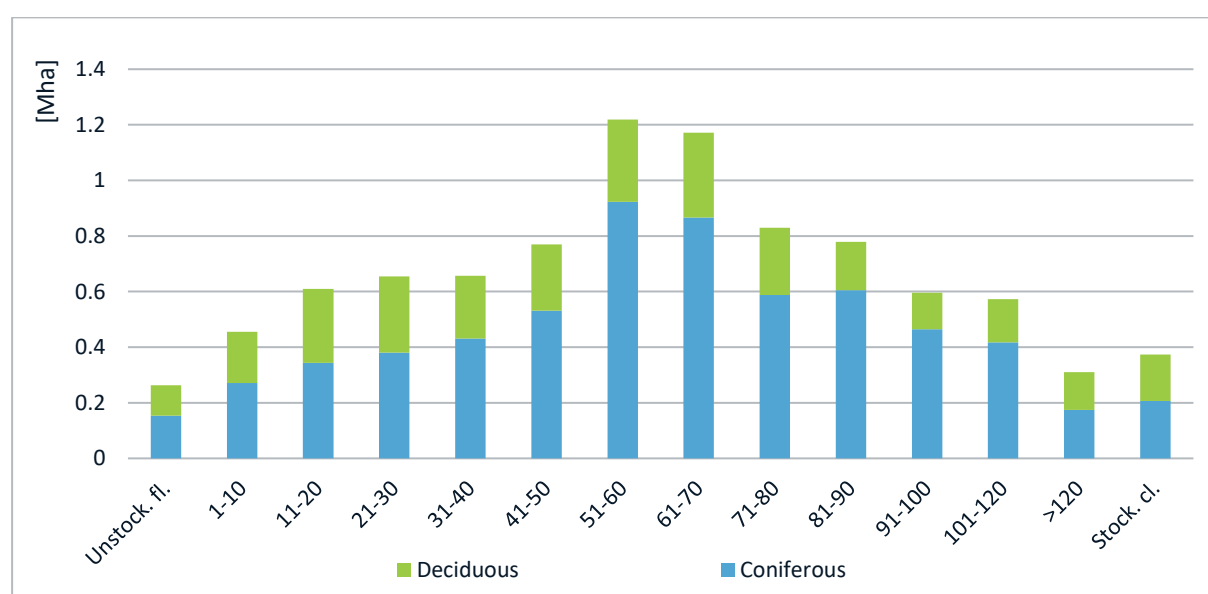


Figure 6.5. Forest area by age classes including temporary unstocked forests (Unstock. fl.), forests under stocking and restocking, as well as with structure under development (Stoc. cl.) as of 1 January 2025

6.2.1.5. Structure of timber resources by volume

According to NFI data, estimated timber resources, as of the beginning of 2025 (as of 1 Jan. 2025) amounted to 2 734 641 thous. m³ of gross merchantable timber.

6.2.2. Information on approaches used for representing land area and on land-use databases used for the inventory preparation

According to the description suggested in the chapter 3.3.1. of IPCC 2006 Guidelines of the Volume 4, managed forest land areas associated with the forestry activities in Poland is identified using Approach 3. Geographic boundaries encompassing units of land subject to multiple activities are identified based on data *on the condition and changes in the registered intended use of land* developed on the basis of annual reports on land.

6.2.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the regulations of art. 3 of the Act on Forests of September 28th 1991 (*Journal of Law of 1991 No 101 item 444, as amended*), forest land is the area:

- 1) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
 - a. designated for forest production, or
 - b. constituting a Nature Reserve or integral part of a National Park, or
 - c. entered on the Register of Monuments;
- 2) of contiguous area greater than or equal to 0.10 ha, associated with forest management.

Both of these criteria must occur simultaneously for a given area to be recognized as a forest in accordance with the applicable legal regulations. Worth to note, this subcategory includes entire land with woody vegetation consistent with thresholds used to define forest land in the national GHG inventory with:

- minimum area: 0.1 hectare,
- minimum width of forest land area: 10 m,
- minimum tree crown cover: 10% with trees having a potential to reach a minimum height of 2 metres at maturity in situ. Young stands and all plantations that have yet to reach a crown density of 10 percent or a tree height of 2 metres are included under forest. Areas normally forming part of the forest area that are temporarily un-stocked as a result of human intervention, such as harvesting or natural causes such as wind-throw, but which are expected to revert to forest are also included.

Furthermore, with regard to the regulations of art. 3 of the act on forests, forest land considered a subject to the forest management is the area:

- 1) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
 - a. designated for forest production, or
 - b. constituting a Nature Reserve or integral part of a National Park, or
 - c. entered on the Register of Monuments;
- 2) of contiguous area greater than or equal to 0.10 ha, associated with forest management.

The provisions within this act enable the standardization of the definition of forest land as part of the overall land use scheme. In Poland, a regulatory system has been established to identify, collect, process, report, and publish annual statistics on land use. The annual summary reports on land use areas, submitted by the Head Office of Geodesy and Cartography, are prepared in accordance with the regulations outlined in the Act on geodesy and cartography (*Journal of Laws of 1989 No. 30, item. 163, as amended*). These reports serve as the foundation for statistical publications that meet the requirements of the National Land Identification System. For the specific purposes of Greenhouse Gas (GHG) inventory, data provided by the National Statistics have been consistently utilized. To enhance the quality of data for GHG inventory and address specific inventory needs, improvements have been made to the system. This involves employing statistical sampling in conjunction with spatial information sourced from

the register of land and buildings. These enhancements aim to provide more accurate and comprehensive data for GHG inventory purposes.

6.2.4. Forest Land remaining Forest Land (CRT sector 4.A.1)

GHG balance in this category is a net sink. In 2024 net CO₂ sink was about 32 005 ktCO₂ eq. Methodological assumptions are provided in the following chapters.

6.2.4.1 Methodological issues

Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis.

6.2.4.2 Subcategory area

Land use change matrix is presented in the annex 5.8.

In accordance with the stipulations outlined in Decision 9/CP.2, entitled "Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration," when Parties invoke Article 4.6 of the Convention, seeking leeway to utilize base years different from 1990, Poland has exercised its flexibility. Specifically, Poland has opted to consider the year 1988 as the initial point for reporting transitions, as per the IPCC 2006 guidelines. This decision aligns with the flexibility provided under Article 4.6 and reflects Poland's preference for a base year other than the commonly accepted 1990.

6.2.4.3. Living biomass

Carbon stock-change method to estimate emission and removals balance related to the subcategory 4.A.1 *Forest Land remaining Forest land* were estimated with the available methods and factors that were possible to be applied to national circumstances. In this particular case, the stock-difference method required biomass carbon stock inventories for a given land area, at two points in time. Annual biomass change is the difference between the biomass stock at time t_1 and time t_0 , divided by the number of years between the inventories (Equation 2.8). Annual change in carbon stocks in living biomass reservoir was estimated considering the changes in forest resources on forest land all forms of ownership, using the information contained in the statistical yearbooks "Forestry". Estimations were based on the equation 2.8 contained in the IPCC guidelines as suggested in the Volume 4, Chapter 2.3.1.1. Data sources contains tables describing forest resources structure by species and age classes.

As mentioned above, the general methodology to estimate emissions and removals in the forestry sector is based on the IPCC methodology (IPCC 2006). However, wherever it was possible, country specific data was used (Tier 2), and IPCC default values (Tier 1) were only used in a few cases. Changes in carbon stocks in the biomass pool are accounted annually on the basis of the Polish forestry statistics which provides relevant information, describing aboveground volume of all forests at the country level, available annually for the each inventory year. Moreover gross merchantable volume stock used in the above mentioned calculations is estimated on the basis of data obtained from the most recent 5-year cycle of large-scale inventory, which is published in the form of official statistics by the Statistics Poland. Recently submitted estimates of the carbon stock changes in living biomass for the

subcategory forest land remaining forest land are aiming to maintain time-series consistency as much as possible. Since recent statistical data is not fully comparable with historical statistics data published up to 2009, historical data was considered comparable when calibrated using the calibration factors obtained in line with the calculation method as provided in the chapter 5.3.3.2 of the Volume 1 of the IPCC 2006 Guidelines. Recent implementation of more detailed methodologies aims in finding a common point in time for which reflected comparisons of could be made, considering existing data limitations.

As indicated in a number of previous reviews, fluctuation in the ratio of implied carbon stock change factors in living biomass is affected by the changes in the species and age-structure distribution of the timber resources. This statement is supported by the modelling results of the Carbon Budget Model of the Canadian Forest Sector, as provided for example on the Fig. 5. *Compatibility of data included in the forest reference level with the data contained in the 2018 National Inventory Report of the Polish National Forestry Accounting Plan* (https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/Krajowy_Plan_Rozliczen_dla_Lesnictwa/NFAP_2019_POLAND_ENG_FINAL.pdf). In this particular case the annual stock differences (which are the differences of average growing stocks of two consecutive years) reflect the changes in the species and age-structure distribution of the timber resources.

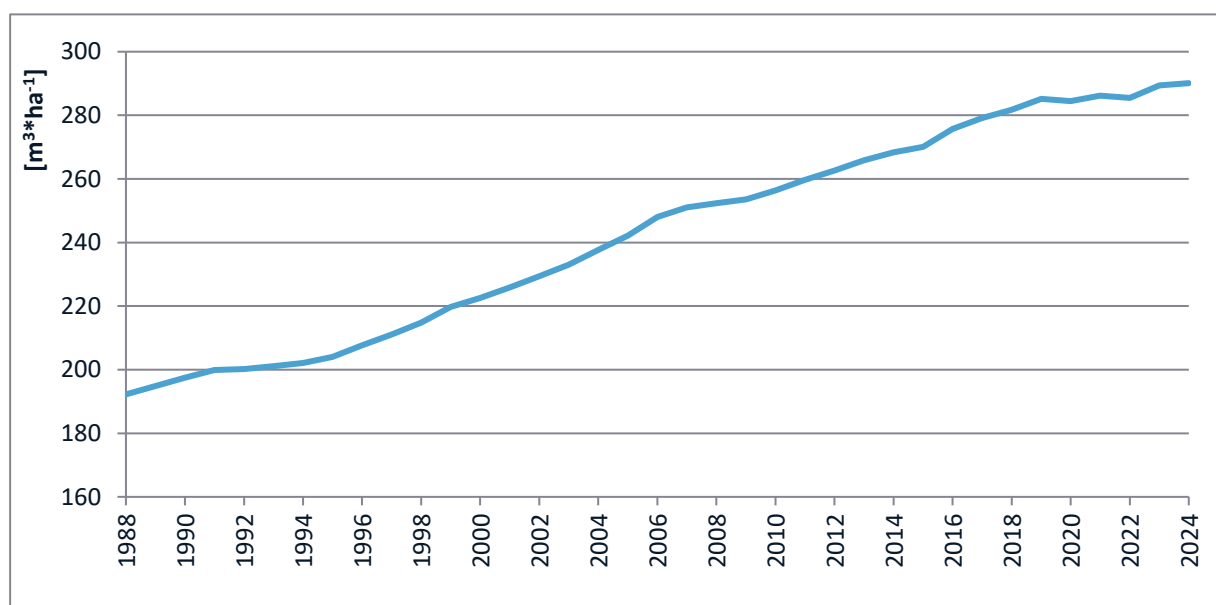


Figure 6.6. Average volume stock of merchantable timber in Polish forests

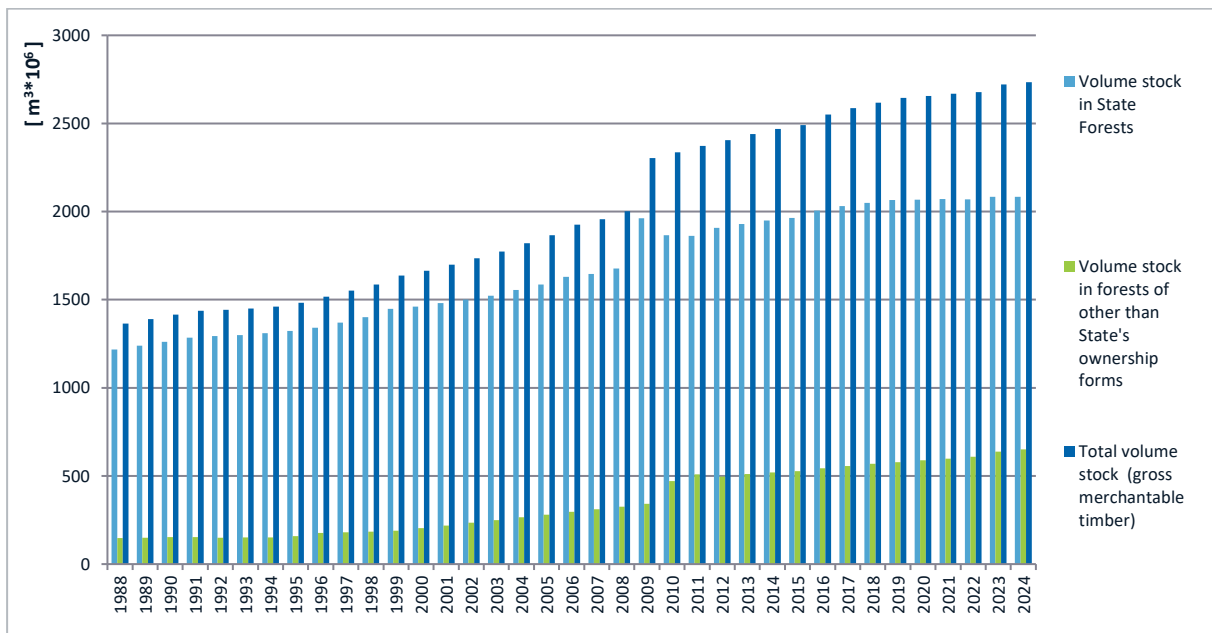


Figure 6.7. Volume stock of merchantable timber in Polish forests (as of 1 January)

While uncertainties surround these statistics, they are considered to be smaller compared to those associated with gain-loss methods and systematic errors. It's worth noting that growing stocks and their changes encompass the effects of various processes mentioned earlier. As a result, it is challenging to draw specific inferences on emissions and removals separately for each of these processes. The integrated nature of growing stocks and their changes implies that the uncertainties are inherent in considering the cumulative impact of multiple factors rather than isolating individual processes for distinct analysis.

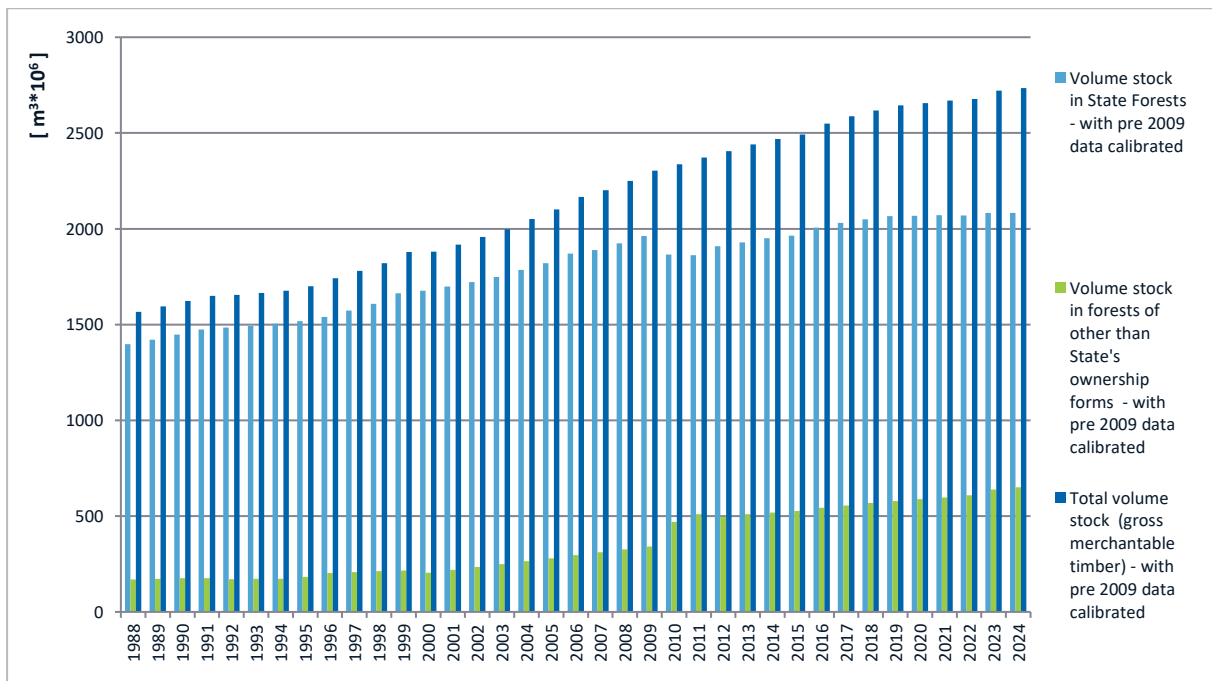


Figure 6.8. Volume stock of merchantable timber in Polish forests with pre-2009 data calibrated (as of 1 January)

Data provided on the graph above was prepared on the basis of data collected from the periodical forest inventory surveys by the Forest Management and Geodesy Bureau. To eliminate potential overestimations of carbon sinks linear calibration of pre-2009 data sets

was applied. The inventory data is stored in a publically available databases, i.e. the Forest Data Bank (<https://www.bdl.lasy.gov.pl/portal/tworzenie-zestawienia-rw>). During the continuous survey of the forest inventory, the main stand measures (such as height, diameter, basal area, and density) are estimated by various measurement methods. The survey methods applied in individual stands depend on species, age and site. Since the recent forest inventory scheme is based on survey's considering measurements of individual sample plots, more accurate and fully comparable results were obtained since 2009.

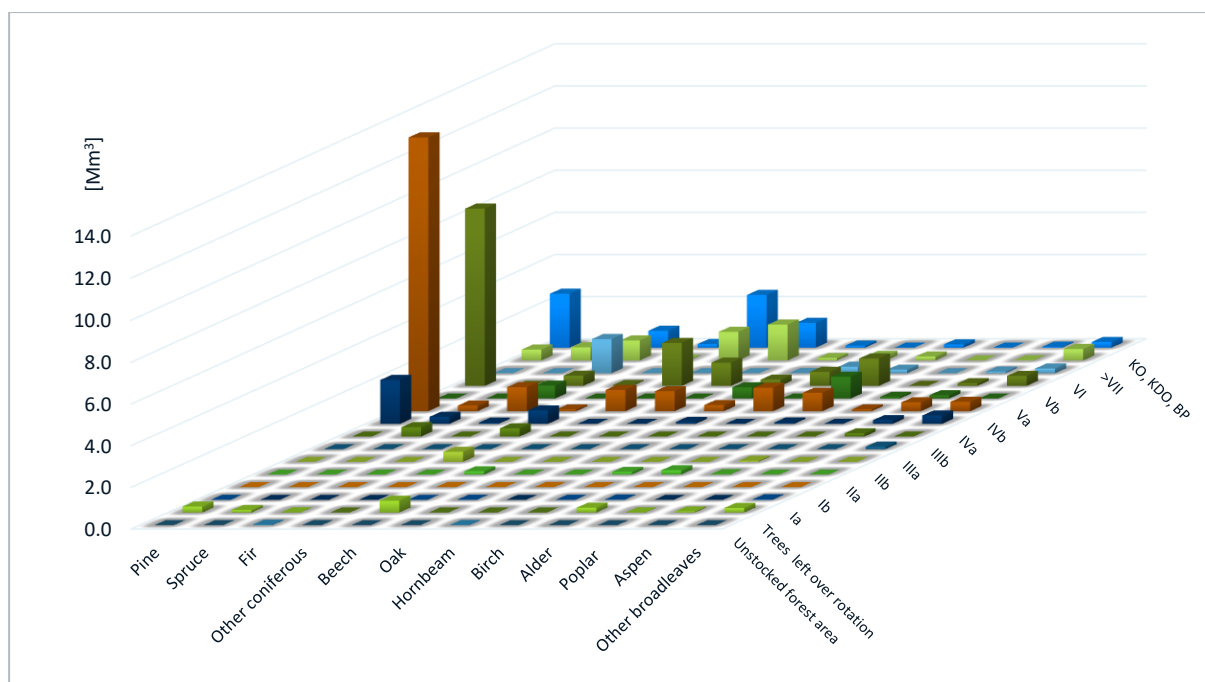


Figure 6.9. Annual level of volume stock changes (increases) of merchantable timber in Polish forests by species and age classes in 2024

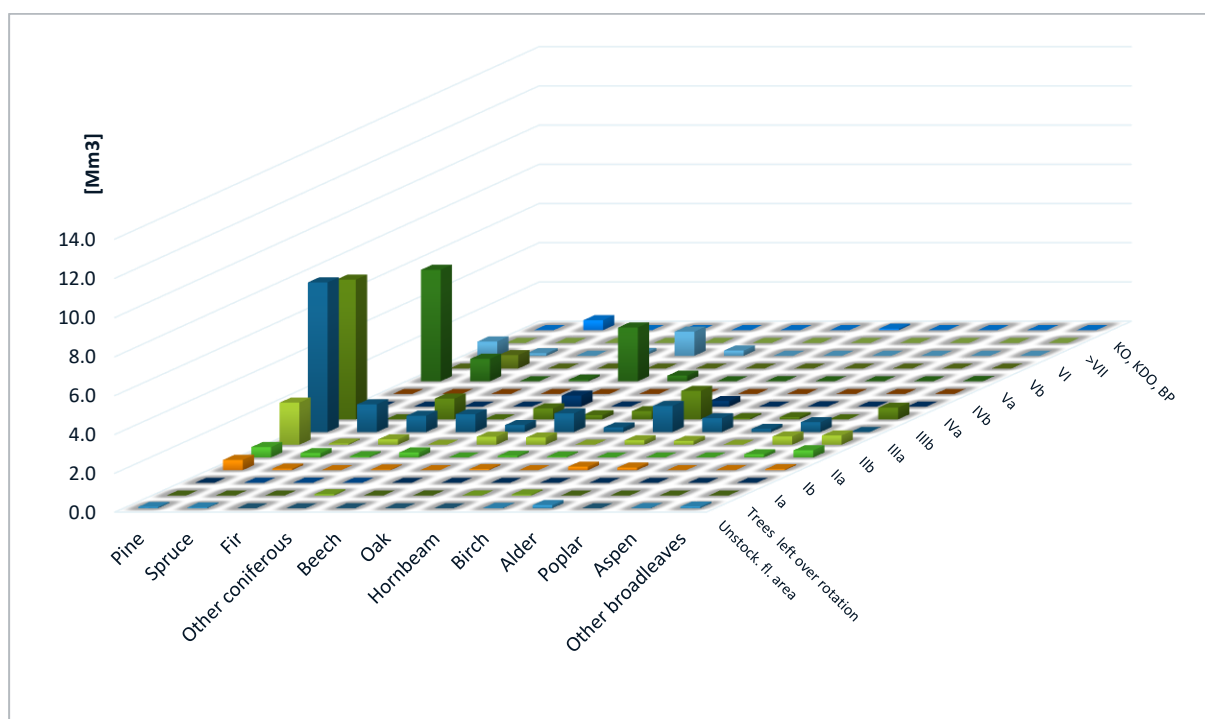


Figure 6.10. Annual level of volume stock changes (declines provided in a form of absolute values) of merchantable timber in Polish forests by species and age classes in 2024

The data preparation process for subcategory 4.A.1 involves utilizing general data on the forest area (excluding areas used for forest management) as of January 1. This includes deducting associated volume stock in age subclasses 1a and 1b, assuming they represent relevant area resources.

6.2.4.4. Basic wood density

The current form of the equation 2.8 of chapter 4 of the Volume 4 of the IPCC 2006 (p. 2.12) actually triggered the use of a weighted mean of wood density. Basic wood density by species can only be applied when the volume of the average merchantable growing stock by single species is provided. Since the average merchantable growing stock has been applied in the eq. 2.8, the weighted mean of wood density was also applied to adjust the BCEF (as provided in the section 2.3.1.1 of the chapter 2 of the Volume 4 of the IPCC 2006. In the calculation of specific wood density (oven dry) by species, air dry wood density values by species and volumetric shrinkage of wood by species were used. Basic wood density values by major tree species obtained with the simplified approach by multiplication of air-dry wood density with relevant wood shrinkage is presented in the table 6.9.

Table 6.7. Air-dry wood density [t/m³]¹

Species	Air-dry wood density [t/m ³]
Pine	0.52
Spruce	0.47
Fir	0.45
Beech	0.73
Oak	0.69
Hornbeam	0.83
Birch	0.65
Alder	0.53
Poplar	0.45
Aspen	0.44

Data source: Krzysik F. Wood science (In Polish). PWN Warszawa 1975

Table 6.8. Volumetric wood shrinkage [%]

Species	Volumetric wood shrinkage [%]
Pine	12.4
Spruce	12.0
Fir	11.7
Beech	17.6
Oak	12.6
Hornbeam	19.7
Birch	14.2
Alder	12.6
Poplar	14.3
Aspen	11.0

Data source: Krzysik F. Wood science (In Polish). PWN Warszawa 1975

Air-dry wood density [t/m³] was multiplied by the volumetric shrinkage of wood to estimate wood density by species. Results are presented in the table below. Almost in all cases country specific wood density is lower than value provided by the IPCC in the table 4.14 on p. 4.71 of chapter 4 of the Volume 4 of the IPCC 2006:

$$D = \text{Air-dry wood density [t/m}^3\text{]} * (1 - \text{volumetric shrinkage of wood})$$

¹ with the level of 15% of wood humidity

Table 6.9. Wood density by major tree species

Species	Wood density [t/m ³]
Pine	0.43
Spruce	0.38
Fir	0.36
Beech	0.57
Oak	0.57
Hornbeam	0.63
Birch	0.52
Alder	0.43
Poplar	0.35
Aspen	0.36
Other	0.36

6.2.4.5. Biomass conversion and expansion factor

Due to lack of proper country-specific data and in order to be consistent with previous estimate, IPCC default values for the BEF 2 (table 3 A.1.10 of the IPCC 2003 GPG) were used. Recent approach to estimate the BCEF, is consistent with the guideline provided in the section 2.3.1.1 p. 2.13 of chapter 4 of the Volume 4 of the IPCC 2006.

Table 6.10. BEF factors

Climatic zone	Forest type	Minimum dbh (cm)	BEF ₂ (overbark)
Temperate	Pines	0-12.5	1.3
	Spruce, Fir, Other coniferous	0-12.5	1.3
	Broadleaf	0-12.5	1.4

In order to assess biomass conversion and expansion factors for expansion of merchantable growing stock volume to above-ground biomass, tonnes above-ground biomass (m³ growing stock volume), transforming merchantable volume of growing stock directly into its aboveground biomass default biomass expansion factor (BEFs) and country specific D values that were separately assessed has been utilised. The following conversion has been applied: BCEFs = BEFs x D. Recent process, related to the possibility of using country-specific BCEFs values is assuming application of default biomass expansion factor (BEFs) only. Nevertheless, forest monitoring system data supports biomass stock estimation, with its primary aim being accurate information on the status and development of all national forests. While collected at the stand level, the inventory provides reliable aggregated estimates. Actual net annual CO₂ removals at local scale may differ from estimates, as national stock volume inventories cannot fully capture inter-annual variability in timber growth and harvests driven by locally observed meteorological conditions.

6.2.4.6. Root-to-shoot ratio

Root-to-shoot ratio was adjusted based on default values proposed to be used by the IPCC in IPCC 2006 Guidelines of the Volume 4, table 4.4.

Table 6.11. R factors²

Species	Ratio of below-ground biomass to above-ground biomass (R)				
	Above-ground biomass [tonne root d.m./ha ⁻¹]				
	<50	50-70>	<70-75>	<75-150>	<150
Pine	0.40	0.29	0.29	0.29	0.20
Spruce	0.40	0.29	0.29	0.29	0.20
Fir	0.40	0.29	0.29	0.29	0.20
Beech	0.46	0.46	0.46	0.23	0.24
Oak	0.30	0.30	0.30	0.23	0.24
Hornbeam	0.46	0.46	0.46	0.23	0.24
Birch	0.46	0.46	0.46	0.23	0.24
Alder	0.46	0.46	0.46	0.23	0.24
Poplar	0.46	0.46	0.46	0.23	0.24
Aspen	0.46	0.46	0.46	0.23	0.24

The above R value has been applied in the equation 2.8 of chapter 4 of the Volume 4 of the IPCC 2006 (p. 2.12) for recent estimates of CO₂ removals. As indicated above, process related to the possibility of using country-specific values for the Root-to-shoot ratio is carried out as an independent activity in parallel to subsequent improvements introduced into the inventory preparation. Since the official data is not yet available, Poland has continued its consideration of application of the default values results to obtain a consistent time series in the GHG inventory.

6.2.4.7. Carbon fraction

Estimations are based on the following default factors (table 6.11).

Table 6.11. CF factors

Species	IPCC
Pine	0.51
Spruce	0.51
Fir	0.51
Beech	0.48
Oak	0.48
Hornbeam	0.48
Birch	0.48
Alder	0.48
Poplar	0.48
Aspen	0.48

6.2.4.8. Dead organic matter

Dead organic matter (DOM), comprising dead wood and litter, plays a crucial role in carbon dynamics, impacting the accuracy of reporting carbon emissions and removals. Estimating the carbon dynamics of DOM pools is essential, especially considering that not all carbon from biomass killed during events like biomass burning is immediately emitted into the atmosphere. Instead, most of it is added to dead wood, litter, and soil pools, contributing to emissions over years to decades as the organic matter decomposes. Decay rates vary

² default values applied in the inventory for "Oak AGB < 50 tonnes/ha" and "Oak AGB 50–70 tonnes/ha" are the same as the IPCC default for "Quercus spp. AGB >70 tonnes/ha" in accordance with table 4.4 of the 2006 IPCC Guidelines. The value of 0.3 for "Quercus spp. AGB > 70 tonnes/ha" was used due to the lack of the appropriate value in Table 4.4 of the chapter 4 of the IPCC 2006 Guidelines. Nevertheless, the current approach applied should be recognized in terms of conservative approach, limiting the positive effect of young oak forest on overall carbon stock changes. Additionally, it should be noted that process related to the possibility of using country-specific values for the Root-to-shoot ratio is carried out as an independent activity in parallel to subsequent improvements introduced into the inventory preparation (this process also including Tier 3 models implementation).

significantly across regions, influenced by environmental factors such as temperature and moisture. In forest ecosystems, DOM pools tend to be largest after stand-replacing disturbances due to the influx of residual above-ground and below-ground biomass. In the post-disturbance years, these pools decline as carbon loss through decay surpasses the rate of carbon addition through litter fall, mortality, and biomass turnover. Later in stand development, DOM pools increase again, and representing these dynamics requires sophisticated estimation methods, particularly higher Tier methods.

At Tier 1, the assumption for dead wood and litter pools across all land-use categories is that their stocks remain constant over time if the land remains within the same category. In this case, the carbon released during disturbances or management events is assumed to be entirely released to the atmosphere in the year of the event. This aligns with the notion that the carbon transferred to dead organic matter equals the carbon released from dead organic matter through decomposition and oxidation. Recent inventories have used Tier 2 methods to estimate carbon dynamics in dead organic matter.. This involves detailed inventories with repeated measurements of dead wood pool dynamics, utilizing Equation 2.19 as described in Section 2.3.2.1 of Chapter 2 of Volume 4 of the IPCC 2006. Basic wood density and carbon fractions provided in Section 6.2.4.4 and 6.2.4.7 are considered in these estimates, showcasing a more nuanced and detailed approach to understanding and quantifying carbon dynamics within dead organic matter pools.

According to NFI data, estimated dead wood resources, as of the beginning of 2025 (as of 1 Jan. 2025) amounted to 51,056 thous. m³ of standing dead wood and 64,278 thous. m³ of lying dead wood.

6.2.4.9. Mineral soils

Annual change in carbon stocks in this carbon reservoir was estimated using equation 2.25 contained in IPCC 2006 Guidelines of the Volume 4, section 2.3.3. For the needs of equation application, reference values of SOC_{ref} were assessed for the dominant tree habitats.

Table 6.12. Forest habitat types in Poland with the SOC_{ref} assignment

Forest habitat type	SOC _{ref} [tC*ha ⁻¹]
Dry coniferous	39.1
Fresh coniferous	51.5
Moist coniferous	52.0
Fresh mixed coniferous–broadleaved	63.4
Moist mixed coniferous–broadleaved	95.6
Mountain mixed coniferous–broadleaved	385.2
Fresh mixed forests	77.7
Moist mixed forests	119.2
Upland mixed forests	92.4
Mountain mixed forests	134.9
Fresh forests	76.7
Moist forests	99.3
Floodplain forest	101.6
Upland floodplain forest	153.3
Upland forest	92.4
Mountain forest	158.9
Mountain floodplain forest	153.3
Dry coniferous	39.1

Data source: Preliminary assessment by Biosoil Soil

Table 6.13. Percentage share of soil types by land use system

Forest habitat type	2024 _(t) [%]	2004 _(t-20) [%]
Dry coniferous	0.48	0.17
Fresh coniferous	25.38	20.18
Moist coniferous	1.21	0.65
Fresh mixed coniferous–broadleaved	25.25	24.56
Moist mixed coniferous–broadleaved	4.32	4.23
Mountain mixed coniferous–broadleaved	0.58	0.55
Fresh mixed forests	15.05	18.16
Moist mixed forests	3.05	3.79
Upland mixed forests	3.05	3.79
Mountain mixed forests	1.90	1.96
Fresh forests	7.89	8.92
Moist forests	3.05	3.79
Floodplain forest	0.35	0.41
Upland floodplain forest	0.01	0.04
Upland forest	3.58	4.12
Mountain forest	4.84	4.63
Mountain floodplain forest	0.03	0.04
Dry coniferous	0.48	0.17
Total	100.0	100.0

The reason of the increase of the amount of soil carbon in all forests is that about one-third of all forests are afforestation's since 1945, and most of these forests are still in their intensive growing phase, which means that carbon stocks of soil organic matter pool have not saturated yet. Additionally, no major disturbances or other processes have occurred that could have resulted in substantial emissions from the soil organic matter. Therefore, quantitative estimates can be made on the increase.

The estimation of carbon stock changes in the mineral soil pool in the subcategory of forest land remaining as forest land is based on changes in the areas of different forest habitat types. Furthermore, estimates of carbon stock changes in mineral soils followed IPCC default transition periods, specifically a 20-year duration [IPCC, 2006]. The assumptions made in this approach allow for the assignment of the indirect impact of forest vegetation associated with a particular forest habitat on the structure and decomposition of forest litter, directly influencing the changes in carbon stocks in the upper soil layers. In essence, recent application of default values reflects a pragmatic approach, balancing the country-specific data obtained from the study with the convenience and comparability provided by the IPCC default values for consistent reporting, over the time series. It is worth noting that inventory scope emphasizes the utilization of results from the Biosoil Soil project—a significant initiative aimed at monitoring soil properties and biodiversity in Poland, particularly within forest ecosystems. This project involves analyzing soil samples collected from 148 second-order monitoring stations every four years. Each sampling area comprises nine boreholes arranged diagonally, with samples taken from six different depths, resulting in a total of 888 samples. The findings from this comprehensive monitoring effort will inform further research and policy-making related to forest management and environmental protection strategies. This revision enhances readability and coherence while ensuring that all critical information is retained.

6.2.4.10. Organic soils

The main basis for establishing histosols area under this Submission was the project *Spatial Information System on Wetlands in Poland* elaborated in 2004-2006 by the Institute of Technology and Life Sciences. Here available vector layers were compared with Corine land cover data, used as a proxy. Recent approach utilises Corine Land Cover maps published for:

1990, 2000, 2006, 2012 and 2018. The land cover classes were divided into IPCC classification where particular land uses were taken into account. Data between years covered by CLC were interpolated, data for 1988-1989 were extrapolated based on changes between 1990 -2000.

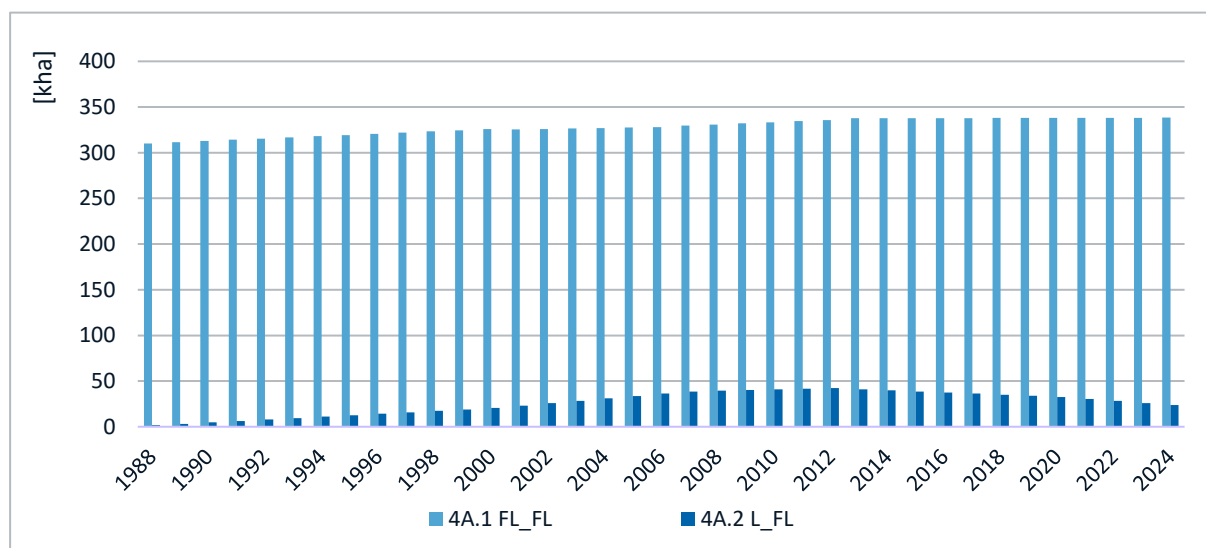


Figure 6.11. Organic soils area on forest land in the period 1988-2024

Table 6.14. CO₂ emission factor for drained organic soils

Name	Volume	Unit
EF _{drainage}	0.68	[tC/ha*y ⁻¹]

The same EF was applied for the estimation of CO₂ emissions on land subject to the categories 4.A.1 as well as for the land subject to the subcategory 4.A.2.

6.2.4.11. Biomass burning

According to the article 30 of *Act on forests of 28th September, 1991 (Journal of Law of 1991 No 101 item 444, as amended)* the burning of surface soil layers or remnants of vegetation is forbidden. In relation to this record it is considered that controlled biomass burning does not occur on forests. CH₄, N₂O, CO and NO_x emissions from uncontrolled forest fires were calculated using following equation 2.27 (IPCC 2006, page 2.42.).

Table 6.15. Emissions ratios for calculation CH₄, N₂O, CO and NO_x emissions from forests fires [table 2.5 p. 2.47 of IPCC 2006 Guidelines, Volume 4]

Compound	Ratio [g/kg d.m burnt]		
G _f CH ₄	4.7	default	[IPCC 2006]
G _f CO	107	default	[IPCC 2006]
G _f N ₂ O	0.26	default	[IPCC 2006]
G _f NO _x	3.0	default	[IPCC 2006]

Table 6.16. Fraction of biomass combusted

Compound	Ratio		
C _f	0.45	default	[IPCC 2006]

Table 6.17. Mass of available fuel

Year	Unit	Compound (M _b)	Year	Unit	Compound (M _b)
1988	[t. d.m./ha]	109.1	2007	[t. d.m./ha]	96.8
1989	[t. d.m./ha]	109.2	2008	[t. d.m./ha]	98.4
1990	[t. d.m./ha]	109.2	2009	[t. d.m./ha]	98.8
1991	[t. d.m./ha]	112.4	2010	[t. d.m./ha]	104.1
1992	[t. d.m./ha]	110.9	2011	[t. d.m./ha]	102.4
1993	[t. d.m./ha]	103.4	2012	[t. d.m./ha]	104.3
1994	[t. d.m./ha]	99.4	2013	[t. d.m./ha]	120.3
1995	[t. d.m./ha]	100.7	2014	[t. d.m./ha]	111.9
1996	[t. d.m./ha]	101.9	2015	[t. d.m./ha]	110.6
1997	[t. d.m./ha]	100.8	2016	[t. d.m./ha]	113.3
1998	[t. d.m./ha]	101.6	2017	[t. d.m./ha]	115.5
1999	[t. d.m./ha]	98.2	2018	[t. d.m./ha]	114.9
2000	[t. d.m./ha]	99.0	2019	[t. d.m./ha]	118.0
2001	[t. d.m./ha]	97.8	2020	[t. d.m./ha]	116.2
2002	[t. d.m./ha]	98.5	2021	[t. d.m./ha]	120.7
2003	[t. d.m./ha]	97.7	2022	[t. d.m./ha]	122.6
2004	[t. d.m./ha]	99.4	2023	[t. d.m./ha]	124.2
2005	[t. d.m./ha]	98.0	2024	[t. d.m./ha]	126.2
2006	[t. d.m./ha]	98.1			

6.2.5. Land converted to Forest Land (CRT sector 4.A.2)

GHG balance in this category is a net sink. In 2024 net CO₂ sink was approximately 3 282kt of CO₂ eq. For the methodologies used, see following chapters.

6.2.5.1 Methodological issues

The strict regulations on afforestation aim to conserve traditional varieties and promote biodiversity. However, a significant methodological issue is the integration of diverse data sources—remote sensing, national inventories, and field measurements—to create a cohesive monitoring framework. This requires a flexible approach that accommodates new technologies and methodologies while maintaining consistency across assessments to ensure comparability over time. Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis.

Worth to note, afforestation of orchards, in terms of planning regulations, is highly limited, encouraging the conservation of traditional orchards which helps to guarantee the survival of a wide range of trees and fruit varieties that are particular to each region of the country – and supports the growing popularity of locally-produced food. Fruit trees age much more quickly than most other species found in the countryside so they rapidly accumulate the 'veteran' features associated with over-mature trees. Large volumes of standing dead wood in the form of 'stag's heads', whole limbs and rotting heartwood are specific habitats favoured by suites of very specialised organisms that have become increasingly rare in the countryside. The presence of old trees spaced within permanent grassland creates a range of habitats very similar to those found in wood pasture landscapes. The main principles of the planning regulations are covered by the following relevant regulations:

1. Ordinance of the Minister of Agriculture and Rural Development of 18 June 2007 on the

detailed conditions and procedures for granting financial assistance under the "Afforestation of agricultural land and afforestation of non-agricultural land" covered by the Rural Development Program 2007-2013 (OJ 2007 No. 114, item 786);

2. Ordinance of the Minister of Agriculture and Rural Development of 21 September 2007 amending the Regulation on detailed conditions and procedures for granting financial assistance under the "Afforestation of agricultural land and afforestation of non-agricultural land" area covered by the RDP 2007-2013 (Official Journal from 2007 No. 185, item 1316);
3. Ordinance of the Minister of Agriculture and Rural Development of 18 July 2008 amending the Regulation on detailed conditions and procedures for granting financial aid under the "Afforestation of agricultural land and afforestation of non-agricultural land" covered by the RDP 2007-2013 (Journal of Laws of 2008, No. 134, item 853);
4. Ordinance of the Minister of Agriculture and Rural Development of 19 March 2009 on detailed conditions and procedure for granting financial aid under the measure "Afforestation of agricultural land and afforestation of non-agricultural land", covered by the RDP 2007-2013 (Journal of Laws of 2009, No. 48, item 390);
5. Ordinance of the Minister of Agriculture and Rural Development of 31 May 2010 amending the Regulation on detailed conditions and procedures for granting financial assistance under the "Afforestation of agricultural land and afforestation of non-agricultural land" covered by the RDP for 2007-2013 (Journal of Laws of 2010, No. 94, item 608).

6.2.5.2. Subcategory area

Land use change matrix is presented in the annex 5.8.

6.2.5.3. Living biomass

Annual changes in carbon stocks within the living biomass reservoir were estimated by analyzing volume stock changes across a specified forest land area at two distinct time points. This approach utilized annual volume stock changes specific to age classes 1a and 1b (young stands) by dominant tree species, as outlined in Equation 2.8 from the IPCC guidelines (Volume 4, Chapter 2, Section 3.1.1). Additionally, it incorporated broader volume changes in forest resources on all forest lands—regardless of ownership—drawing from the 10-year current volume stock changes, available in the publicly accessible Forest Data Bank (<https://www.bdl.lasy.gov.pl/portal/tworzenie-zestawienia-rw>).

Summaries of stands volume changes [$\text{m}^3 \cdot \text{ha}^{-1}$] in forests provided the core data, broken down by dominant species (e.g., pine, spruce), age classes, and subclasses for standing wood per hectare. These align with subcategory 4.A.1 methodologies and leverage the same conversion factors detailed in sections 6.2.4.4 to 6.2.4.7, which account for biomass-to-carbon ratios and wood density.

Furthermore, volume estimation involves analysing species-specific simplified models for young forests using a sample of known-age stands. While accuracy is challenging to quantify due to unknown error distributions and assumptions, the double-checking of data processing in the QA/QC section minimizes calculation errors during GHG inventory development. For carbon stock changes in biomass, the calculation system allows for a simple sensitivity analysis, particularly effective when major sources of CO₂ emissions and removals are considered.

6.2.5.4. Dead organic matter

In the intricate dynamics of afforestation and reforestation efforts, the management of dead wood poses a unique challenge, intricately woven with assumptions and practical considerations. The convention of denoting carbon stock changes in dead wood as 'NO' in the reporting tables arises from the assumption that no dead wood exists in these areas before conversion, leading to an initial absence of this carbon pool. Consequently, the tables employ 'NO' to signify the non-occurrence of changes in the dead wood stock during afforestation and reforestation activities. The rationale behind this assumption stems from the belief that the accumulation of dead wood is initially marginal on these sites, and the dead wood pool cannot decrease since there is no pre-existing dead wood before the land conversion. It is only after approximately two decades, with natural mortality or thinnings occurring, that dead wood begins to accumulate. This cautious approach in CRT tables notation seeks to maintain accuracy and adherence to established principles. Upon afforestation, the process involves clearing the area of any existing above-ground biomass. However, dead woody debris, litter, and dead trees commence accumulation post-conversion. The specific rate and timing of this accumulation remain uncertain due to the lack of representative measurements. Standard forestry practices suggest that the pace and magnitude of accumulation are contingent upon factors such as species, site characteristics, and the applied silvicultural regime. Fast-growing species, strategically planted or thinned, tend to minimize dead wood production, while slow-growing species may contribute to the accumulation of dead wood and litter even at early stages. The foundation of this demonstration lies in well-established principles of forest science, everyday experiences in forestry practice, and insights derived from forest surveys. The inherent uncertainties notwithstanding, the demonstration exudes a high level of confidence, attributed to the synthesis of experiential knowledge and sound reasoning.

Importantly, the potential carbon gains associated with this approach could exert a positive influence on the final carbon balance related to the category 4.A.2 - Land converted to forest land. The prevailing methodology might inadvertently lead to the potential overestimation of net emissions, thereby underestimating the actual net removals. This underscores the need for continuous refinement and integration of evolving scientific insights to enhance the accuracy of carbon accounting in the context of land-use changes. Current demonstration that this reservoir is not a source depends on the data availability, generally following justifications were considered:

1. direct implementation of Tier 1 description suggested in the chapter 4.2.2.1 of IPCC 2006 Guidelines of the Volume 4, assuming that the average transfer rate into the dead organic matter reservoir is equal to the transfer rate out of this pool so the net change is in equilibrium;
2. expert judgments based on a combination of qualitative and quantitative arguments, like international references to the neighbouring country's GHG's inventories;
3. conservative assumptions based on in-country forestry practices, as described below.

The cultivated paradigm shift towards close-to-nature forest management over the past decades marks a significant evolution in forestry practices, particularly with regard to the reduction of clear cuts. The Forest Act of 1991, a pivotal legislative milestone, underscored the importance of managing semi-natural forests in a more naturalistic manner. This transformative approach involves leaving increased amounts of deadwood in the forest after harvests, creating and maintaining gaps, and promoting species diversity. Notably, the growing prevalence of broadleaved species in the species structure is playing a crucial role in shaping positive outcomes in the final changes of the carbon stock (CS) in the dead organic matter pool. The commitment to these principles has led to a presumption of stability in the

accumulation of dead wood within Polish forests. The deliberate effort to mimic natural processes through forest management aligns with the overarching goal of preserving ecosystem integrity. Another contributing factor to the rise in the dead organic matter stock across all forests is the extensive afforestation undertaken since 1945, particularly as a post-World War II initiative. Many of these afforested areas are still in their intensive growing phase, implying that carbon stocks in the dead organic matter pool have not yet reached saturation levels. This ongoing growth phase, coupled with the absence of major disturbances or significant processes that could trigger substantial emissions from the dead organic matter pool, reinforces the assumption of a relatively stable accumulation of dead wood in Polish forests.

In the realm of forest carbon estimation, the guidance provided by the Intergovernmental Panel on Climate Change (IPCC) serves as the cornerstone, offering a comprehensive framework for methods, accounting equations, and parameters. However, navigating the extensive IPCC guidance can be challenging. Consequently, various tools for forest carbon accounting have emerged, differing in geographical coverage, forestry activities covered, and the carbon pools considered. One such pool is the Dead Organic Matter (DOM) wood carbon pool, encompassing all non-living woody biomass, including standing and fallen trees, roots, and stumps with a diameter over 7 cm (over bark). Additionally, the DOM, including litter carbon pool, spans non-living biomass with a size greater than the limit for soil organic matter (SOM) and smaller than that of DOM wood, typically 2 mm to 7 cm in diameter over bark. This pool encapsulates biomass in various stages of decomposition before eventual transformation into SOM, providing a nuanced understanding of carbon dynamics within forest ecosystems.

The Tier 1 assumptions regarding land converted to forest land (4.A.2) provide a structured framework for understanding carbon dynamics, particularly in relation to dead wood and litter pools. The core assumption involves a linear increase in these carbon pools from zero (in non-forest land) to default values for the respective climate regions over a specified period, typically set at 20 years. This standardized approach helps streamline reporting and analysis, ensuring consistency across different regions. In the context of unmanaged to managed forest land conversion, the Tier 1 assumption posits that dead organic matter carbon stocks in unmanaged forests mirror those of managed forests, and thus no carbon stock changes need to be reported. This simplification aligns with the overarching principles of Tier 1 methods, emphasizing ease of application and data availability. For the conversion of non-forest land to forest land, the Tier 1 assumption acknowledges the likelihood of net removals in the DOM and litter pools. However, due to the absence of advanced estimation methodologies, reporting balanced emissions in these pools is considered a pragmatic and acceptable approach, with the understanding that more refined estimations may be developed in the future. In the specific case of category 4.A.2, the scarcity of representative data on deadwood and litter pools prompts a reliance on limited available information. Despite the lack of comprehensive data, there is a justifiable assertion that these pools in our forests likely sequester carbon in the medium term rather than releasing it. This assumption is supported by historical practices; until the late 20th century, managed forests in Europe often had deadwood removed for perceived health benefits, leading to increased biodiversity. Recognizing the ecological importance of deadwood, efforts have shifted towards retaining and managing it.

Worth to note, Poland's lower volume of deadwood compared to other EU countries reflects historical management practices. However, the country's forests, especially in national parks, exhibit higher volumes, highlighting the relevance of location-specific management strategies. The argument that Poland's forests are still in their intensive growing phase further supports the Tier 1 assumption, suggesting that carbon stocks in dead organic matter pools have not

yet reached saturation. Highly reduced deadwood removal from sanitary thinning (triggered by external reasons), along with ongoing afforestation efforts since 1945, contributes to the observed increase in deadwood and litter in Polish forests. While the evidence is based on systematic but limited sampling, the net accumulation of standing dead trees indicates a slow but steady trend. Importantly, the absence of major disturbances or processes that could lead to substantial emissions reinforces the rationale behind adopting the Tier 1 assumption for these carbon pools, emphasizing equilibrium in the long run. In summary, despite the inherent challenges and limitations in data availability, the Tier 1 assumptions provide a practical and justifiable framework for estimating carbon stock changes in dead wood and litter pools, contributing to a nuanced understanding of Poland's forest ecosystems within the context of land-use changes. To highlight applied assumptions for the dead organic matter pool and its carbon stock change assuming as insignificant amounts and to keep the notations keys use relevant, notation key "NO" has been applied in relevant CRT tables.

6.2.5.5. Mineral soils

Annual changes in carbon stocks in soils were estimated using equation 2.25 as contained in the chapter 2 of the Volume 4 of the IPC 2006. For the needs of equation application, national reference values of SOC_{ref} were assessed for the dominant tree habitats.

Table 6.18. Forest habitat types in Poland with the SOC_{ref} assignment

Forest habitat type	SOC_{ref} [tC/ha]
Dry coniferous	39.1
Fresh coniferous	51.5
Moist coniferous	52.0
Fresh mixed coniferous–broadleaved	63.4
Moist mixed coniferous–broadleaved	95.6
Mountain mixed coniferous–broadleaved	385.2
Fresh mixed forests	77.7
Moist mixed forests	119.2
Upland mixed forests	92.4
Mountain mixed forests	134.9
Fresh forests	76.7
Moist forests	99.3
Floodplain forest	101.6
Upland floodplain forest	153.3
Upland forest	92.4
Mountain forest	158.9
Mountain floodplain forest	153.3
Dry coniferous	39.1

Data source: Preliminary assessment by Biosoil Soil

Estimates of carbon stock changes in mineral soils followed IPCC default transition periods, specifically a 20-year duration [IPCC, 2006].

Table 6.19. Percentage share of forest soil types by land use system (for time t)

Forest habitat type	2024 _(t) [%]
Dry coniferous	0.48
Fresh coniferous	25.38
Moist coniferous	1.21
Fresh mixed coniferous–broadleaved	25.25
Moist mixed coniferous–broadleaved	4.32
Mountain mixed coniferous–broadleaved	0.58
Fresh mixed forests	15.05
Moist mixed forests	3.05
Upland mixed forests	3.05
Mountain mixed forests	1.90
Fresh forests	7.89
Moist forests	3.05
Floodplain forest	0.35
Upland floodplain forest	0.01
Upland forest	3.58
Mountain forest	4.84
Mountain floodplain forest	0.03
Dry coniferous	0.48
Total	100.0

Table 6.20. Percentage share of cropland soil types by land use system (for time t)

SOC content	2024 _(t)
Very low	29.27
Low	39.10
Average	20.10
High	11.53
Total	100.00

Table 6.21. Percentage share of grassland soil types by land use system (for time t)

SOC content	2024 _(t)
Very low	13.57
Low	43.17
Average	32.23
High	11.02
Total	100.00

6.2.5.5. Organic soils

Table 6.22. CO₂ emission factor for drained organic soils

Name	Volume	Unit
EF _{drainage}	0.68	[tC/ha*y ⁻¹]

The area estimation of organic soils in forests is detailed in Section 6.2.4.10 of the report.

6.2.6. Uncertainties and time-series consistency

The forest monitoring system in place, designed with the primary objective of providing accurate and comprehensive information on the status and development of all forests in Poland, forms a crucial foundation for biomass estimation in the context of carbon accounting. The forest inventory, structured to collect data at the stand level, serves the purpose of offering precise estimates at aggregated levels. However, it is acknowledged that while this system is robust, actual values related to net annual CO₂ removals may deviate from estimates

due to various factors. One key consideration is that the stock volume inventory, covering the entire country, may not fully capture all inter-annual variability in timber growth and harvests. This limitation is particularly relevant given the high variability in meteorological conditions, which can exert a significant influence on forest dynamics. Recognizing this, it is important to understand that fluctuations in actual values may occur, and these deviations may be attributed to the dynamic and complex nature of forest ecosystems. The inter-annual variability of estimated net removals in the Forest Land sector is multifaceted, influenced by factors such as the changing structure of forests over time based on species composition, site fertility, and age. The variability in annual harvests and mortality further contributes to the observed fluctuations. These effects, with different delayed impacts, may introduce variability in the estimated net removals, although the magnitude of these effects is considered relatively small when default factors are appropriately adjusted to national circumstances. Despite these inherent challenges and sources of variability, the conclusion is that the carbon stock change estimation, anchored in the assumptions described, remains reliable. The assessment indicates that the accuracy of emissions and removals associated with forest land is not significantly compromised by the described factors. The default factors, adjusted to align with national circumstances, play a crucial role in mitigating the potential impacts of inter-annual variability, ensuring a reasonable level of precision in the estimation process.

6.2.7. Category-specific QA/QC and verification

Detailed information contain chapter 6.6.6.

6.2.8. Recalculations

Detailed information contain chapter 6.6.7.

6.2.9. Planned improvements

Detailed information contain chapter 6.6.8.

6.3. Cropland (CRT sector 4.B)

6.3.1. Source category description

Estimations for category 4.B were based on IPCC methodology described in the chapter 5. of IPCC 2006 guidelines of the Volume 4. Overall trend in the reporting period is presented on graph below.

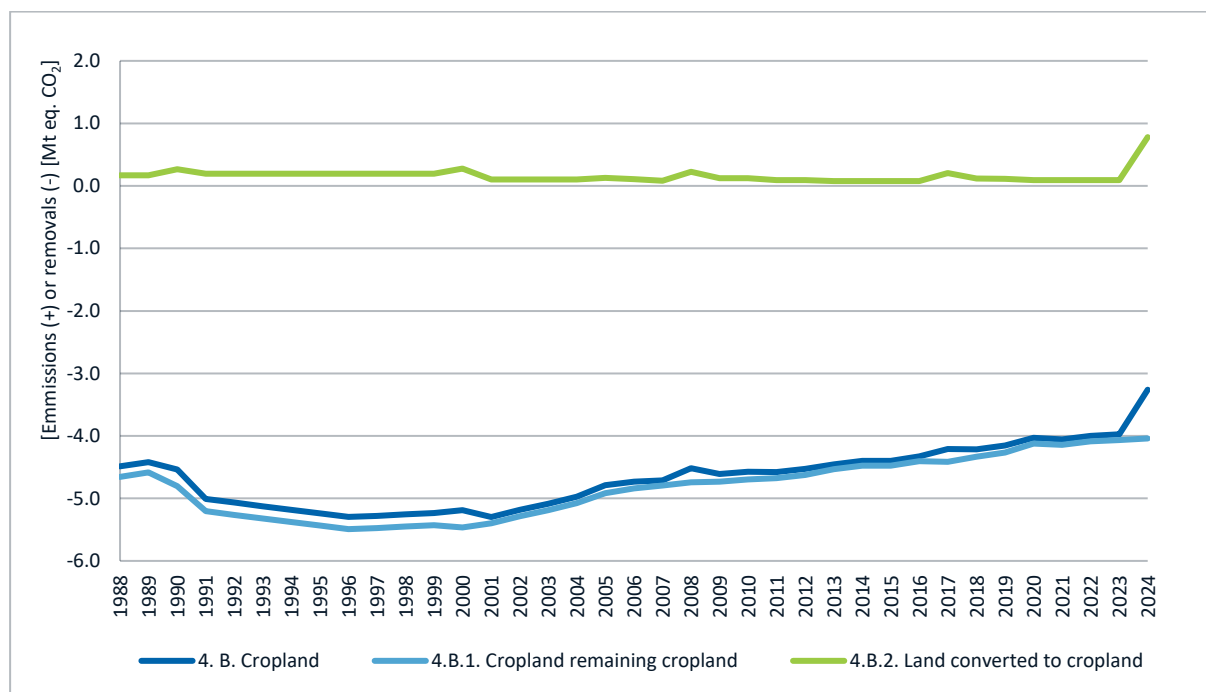


Figure 6.12. Trends in emissions/removals for the category 4.B. *Cropland*

6.3.1.1. Cropland remaining Cropland (CRT sector 4.B.1)

GHG balance in this category was identified as a net CO₂ sink. Net CO₂ balance expressed in CO₂ eq. was equal to CO₂ removals of 4 041 kt.

6.3.1.2. Land converted to Cropland (CRT sector 4.B.2)

GHG balance in this category was identified as a net CO₂ source. Net CO₂ balance expressed in CO₂ eq. was equal to CO₂ emissions of 780 kt.

6.3.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The chosen methodology for estimating carbon stock changes in the context of land-use changes in Poland aligns with Approach 2, as outlined in Chapter 3.3.1 of the IPCC 2006 Guidelines, Volume 4. This approach relies on the information available in the register of land and buildings (cadastral data) as a source of activity data, specifically the area, for the relevant land categories falling under the scope of 4.B.1 Cropland remaining Cropland and 4.B.2 Land converted to Cropland subcategories. For 4.B.1 Cropland remaining Cropland and 4.B.2 Land converted to Cropland, the land use change matrix serves as an important source of activity data. This matrix provides essential information on the transitions and transformations occurring within these specific land categories.

The estimation of carbon stock changes in this context adopts a mixed methodological

approach. This involves estimating annual rates of gains and losses, particularly focusing on national-level data related to the major types of perennial crops in which case Tier 1 methods prioritize simplicity and ease of application, making them suitable for scenarios where detailed data may be limited but where a reasonable level of accuracy can still be achieved.

However, it's noted that there has been an advancement in the estimation of carbon stock changes for non-forest woody areas, shifting towards a Tier 2 approach. This upgraded methodology involves estimating annual carbon stock changes at the national level, taking into account the major types of forest species establishing non-forest woody areas. Tier 2 methods generally incorporate more detailed and region-specific data collected via National Forest Inventory, offering a higher level of precision compared to Tier 1. This dual-tiered approach reflects a pragmatic adaptation to the availability and quality of data. For the major types of perennial crops, the Tier 1 method suffices, providing reasonable estimates at the national level. On the other hand, the improved estimation for non-forest woody areas utilizes Tier 2, acknowledging the need for a more nuanced and detailed approach to capture the dynamics of carbon stock changes in these specific land-use categories. In summary, the selected approach utilising both Tier 1 and Tier 2 methodologies, aligning with the IPCC guidelines and adapting to the specific characteristics of different land-use categories. This demonstrates a thoughtful and flexible approach to carbon accounting, balancing the need for accuracy with the practical constraints posed by data availability.

6.3.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551), agricultural land considered as cropland consists of:

- arable land includes land which is cultivated, i.e. sowed and fallow land. Arable land should be maintained in good agricultural condition. Cultivated arable land is understood as land sowed or planted with agricultural or horticultural products, willow and hops plantations, area of greenhouses, area under cover and area of less than 10a, planted with fruit trees and bushes, as well as green manure,
- fallow land includes arable land which is not used for production purposes but is maintained in good agricultural condition,
- orchards include land with the area of at least 10a, planted with fruit trees and bushes.

Furthermore, some agroforestry systems are also as classified as croplands due to their intentional integration of trees and shrubs with agricultural crops, creating multifunctional landscapes that enhance both productivity and sustainability

6.3.4. Methodological issues

6.3.4.1. Subcategory area

Land use matrix is provided in the annex 5.8.

6.3.4.2. Living organic matter on cropland remaining cropland (4.B.1)

Annual carbon stock change in biomass of perennial woody crops was calculated with Tier 1 methodolog. In this context, annual growth rate of perennial woody crops was calculated using equation 2.7 of IPCC 2006 guidelines of the Volume 4. For calculations there were used

default factors as below:

- biomass accumulation rate – 2.1 [tC/ha] table 5.1 p. 5.9,
- harvest/maturity cycle – 30 [year] table 5.1 p. 5.9, biomass carbon loss – 63 [t/ha*yr] table 5.1 p. 5.9.

Estimation of C stocks changes was made individually on each of the two different types of units of land included in the Cropland category and their subcategories: perennial crops (orchards) and non-woody agricultural land (agroforestry systems). Furthermore, the carbon stock-change method was employed to estimate the emission and removals balance in the agroforestry systems in the subcategory 4.B.1 Cropland remaining Cropland demonstrating a meticulous and data-driven approach. This methodology utilizes recently available National Forest Inventory (NFI) data, incorporating relevant factors as outlined in the sections starting from 6.2.4.4. In this specific case, the stock-difference method is applied, necessitating biomass carbon stock inventories for a given land area at two distinct points in time. The annual biomass change was then computed as the difference between the biomass stock at time t_1 and time t_0 , divided by the number of years between the inventories (as required per Equation 2.8). This approach provides a dynamic understanding of how carbon stocks in perennial woody biomass within non-forest woody areas evolve over time. The annual change in carbon stocks in the living biomass reservoir is a critical component of this estimation, taking into account alterations in non-forest woody resources. This involves considering changes in the structure of non-forest resources by species and age classes under specific land-use conditions. The equation 2.8, as suggested in Volume 4, Chapter 2.3.1.1 of the IPCC guidelines, forms the foundation for these estimations, providing a standardized and widely accepted framework for calculating annual carbon stock changes. Moreover, data sources play a pivotal role in this methodology, with tables describing the structure of non-forest resources by species and age classes under particular land-use categories. These tables provide the necessary information to quantify the changes in biomass carbon stocks over time, contributing to a comprehensive assessment of the emission and removals balance in the context of cropland remaining cropland. The integration of recently available NFI data, coupled with the application of established IPCC guidelines, underscores a commitment to accuracy and reliability in the estimation process. This approach not only leverages current data but also aligns with international standards, ensuring that Poland's assessments of carbon stock changes in non-forest woody areas are robust and comparable on a global scale.

6.3.4.3. Living organic matter on land converted to croplands (4.B.2.)

In the intricate process of estimating carbon stock changes associated with the conversion of diverse land use categories to cropland, a systematic and data-driven approach is paramount. The prevalent data underscores the dynamic nature of land use changes, with notable conversions emanating from various sources, particularly grasslands. These transformations are not limited to natural landscapes but also extend to areas like Settlements and Other land, where industrial dumps, ecologization efforts, and reclamation projects along rivers, contribute to the evolving agricultural landscape. The chosen estimation methodology hinges on Equation 2.15 from the 2006 IPCC Guidelines, offering a standardized framework for evaluating carbon stock changes. The crux of the calculation lies in determining the initial carbon stock changes in biomass, denoted as $\Delta C_{\text{conversions}}$, under Tier 1. This tier prioritizes simplicity and ease of application, making it well-suited for scenarios where detailed data may be limited but where a reasonable level of accuracy can still be achieved. In the calculation, specific assumptions come into play regarding the biomass carbon stock before conversion. For grasslands, a default value of 13.6 tons of dry matter per hectare is employed, aligning

with the characteristics of the cold temperate wet eco-region, as stipulated in Table 6.4 of the 2006 Guidelines. For annual crops, a value of 5 tons of carbon per hectare is utilized, as per Table 5.9 of the same guidelines. These assumptions provide a baseline for understanding the initial carbon stocks in biomass before the conversion process.

A crucial aspect of this methodology is the assumption that the entire carbon stock in biomass present in the land use category before conversion is lost at the moment of conversion to cropland. This assumption is grounded in practical agricultural practices, which often involve intensive soil preparation and the removal of any pre-existing vegetation during the conversion process. While Tier 1 methods offer a simplified approach to carbon accounting, it's important to note that they may lack the granularity and precision of Tier 2 methods. Nevertheless, the chosen approach balances practical constraints and data availability considerations, providing a pragmatic means to estimate carbon stock changes associated with land-use conversions to cropland. In essence, this methodology, guided by the 2006 IPCC Guidelines, forms a crucial component of understanding the carbon dynamics in agricultural lands undergoing transformations. It offers valuable insights into the intricate balance between emissions and removals associated with land-use changes, contributing to a nuanced understanding of the carbon footprint in evolving agricultural ecosystems.

6.3.4.4. Mineral soil

An improvement plan has been elaborated to enhance the assessment of carbon stock changes in the dead organic matter of land categorized as "remaining cropland". This initiative is a response to the development of a national system designed to comply with the reporting requirements outlined in EU Regulation 2018/841 (as amended). The existing methodology assumes that there is no change in the dead organic matter carbon pool due to the absence of management alterations. Consequently, it is expected that reference soil carbon stocks and associated change factors will remain relatively stable over time. Regarding the estimation of carbon stock changes in soil organic matter within this land category, specific assumptions have been employed. The determination of the area for various soil types, including high activity soils, low activity soils, sandy soils, and wetland soils, relies on soil valuation classes. The percentage distribution of each soil group within the cropland category has been established through an analysis of available datasets. For the estimation of carbon stock changes in soil organic matter in land remaining within the same category, assumptions were made based on the estimation of the area for different soil groups (high activity soils, low activity soils, sandy soils, and wetland soils) derived from soil valuation classes. Annual changes in soil carbon stocks were estimated using Equation 2.25 from Chapter 2, Volume 4 of the 2006 IPCC Guidelines. National reference SOC content was assessed based on domestic research data, with assignments to agricultural land valuation classes. Soil groups were classified by agricultural land valuation classes based on clay mineralogy and drainage: high-activity clays (e.g., montmorillonite) for long-term C stabilization; low-activity clays (e.g., kaolinite) with rapid C response; sandy soils (<8% clay); wetland mineral soils prone to drainage-induced C loss. Agricultural land valuation classes were assigned to soil groups as follows:

- high active - soils having appreciable contents of high activity clays (eg. 2:1 expandable clays such as montmorillonite) which promote long-term stabilization of organic matter, particularly in many carbon-rich temperate soils.
- low active - soils with low-activity clays (eg., 1:1 non-expandable clays such as kaolinite and hydrous oxide clays of iron and aluminium) which have a much lower ability to stabilize organic matter and consequently respond more rapidly to changes in the soil's

carbon balance; among these are highly-weathered acid soils of subtropical and tropical regions.

- sandy - soils with less than 8% clay and more than 70% sand, which generally have low structural stability and low capacity to stabilize carbon.
- wetland - mineral soils which have developed in poorly-drained, wet environments; they have reduced decomposition rates and high organic matter contents; if drained for agriculture they are subject to large losses of carbon.

The percentage fraction of particular valuation classes in croplands was calculated based on available data sets.

Table 6.23. Area of soil valuation classes

Valuation classes	1976	1979	1985	1990	2000	2021	2022	2024
	thous. ha							
	arable land and orchard							
Total	15173.7	15073.4	14818	14682.8	14451.1	14 430.0	14 407.0	14358.0
I	69	68.5	67.4	66.5	65.0	64.6	64.5	64.2
II	480	483.8	485	482.2	479.6	482.9	482.0	480.0
III	3621.5	3618.9	3643.7	3650.7	3664.6	3 714.5	3 708.2	3693.9
IV	5961	5924.2	5807.6	5743.4	5640.2	5 688.4	5 681.9	5671.2
V	3151.8	3114.5	3018.3	2976.2	2908.3	2 882.2	2 876.7	2863.3
VI	1890.4	1863.5	1796.1	1763.8	1682.6	1 597.4	1 593.7	14358.0
Land not classified	0.0	0.0	0.0	0.0	10.8	0	0	0

Linear interpolation was applied to estimate values for years with missing data, bridging successive available data poi

Table 6.24. Interpolated results for the area of cropland under different valuation classes in a percentage of the total area (1/6)

SOC content	1988	1989	1990	1991	1992	1993	1994
Very low	28.49	28.55	28.60	28.66	28.71	28.77	28.82
Low	39.15	39.13	39.12	39.11	39.09	39.08	39.07
Average	20.31	20.29	20.27	20.26	20.25	20.24	20.23
High	12.06	12.03	12.01	11.98	11.94	11.91	11.87

Table 6.24. Interpolated results for the area of cropland under different valuation classes in a percentage of the total area (2/6)

SOC content	1995	1996	1997	1998	1999	2000	2001
Very low	28.88	28.93	28.99	29.04	29.10	29.20	29.22
Low	39.06	39.05	39.05	39.04	39.03	39.03	39.05
Average	20.22	20.21	20.20	20.19	20.18	20.13	20.12
High	11.84	11.81	11.77	11.74	11.70	11.64	11.62

Table 6.24. Interpolated results for the area of cropland under different valuation classes in a percentage of the total area (3/6)

SOC content	2002	2003	2004	2005	2006	2007	2008
Very low	29.23	29.25	29.27	29.28	29.30	29.31	29.33
Low	39.07	39.09	39.10	39.12	39.14	39.16	39.18
Average	20.11	20.10	20.10	20.09	20.08	20.07	20.07
High	11.59	11.56	11.53	11.51	11.48	11.45	11.43

Table 6.24. Interpolated results for the area of cropland under different valuation classes in a percentage of the total area (4/6)

SOC content	2009	2010	2011	2012	2013	2014	2015
Very low	29.34	29.36	29.38	29.39	29.41	29.42	29.44
Low	39.20	39.22	39.23	39.25	39.27	39.29	39.31
Average	20.06	20.05	20.05	20.04	20.03	20.02	20.02
High	11.40	11.37	11.34	11.32	11.29	11.26	11.23

Table 6.24. Interpolated results for the area of cropland under different valuation classes in a percentage of the total area (5/6)

SOC content	2016	2017	2018	2019	2020	2021	2022
Very low	29.46	29.47	29.49	29.50	29.52	29.54	29.53
Low	39.33	39.35	39.36	39.38	39.40	39.42	39.44
Average	20.01	20.00	20.00	19.99	19.98	19.97	19.97
High	11.21	11.18	11.15	11.12	11.10	11.07	11.06

Table 6.24. Interpolated results for the area of cropland under different valuation classes in a percentage of the total area (6/6)

SOC content	2023	2024
Very low	29.53	29.52
Low	39.44	39.50
Average	19.97	19.94
High	11.06	11.04

Table 6.25. Soil activity level clasification

SOC content	Soil valuation classes
Very low	I, II, III
Low	IV
Average	V
High	VI

Table 6.26. SOC content by soil groups

SOC content	[%C]
Very low	1.60
Low	0.87
Average	0.58
High	2.04

Source: Kuś J. (2015)

Table 6.27. Soil density by soil groups

SOC content	[t/m3]
Very low	1.6
Low	1.6
Average	1.6
High	1.6

Table 6.28. Thiknesss assessment by soil groups

SOC content	[m]
Very low	0.3
Low	0.3
Average	0.3
High	0.3

The valuation classes of agricultural land, as presented in Table 6.24, play a critical role in describing the quality of the land in terms of its value to agricultural production, including considerations related to carbon content. These classes provide a systematic categorization based on the perceived agricultural value, with Class I representing the highest value and Class VI the lowest. The classification aims to capture the inherent productivity and potential of the land for agricultural purposes, considering all applicable factors that contribute to its overall quality and productivity. Typically, the valuation classes are determined by assessing key attributes of the land, such as soil fertility, drainage, texture, and other factors influencing its suitability for agricultural activities. Land with optimal conditions for agriculture, such as rich soil, good drainage, and favourable climate, is assigned a higher valuation class, indicating its potential for higher agricultural productivity, including the potential to sequester and store carbon in the soil. Conversely, lower valuation classes may be assigned to land with less favourable attributes, such as poor soil quality, inadequate drainage, or other limitations that may restrict its agricultural potential. Understanding and categorizing agricultural land into valuation classes are essential for land-use planning, sustainable agriculture practices, and, in the context of carbon accounting, for assessing the potential of different lands to sequester and store carbon. In summary, the valuation classes of agricultural land, ranging from Class I to Class VI, offer a systematic framework to characterize and categorize land based on its agricultural value, providing valuable insights into its potential for carbon sequestration and overall contribution to agricultural productivity. Finally, to ensure consistency in assessing stock changes for mineral soils only, the share of organic soils has been excluded from each valuation class.

6.3.4.5. Organic soils

The refinement of the area of cultivated organic soils in Poland highlights a commitment to accuracy and updated information in carbon accounting. The updated and unified data, as presented by Walęzak et al. in 2020, reflects a robust approach to enhancing the precision of estimations related to organic soils in Poland. This refinement is crucial for effective environmental management and climate change mitigation strategies. The foundational basis for determining the area of histosols in this submission draws upon the Spatial Information System on Wetlands in Poland, a project undertaken between 2004 and 2006 by the Institute of Technology and Life Sciences. This system provides comprehensive data on wetland areas, which are significant for organic soil classification and assessment. By utilizing this spatial information system, researchers can accurately delineate the extent of organic soils, which are vital for carbon storage and biodiversity. This project served as a valuable resource, providing vector layers that were then compared with Corine Land Cover (CLC) data, acting as a proxy for land cover information. In the recent approach, a more dynamic and detailed strategy is employed, utilizing Corine Land Cover maps published for multiple years: 1990, 2000, 2006, 2012, and 2018. These maps offer a temporal evolution of land cover classes, which are then categorized according to the IPCC classification. The incorporation of IPCC classification ensures a standardized and internationally recognized framework for understanding land use changes. To bridge the data gaps between the years covered by CLC, interpolation methods are applied, ensuring a smooth transition in land cover information. Additionally, for the years 1988-1989, extrapolation is employed, guided by the changes observed between 1990 and 2000. This adaptive approach acknowledges the need to fill in historical data and ensures a more comprehensive and continuous representation of the area of cultivated organic soils over time. Overall, this updated methodology aligns with modern GIS techniques and utilizes a combination of historical project data and contemporary CLC maps to provide a more accurate and coherent estimation of the area of histosols. This

meticulous approach contributes to the overall reliability of carbon accounting in organic soils, addressing the feedback received and incorporating advancements in spatial data analysis and interpretation.

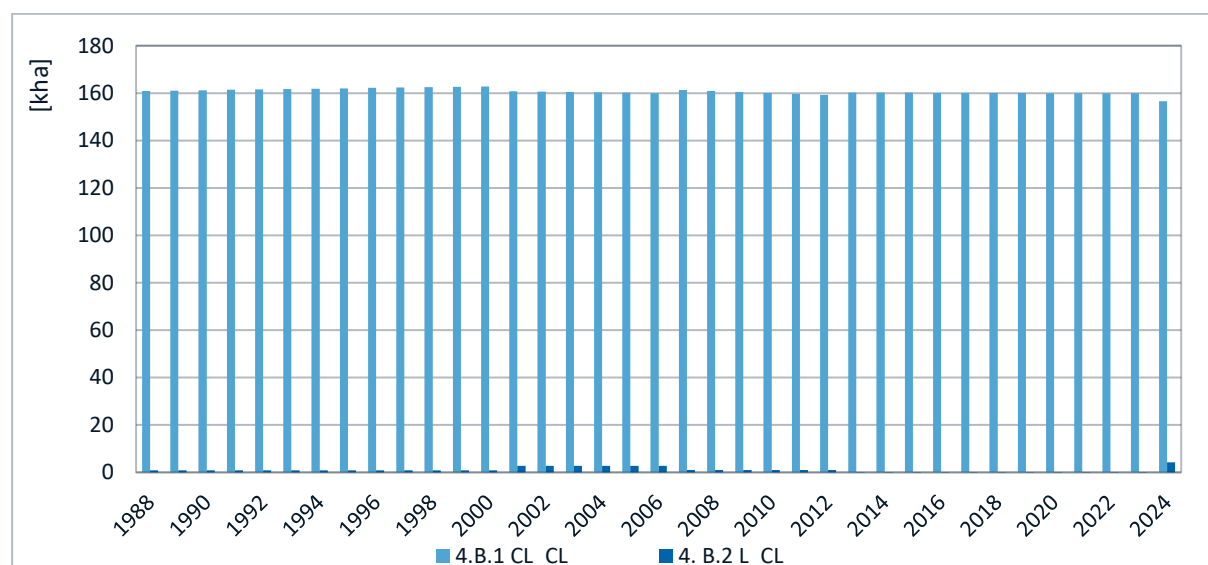


Figure 6.13. Organic soils area on cropland in the period 1988-2024

Table 6.29. CO₂ emission factor for drained organic soils

Name	Volume	Unit
EF _{drainage}	5.0	[tC/ha*y ⁻¹]

The same EF was applied for the estimation of CO₂ emissions on land subject to the categories 4.B.1 as well as for the land subject to the subcategory 4.B.2. The application of the same emission factor (EF) for the estimation of CO₂ emissions on land subject to both the categories 4.B.1 and the subcategory 4.B.2 indicates a simplification or assumption made in the estimation process. The emission factor is a key parameter used to convert changes in carbon stocks into CO₂ emissions or removals. In this case, using the same EF suggests that the carbon dynamics or processes leading to CO₂ emissions are assumed to be similar for both land categories. Application of the same EF simplified calculations and streamlined the estimation process. It's important to recognize that land-use categories and subcategories may have diverse characteristics, management practices, and carbon stock changes. The decision to use the same EF is justified with the limited data differentiation. Furthermore, it's crucial to keep in mind that carbon accounting involves a trade-off between simplicity and accuracy. Balancing these factors is important for obtaining reliable estimates while managing the complexity of the assessment.

The estimation of N₂O (nitrous oxide) emissions from the cultivation of histosols involves the use of a default emission factor as provided by the Intergovernmental Panel on Climate Change (IPCC) in 2006. The emission factor specified for mid-latitude organic soils in the IPCC 2006 Guidelines is 8 kg N₂O-N (nitrous oxide nitrogen) per hectare. The default emission factor serves as a standardized value representing the expected release of N₂O during the cultivation of histosols in mid-latitude regions. This factor takes into account various factors such as soil characteristics, management practices, and climate conditions that influence N₂O emissions from organic soils. In the reporting structure, these N₂O emissions are typically categorized within the agricultural sector, specifically in subcategory 3.D.a.6. This level of detail in reporting allows for a more comprehensive understanding of greenhouse gas emissions

associated with specific agricultural activities, in this case, the cultivation of histosols. It's important to note that while default emission factors provide a standardized approach for estimating emissions, they may not capture site-specific variations or the impact of specific management practices. Site-specific factors, are not available and can't be used to refine emission estimates for greater accuracy. In summary, the reported N₂O emissions from the cultivation of histosols are calculated using the default emission factor of 8 kg N₂O-N per hectare from the IPCC 2006 Guidelines. This value contributes to the overall accounting of greenhouse gas emissions in the agricultural sector, facilitating a comprehensive assessment of the environmental impact associated with the cultivation of histosols.

6.3.4.6. CH₄, N₂O, CO and NO_x emissions from fires

CH₄, N₂O, CO and NO_x emissions from wildfires on croplands are reported in subcategory 4.C.1.

6.3.4.7. Mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices

In the context of the carbon eq. calculation associated with direct N₂O emissions resulting from changes in land use or management of mineral soils in Poland, a Tier 3 method was not applied. Instead, the estimation process adheres to the guidelines outlined in the 2006 IPCC Guidelines. Specifically, the focus is on N (nitrogen) mineralization associated with the loss of soil organic matter (SOM), and N immobilization linked to the gain of soil carbon on mineral soils is not considered in this particular subcategory. The estimation methodology involves using the annual loss of soil carbon in mineral soil as the indicator for the amount of N mineralized. This loss of soil carbon is associated with changes in land use and management practices that impact the mineral soils. The area of mineral soil affected by land use change is determined by subtracting the area of organic soil from the total area of land converted to cropland. This area serves as the key activity data for the estimation process. By utilizing the annual loss of soil carbon in mineral soil and the corresponding area of mineral soil affected by land use change, the estimation model calculates the N₂O emissions resulting from the mineralization associated with the loss of SOM. This approach aligns with the Tier 1 method outlined in the 2006 IPCC Guidelines, providing a practical and standardized way to assess and report direct N₂O emissions from mineral soils in the context of land use changes. Moreover, it is worth to note Tier 3 methods are known for their higher level of detail and accuracy. However, the application of Tier 1 methods is justified in cases where data limitations or practical constraints may impede the use of more intricate methodologies. The chosen approach reflects a pragmatic balance between accuracy and feasibility in estimating N₂O emissions from mineral soils in response to changes in land use or management practices. Estimation of the N release by mineralization was made according to the following steps:

- Step 1: Calculations of the average annual loss of soil C ($\Delta C_{\text{Mineral, LU}}$) for the land use change, over the inventory period, using equation 2.25.
- Step 2: Each land use change has been assessed by the single value of $\Delta C_{\text{Mineral, LU}}$. As a consequence of this loss of soil C (F_{SOM}), equation 11.8 was applied to estimate N potentially mineralized.

Losses of soil organic matter were accounted for land-use change activity occurring when grassland is converted to cropland. Additionally, nitrogen mineralisation was estimated by dividing the carbon loss on grasslands converted to croplands with a C/N-ratio of 15 (default value from IPCC 2006).

6.3.5. Uncertainties and time-series consistency

The introduction of sampling errors in the context of land classification and area estimation is explored with best practices in uncertainty quantification. It facilitates a more nuanced interpretation of the data, allowing to gauge the reliability and robustness of the estimates. This information is crucial for various applications, including climate change mitigation and adaptation strategies. As the data processing is finalized and uncertainty estimates are derived, it will further contribute to the refinement of the overall carbon accounting process. This iterative approach to data improvement and uncertainty assessment is indicative of a commitment to continuous enhancement and adherence to best practices in greenhouse gas inventory reporting. The incorporation of sampling error in the new land classification and area estimation method adds a layer of transparency and reliability to the carbon accounting process, contributing to a more robust understanding of the dynamics of land use changes and their impact on greenhouse gas emissions.

6.3.6. Category-specific QA/QC and verification

Detailed information contain chapter 6.6.6.

6.3.7. Recalculations

Detailed information contain chapter 6.6.7.

6.3.8. Planned improvements

Detailed information contain chapter 6.6.8. Nevertheless, one of the main plans is to conduct an uncertainty analysis in the future. For the estimation of C stock changes in soils of land “remaining croplands” there is an improvement plan available, related to the development of national system to respond accounting requirements set in EU Regulation 2018/841 (as amended). According to this regulation for the period 2021-2025, each Member State shall use at least Tier 1 methodologies in accordance with the 2006 IPCC guidelines for national GHG inventories, except for a carbon pool that accounts for at least 25% of emissions or removals in a source or sink category which is prioritised within a Member State’s national inventory system because its estimate has a significant influence on a country’s total inventory of GHGs in terms of the absolute level of emissions and removals, the trend in emissions and removals, or the uncertainty in emissions and removals in the land use categories, in which case, at least Tier 2 methodologies in accordance with the 2006 IPCC guidelines for national GHG inventories shall be used. From the greenhouse gas inventory submission in 2028 onwards, Member States shall use at least Tier 2 methodologies in accordance with the 2006 IPCC guidelines for national GHG inventories, whereas Member States shall, as early as possible and from the greenhouse gas inventory submission in 2030 onwards, at the latest, for all carbon pool emission and removal estimates falling in areas of high carbon stock land use units such as i.e.: areas of land use units under protection or under restoration and units of land use units under high future climate risks apply Tier 3 methodologies, in accordance with the 2006 IPCC guidelines for national GHG inventories.

6.4. Grassland (CRT sector 4.C)

6.4.1. Source category description

Calculation for category 4.C based on IPCC methodology described in the chapter 6 of IPCC 2006 guidelines of the Volume 4.

Activity data used to calculate GHG emissions for the land included in the *Grassland* category is provided by the land use change matrix, both for the 4.C.1 – *Grassland remaining Grassland* and 4.C.2 *Land converted to Grassland* category. Estimation of carbon stock change in the *Grassland* category corresponds to Tier 1 for perennial grasslands and Tier 2 for non-forest woody vegetation, with country specific data on reference C stock in soils. Overall trend in the reporting period is presented on graph below.

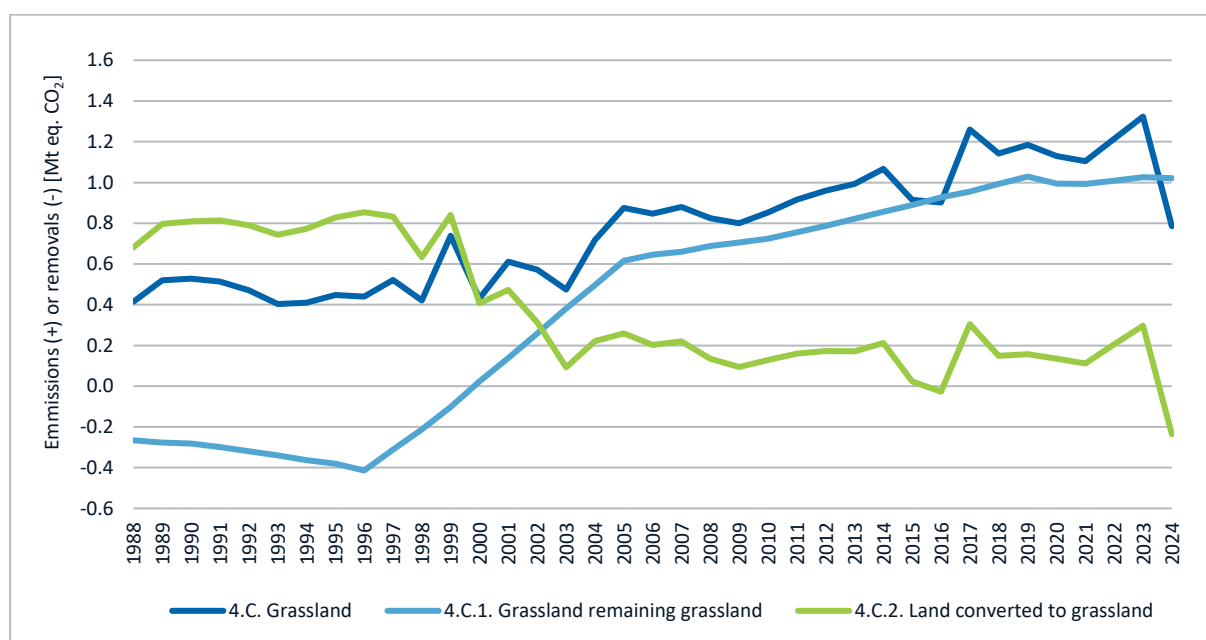


Figure 6.14. Trends in emissions/removals for the category 4.C *Grassland*

6.4.1.1. Grassland remaining Grassland (CRT sector 4.C.1)

GHG balance in this was identified as a net CO₂ source. Net CO₂ balance expressed in CO₂ eq. was equal to 1 021kt of CO₂ emissions.

6.4.1.2. Land converted to Grassland (CRT sector 4.C.2)

GHG balance in this was identified as a net CO₂ sink. Net CO₂ balance expressed in CO₂ eq. was equal to 236 kt of CO₂ removals.

6.4.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

According to the description suggested in the chapter 3.3.1. of IPCC 2006 Guidelines of the Volume 4, Poland has selected Approach 2, considering the set of information's available in the register of land and buildings. Selected approach is a practical option when a comprehensive system for collecting detailed data on land-use changes is already in place, as it minimizes the need for additional, dedicated surveys. By leveraging information from existing registers, the process of obtaining activity data, which is crucial for accurate

greenhouse gas inventory reporting could have been potentially streamlined. The use of the register of land and buildings could help in tapping into a centralized database that likely contains records of land-use changes, property ownership, and related information. This approach aligns with the IPCC guidelines, which encourage countries to utilize the most relevant and reliable data sources available within their national context. While approach 2 offers advantages in terms of efficiency and resource utilization, it is essential to ensure that the data extracted from the register aligns with the specific requirements outlined in the IPCC guidelines.

6.4.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551), agricultural land considered as grassland consists of:

- permanent meadows and pastures include land permanently covered with grass, but it does not include arable land sown with grass as part of crop rotation; permanent meadows are understood as the land permanently covered with grass and mown in principle and in mountain area also the area of mown mountain pastures and meadows.
- permanent pastures are understood as the land permanently covered with grass not mown but grazed in principle and in mountain area – also the area of grazed pastures and meadows.

Permanent meadows and pastures classified to this category must be maintained in good agricultural condition. These areas of land that are designated for the long-term cultivation of grasses, legumes, and other forage crops. Permanent meadows and pastures are crucial for livestock grazing, providing feed for animals, supporting biodiversity, and contributing to sustainable agricultural practices. Furthermore, the term "classified to this category" implies that these meadows and pastures fall into a specific category, likely within a broader agricultural classification system. This classification is based on factors such as land use, soil quality, or other criteria relevant to agricultural management. Moreover, in terms of maintenance (in good agricultural condition) underscores the need for responsible and sustainable land management practices. This includes measures to prevent soil erosion, manage vegetation, control invasive species, and ensure the overall health and productivity of the meadows and pastures. Compliance with this requirement is likely driven by agricultural policies or regulations aimed at promoting environmental sustainability, maintaining the health of agricultural ecosystems, and ensuring the long-term viability of these areas for farming and grazing activities. This approach aligns with broader goals of sustainable land management, conservation, and the promotion of environmentally sound agricultural practices.

Furthermore, some agroforestry systems are also classified in this category due to their integration with grassland ecosystems and their ecological functions. These systems combine trees or shrubs with agricultural activities, such as livestock grazing, within grassland areas. The interspersing of woody vegetation among grasses enhances biodiversity, improves soil health through nutrient cycling, and contributes to carbon sequestration by storing significant amounts of carbon, depending on the system's design and management. The classification as grasslands is also practical because agroforestry systems are typically established on existing grasslands, maintaining their primary function while diversifying land use. In essence,

agroforestry systems are classified as grasslands because they retain the core characteristics of grassland ecosystems while enhancing their ecological and economic value through the introduction of trees or shrubs. This dual functionality ensures sustainable land use while contributing to environmental conservation and agricultural productivity.

6.4.4. Methodological issues

6.4.4.1. Subcategory area

Land use change matrix is provided in the annex 5.8.

6.4.4.2. Living organic matter

Estimates of the change of C stocks vary by type of land included in this land category.

Grassland remaining grassland

In the case of grasslands with grassy vegetation where no changes in management occurred a default approach assuming no changes in the C stocks of any pool (aboveground, belowground) has been applied. Estimation of C stocks changes was made individually on each of the two different types of land included in the Grassland category and their subcategories. The carbon stock-change method was employed to estimate the emission and removals balance in the subcategory *4.C.1 Grassland remaining Grassland* demonstrating a meticulous and data-driven approach. This methodology utilizes recently available National Forest Inventory (NFI) data, incorporating relevant factors as outlined in the sections starting from 6.2.4.4. In this specific case, the stock-difference method is applied, necessitating biomass carbon stock inventories for a given land area at two distinct points in time. The annual biomass change was then computed as the difference between the biomass stock at time t_1 and time t_0 , divided by the number of years between the inventories (as required per Equation 2.8). This approach provides a dynamic understanding of how carbon stocks in perennial woody biomass within non-forest woody areas evolve over time. The annual change in carbon stocks in the living biomass reservoir is a critical component of this estimation, taking into account alterations in non-forest woody resources. This involves considering changes in the structure of non-forest resources by species and age classes under specific land-use conditions. The equation 2.8, as suggested in Volume 4, Chapter 2.3.1.1 of the IPCC guidelines, forms the foundation for these estimations, providing a standardized and widely accepted framework for calculating annual carbon stock changes. Moreover, data sources play a pivotal role in this methodology, with tables describing the structure of non-forest resources by species and age classes under particular land-use categories. These tables provide the necessary information to quantify the changes in biomass carbon stocks over time, contributing to a comprehensive assessment of the emission and removals balance in the context of cropland remaining cropland. The integration of recently available NFI data, coupled with the application of established IPCC guidelines, underscores a commitment to accuracy and reliability in the estimation process. This approach not only leverages current data but also aligns with international standards, ensuring that Poland's assessments of carbon stock changes in non-forest woody areas are robust and comparable on a global scale.

Land converted to grassland

A default biomass value for the cold temperate wet eco-region (Table 6.4 of 2006 Guidelines) of 13.6 t d.m./ha was used in calculations. Estimates are calculated using equation 2.15 from 2006 Guidelines. Initial C stock changes in biomass are calculated under Tier 1 ($\Delta C_{\text{conversions}}$), assuming a default biomass C stock for annual crops (Table 5.9 of 2006 Guidelines).

6.4.4.3. Change of C stock in dead organic matter and soil

An improvement plan has been devised to enhance the assessment of carbon stock changes in the dead organic matter of land categorized as "remaining grasslands." This initiative is a response to the development of a national system designed to comply with the reporting requirements outlined in EU Regulation 2018/841 (as amended). The existing methodology posits that there is no change in the dead organic matter carbon pool due to the absence of management alterations. Consequently, it is expected that reference soil carbon stocks and associated change factors will remain relatively stable over time. Regarding the estimation of carbon stock changes in soil organic matter within this land category, specific assumptions have been employed. The determination of the area for various soil types, including high activity soils, low activity soils, sandy soils, and wetland soils, relies on soil valuation classes. The percentage distribution of each soil type within the grassland category has been established through an analysis of available datasets. For the estimation of carbon stock changes in soil organic matter in land remaining within the same category, assumptions were made based on the estimation of the area for different soil types (high activity soils, low activity soils, sandy soils, and wetland soils) derived from soil valuation classes. The percentage fraction of each soil type within the grassland was calculated using available datasets. In essence, the adopted methodology for estimating carbon stock changes in soil organic matter reflects a comprehensive and data-driven approach. The inclusion of diverse soil types, reliance on soil valuation classes, and the utilization of datasets ensure a thorough and nuanced assessment of how land within the same category experiences alterations in carbon stocks within its soil organic matter.

Table 6.30. Area of soil valuation classes

Valuation classes	1976	1979	1985	1990	2000	2021	2022	2023	2024
	thous. ha								
	grassland								
Total	4175.7	4127.1	4126.9	4122	4085.8	4154.6	4155.9	4 157.3	4162.9
I	2.0	2.2	2.6	2.2	2.8	1.6	1.6	1.7	1.6
II	67.6	67.3	65.3	61.9	56.8	47.2	47.4	47.8	46.4
III	531.7	533.2	555.4	550.9	537.3	521.4	519.7	518.1	516.9
IV	1666.5	1687.6	1738	1750	1762.7	1795.5	1794.5	1 793.6	1797.3
V	1370.2	1326.5	1292	1291	1288.9	1336.4	1336.7	1 337.1	1341.7
VI	537.7	510.3	473.6	466	432.3	452.4	455.6	459.0	458.9
land not classified	0.0	0.0	0.0	0.0	5.0	0	0	0	0

In the absence of comprehensive data, linear interpolation was employed to estimate values between the available data points in successive years. This method assumes a constant rate of change between the known data points, providing a straightforward way to estimate values at intermediate time points.

Table 6.31. Interpolated results for the area of grassland under different valuation classes in a percentage of the total area (1/6)

SOC content	1988	1989	1990	1991	1992	1993	1994
Very low	15.00	14.97	14.92	14.89	14.86	14.84	14.82
Low	42.32	42.38	42.46	42.53	42.61	42.68	42.75
Average	31.31	31.31	31.32	31.34	31.37	31.39	31.41
High	11.37	11.34	11.31	11.23	11.16	11.09	11.02

Table 6.31. Interpolated results for the area of of grassland under different valuation classes in a percentage of the total area (2/6)

SOC content	1995	1996	1997	1998	1999	2000	2001
Very low	14.80	14.78	14.76	14.74	14.73	14.73	14.57
Low	42.83	42.90	42.97	43.04	43.11	43.14	43.26
Average	31.43	31.45	31.47	31.49	31.51	31.55	31.58
High	10.94	10.87	10.80	10.72	10.65	10.58	10.60

Table 6.31. Interpolated results for the area of of grassland under different valuation classes in a percentage of the total area (3/6)

SOC content	2002	2003	2004	2005	2006	2007	2008
Very low	14.52	14.48	14.44	14.40	14.35	14.31	14.27
Low	43.26	43.26	43.26	43.25	43.25	43.25	43.25
Average	31.61	31.64	31.67	31.70	31.73	31.76	31.79
High	10.61	10.63	10.64	10.65	10.67	10.68	10.70

Table 6.31. Interpolated results for the area of of grassland under different valuation classes in a percentage of the total area (4/6)

SOC content	2009	2010	2011	2012	2013	2014	2015
Very low	14.23	14.18	14.14	14.10	14.06	14.02	13.98
Low	43.24	43.24	43.24	43.24	43.24	43.23	43.23
Average	31.81	31.84	31.87	31.90	31.93	31.96	31.99
High	10.71	10.73	10.74	10.76	10.77	10.79	10.80

Table 6.31. Interpolated results for the area of of grassland under different valuation classes in a percentage of the total area (5/6)

SOC content	2016	2017	2018	2019	2020	2021	2022
Very low	13.93	13.89	13.85	13.81	13.77	13.73	13.69
Low	43.23	43.23	43.22	43.22	43.22	43.22	43.18
Average	32.02	32.05	32.08	32.11	32.14	32.17	32.17
High	10.82	10.83	10.85	10.86	10.87	10.89	10.96

Table 6.31. Interpolated results for the area of of grassland under different valuation classes in a percentage of the total area (6/6)

SOC content	2023	2024
Very low	13.65	13.57
Low	43.14	43.17
Average	32.16	32.23
High	11.04	11.02

Table 6.32. Soil activity level clasification

SOC content	Soil valuation classes
Very low	I, II, III
Low	IV
Average	V
High	other

Table 6.33. SOC content by soil groups

SOC content	[%C]
Very low	1.60
Low	0.87
Average	0.58
High	2.04

Source: Kuś J. (2015)

Table 6.34 Soil density by soil groups

SOC content	[t/m ³]
Very low	1.6
Low	1.6
Average	1.6
High	1.6

Table 6.35. Thiknesss assessment by soil groups

SOC content	[m]
Very low	0.3
Low	0.3
Average	0.3
High	0.3

The valuation classes of agricultural land (notably grasslands), as presented in Table 6.31, play a critical role in describing the quality of the land in terms of its value to agricultural production, including considerations related to carbon content. These classes provide a systematic categorization based on the perceived agricultural value, with Class I representing the highest value and Class VI the lowest. The classification aims to capture the inherent productivity and potential of the land for agricultural purposes, considering all applicable factors that contribute to its overall quality and productivity. Typically, the valuation classes are determined by assessing key attributes of the land, such as soil fertility, drainage, texture, and other factors influencing its suitability for agricultural activities. Land with optimal conditions for agriculture, such as rich soil, good drainage, and favourable climate, is assigned a higher valuation class, indicating its potential for higher agricultural productivity, including the potential to sequester and store carbon in the soil. Conversely, lower valuation classes may be assigned to land with less favourable attributes, such as poor soil quality, inadequate drainage, or other limitations that may restrict its agricultural potential.

Furthermore, grassland valuation classes often shift due to management practices such as varying grazing intensity, mowing frequency, or cessation of burning, which over time promote scrub encroachment or nutrient enrichment. Under-grazing typically drives ecological succession toward woodland dominance, while over-grazing or external nutrient inputs alter soil organic carbon (SOC) stocks through erosion, compaction, or enhanced decomposition. These dynamics align with Tier 2 factors in the 2006 IPCC Guidelines (Volume 4, Chapter 6), where grassland management effects on SOC are quantified using country- or region-specific stock change factors as a key advancement over Tier 1 defaults.

Country-specific factors compute differences in SOC stocks relative to a reference condition, starting with the land-use factor (F_{LU}). Input (F_I) and management (F_M) factors then refine these estimates further, distinguishing improved (e.g., fertilized, limed) from unimproved (e.g., natural) grazing or mowing regimes. Tier 2 methods apply these factors separately or on an aggregated scale to soil C pool. Since these factors shape the condition of agricultural land classified as grassland, they are inherently reflected in valuation class changes, enabling aggregated-scale assessments of SOC dynamics.

Understanding and categorizing agricultural land into valuation classes are essential for land-use planning, sustainable agriculture practices, and, in the context of carbon accounting, for assessing the potential of different lands to sequester and store carbon. Furthermore, the valuation classes of agricultural land, ranging from Class I to Class VI, offer a systematic framework to characterize and categorize land based on its agricultural value and potential productivity, providing valuable insights into its potential for carbon sequestration and overall contribution to agricultural productivity. Finally, to ensure consistency in assessing stock changes for mineral soils only, the share of organic soils has been excluded from each valuation class.

6.4.4.4. Organic soils

Following recommendation A.19 as outlined in the review report FCCC/ARR/2018/POL, there was a significant update and consolidation of the area of cultivated organic soils [Walęzak et al, 2020]. The primary foundation for determining the area of histosols in this submission was derived from the Spatial Information System on Wetlands in Poland, a project undertaken between 2004 and 2006 by the Institute of Technology and Life Sciences. In this approach, vector layers from the available project were compared with Corine land cover data, which served as a proxy for validating and refining the estimates. The recent methodology incorporates Corine Land Cover maps published for the years 1990, 2000, 2006, 2012, and 2018. The land cover classes from these maps were categorized into IPCC classifications, accounting for specific land uses. To ensure continuity between the years covered by Corine Land Cover maps, data was interpolated. For the years 1988-1989, where direct data was not available, extrapolation was performed based on observed changes between 1990 and 2000. This meticulous approach involving a blend of historical data, contemporary mapping, and advanced interpolation techniques contributes to a more accurate and updated representation of cultivated organic soils in Poland.

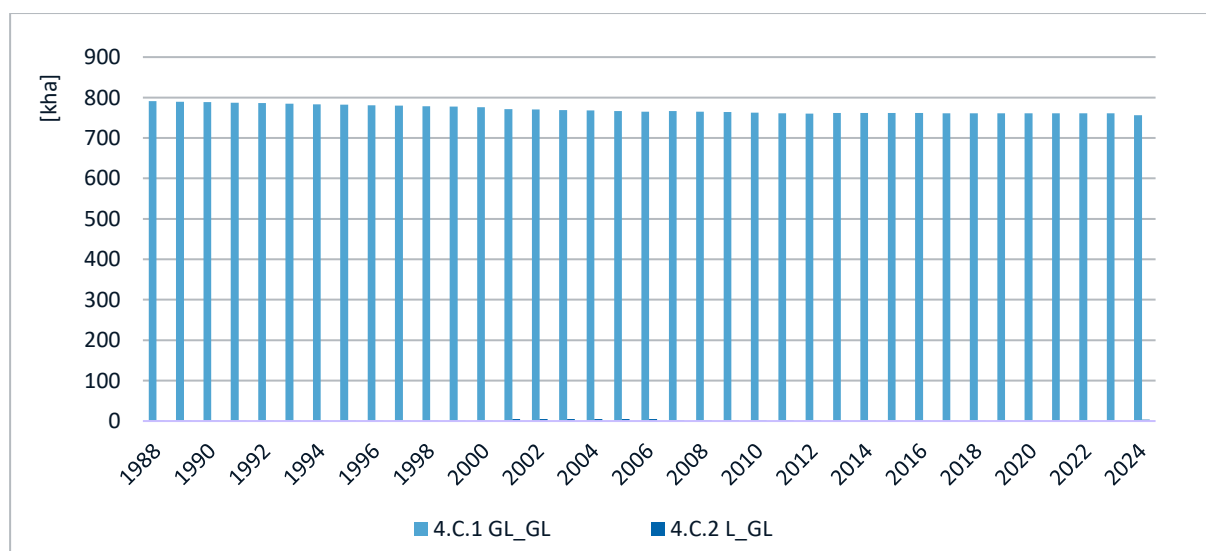


Figure 6.15. Organic soils area on grassland in the period 1988-2024

Table 6.36 CO₂ emission factor for drained organic soils

Name	Volume	Unit
EF _{drainage}	0.25	[tC/ha*y ⁻¹]

The same Emission Factor (EF) was applied for the estimation of CO₂ emissions on land categorized under both 4.C.1 and the subcategory 4.C.2. For the calculation of CO₂ emissions from cultivated organic soils, the default emission factor for cold temperate regions was utilized, specifically 0.25 tC/ha*year⁻¹ [IPCC 2006, table 6.3, page 6.17]. This standardized emission factor serves as a reference value for assessing carbon dioxide emissions associated with the specified land uses, ensuring consistency in the estimation approach.

6.4.4.5. Biomass burning

CH₄, N₂O, CO and NO_x emissions from fires were calculated using following equation (IPCC 2006, page 2.429, equation 2.27). This subcategory is covering the non-CO₂ emission from crop area, meadows and stubbles fires. Estimated non-CO₂ emissions include those from burning of slash on-site and, for more than a decade, those from wildfires. Non-CO₂ emissions from the mentioned sources are not significant, and are only reported for the sake of completeness and that of time series consistency with previous years. Note that CO₂ emissions from these sources are accounted for in the biomass pool, because we apply the stock-change method. Non-CO₂ emissions include the carbon of CO and CH₄, however, these gases are nevertheless reported because of their high global warming potential, because the double counting of the carbon is negligible, and also in order to comply with the IPCC 2006 GL.

Table 6.37. Emissions ratios for calculation CH₄, N₂O, CO and NO_x emissions from grassland fires [table 2.5 p. 2.47 of IPCC 2006 Guidelines, Volume 4]

Compound	Ratio [g/kg d.m burnt]		
CH ₄	2.3	default	[IPCC 2006]
CO	65	default	[IPCC 2006]
N ₂ O	0.21	default	[IPCC 2006]
NO _x	3.9	default	[IPCC 2006]

Table 6.38. Fraction of biomass combusted

Compound	Ratio		
C _f	0.9	Country specific	Łoboda (1994)

Table 6.39. Mass of available fuel

Year	Unit	Compound (M _b)	Year	Unit	Compound (M _b)
1988	[t. d.m./ha ⁻¹]	3.6	2007	[t. d.m./ha ⁻¹]	3.6
1989	[t. d.m./ha ⁻¹]	3.6	2008	[t. d.m./ha ⁻¹]	3.6
1990	[t. d.m./ha ⁻¹]	3.6	2009	[t. d.m./ha ⁻¹]	3.6
1991	[t. d.m./ha ⁻¹]	3.6	2010	[t. d.m./ha ⁻¹]	3.6
1992	[t. d.m./ha ⁻¹]	3.6	2011	[t. d.m./ha ⁻¹]	3.6
1993	[t. d.m./ha ⁻¹]	3.6	2012	[t. d.m./ha ⁻¹]	3.6
1994	[t. d.m./ha ⁻¹]	3.6	2013	[t. d.m./ha ⁻¹]	3.6
1995	[t. d.m./ha ⁻¹]	3.6	2014	[t. d.m./ha ⁻¹]	3.6
1996	[t. d.m./ha ⁻¹]	3.6	2015	[t. d.m./ha ⁻¹]	3.6
1997	[t. d.m./ha ⁻¹]	3.6	2016	[t. d.m./ha ⁻¹]	3.6
1998	[t. d.m./ha ⁻¹]	3.6	2017	[t. d.m./ha ⁻¹]	3.6
1999	[t. d.m./ha ⁻¹]	3.6	2018	[t. d.m./ha ⁻¹]	3.6
2000	[t. d.m./ha ⁻¹]	3.6	2019	[t. d.m./ha ⁻¹]	3.6
2001	[t. d.m./ha ⁻¹]	3.6	2020	[t. d.m./ha ⁻¹]	3.6

2002	[t. d.m./ha ⁻¹]	3.6	2021	[t. d.m./ha ⁻¹]	3.6
2003	[t. d.m./ha ⁻¹]	3.6	2022	[t. d.m./ha ⁻¹]	3.6
2004	[t. d.m./ha ⁻¹]	3.6	2023	[t. d.m./ha ⁻¹]	3.6
2005	[t. d.m./ha ⁻¹]	3.6	2024	[t. d.m./ha ⁻¹]	3.6
2006	[t. d.m./ha ⁻¹]	3.6			

Emission estimates for biomass burning adhered to section 6.2.4.11 of the relevant IPCC guidelines. Initially, the default biomass burned value of 3.6 t d.m. was applied, based on national research (Cenowski, 1996). Recent data improvements have enabled more precise estimates through expert elicitation, surpassing prior expert judgments. Enhanced data availability has strengthened emission evaluations, improving overall estimation reliability.

6.4.5. Uncertainties and time-series consistency

Detailed information contain chapter 6.6.5.

6.4.6. Category-specific QA/QC and verification

Detailed information contain chapter 6.6.6.

6.4.7. Recalculations

Detailed information contain chapter 6.6.7.

6.4.8. Planned improvements

The estimation of carbon (C) stock changes in soils of "remaining grasslands" is part of an improvement plan aligned with the development of a national system to meet the accounting requirements specified in EU Regulation 2018/841 (as amended). According to this regulation, a tiered approach is mandated for greenhouse gas inventory methodologies over specific periods. For the period 2021-2025, each Member State is mandated to use at least Tier 1 methodologies following the 2006 IPCC guidelines for national greenhouse gas inventories. Exceptions are made for carbon pools that account for at least 25% of emissions or removals in a source or sink category, prioritized within a Member State's national inventory system due to its significant influence on the country's total greenhouse gas inventory in terms of absolute levels, trends, or uncertainty. In such cases, at least Tier 2 methodologies in accordance with the 2006 IPCC guidelines for national greenhouse gas inventories shall be used. Starting from the greenhouse gas inventory submission in 2028, Member States are obliged to use at least Tier 2 methodologies according to the 2006 IPCC guidelines. Furthermore, from the greenhouse gas inventory submission in 2030 onwards, and as early as possible, Tier 3 methodologies must be applied for all carbon pool emission and removal estimates falling in areas of high carbon stock land use units such as areas under protection or restoration and areas under high future climate risks. These requirements ensure a progressively refined and sophisticated approach to carbon stock estimation, aligning with evolving methodologies and addressing the complexities of specific land use contexts.

6.5. Wetlands (CRT sector 4.D)

6.5.1. Source category description

Calculation for category 4.D is based on IPCC methodology described in the chapter 7 of IPCC 2006 guidelines of the Volume 4. Overall trend in the reporting period is presented on graph below.

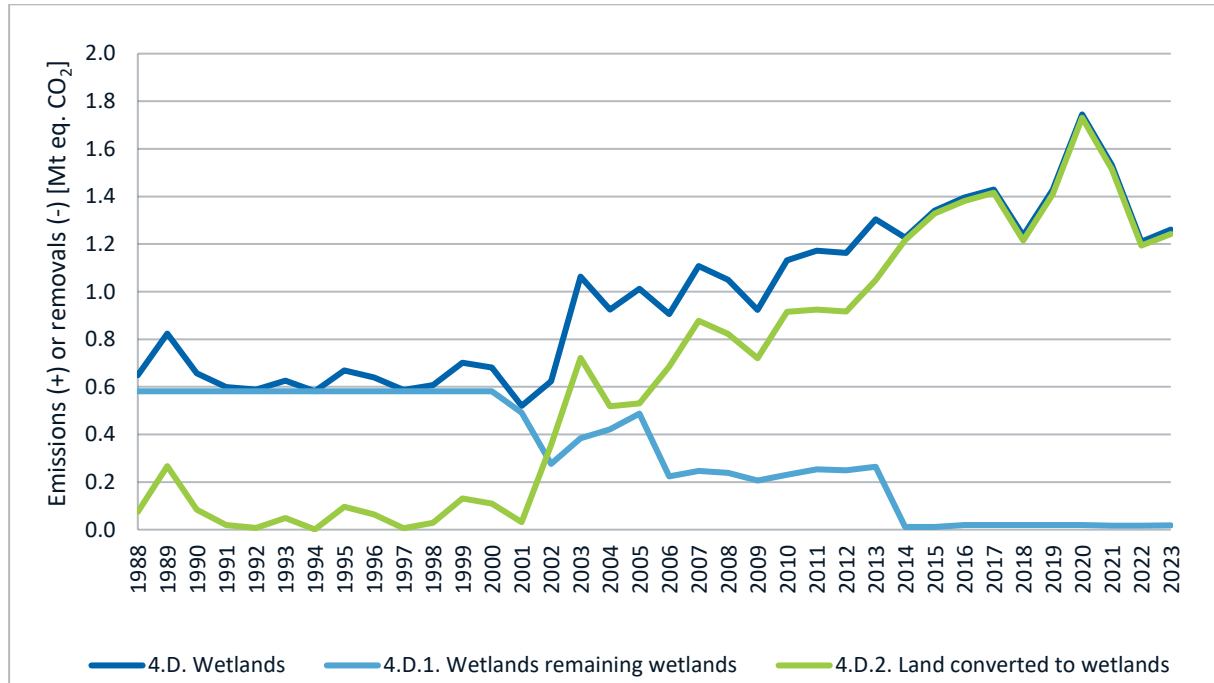


Figure 6.16. Trends in emissions/removals for the category 4.D. *Wetland*

The observed emissions and removals are driven by two main factors. Firstly, a significant increase in land area conversion to wetlands occurred, primarily through the clearing of grasslands. Additionally, in 2002, an area of 2226 hectares, in 2016, an area of 1477 hectares, and in 2024 an area of 17 ha was converted for peat extraction. The carbon stock change in living biomass for lands converted for peat extraction to the carbon stock change in biomass (CSC) was estimated using default factors available for grassland ($B_{\text{before}} = 2.4$ IPCC default tab 6.4. p. 6.27). Consequently, emissions associated with this activity were reported under category 4.D.2.2.2. Moreover, it is assumed that during peat extraction in a new milling season, any potential living biomass should be removed to access the available peat layers. In this specific case, the reported emissions are linked to the carbon stock change in living biomass. It is further assumed that any peat excavation in existing peatlands is preceded by the removal of biomass. The amount of biomass removed in this case was also assigned to the default factors available for grassland ($B_{\text{before}} = 2.4$ IPCC default tab 6.4. p. 6.27). This approach aligns with the principle of conservativeness, ensuring that potential emissions are accounted for in a precautionary manner.

6.5.1.1. Wetlands remaining wetlands

GHG balance in this was identified as a net CO₂ source. Net CO₂ balance was equal to 20 kt of CO₂ eq. emissions.

6.5.1.2. Lands converted to Wetlands

GHG balance in this was identified as a net CO₂ source. Net CO₂ balance was equal to 1 319 kt of CO₂ eq. emissions.

6.5.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

According to the description suggested in the chapter 3.3.1. of IPCC 2006 Guidelines of the Volume 4, Poland has selected Approach 2, considering the set of information's available in the register of land and buildings. This selection is based on the information available in the register of land and buildings. Furthermore, recent approach involves utilizing data and details present in the designated registry to carry out estimations and assessments related to land use and its associated carbon stock changes.

6.5.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551), agricultural land considered as wetland consists of:

1. land under waters:
 - marine internal;
 - surface flowing waters, which covers land under waters flowing in rivers, mountain streams, channels, and other water courses, permanently or seasonally and their sources as well as land under lakes and artificial water reservoirs. from or to which the water course flow;
 - land under surface lentic water which covers land under water in lakes and reservoirs other than those described above;
2. land under ponds including water reservoirs (excluding lakes and dam reservoirs for water level adjustment) including ditches and areas adjacent and related to ponds;
3. land under ditches including open ditches acting as land improvement facilities for land used.

CO₂ and N₂O emissions are estimated from organic soils managed for peat extraction. Since 1999 national statistics contain data on area of organic soils managed for peat extraction It need to be highlighted that data from national statistics are consistent with the previously estimated values of organic soils managed for peat extraction. For the period 1988-1998 the latest available data was applied.

Table 6.40. Open drained area used for peat excavation in Poland (1/4)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Area	5178	5178	5178	5178	5178	5178	5178	5178	5178	5178	5178	5178

Table 6.40. Open drained area used for peat excavation in Poland (2/4)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Area	5178	2912	5138	5141	5508	5107	3429	3433	3410	3317	3314	3312

Table 6.40. Open drained area used for peat excavation in Poland (3/4)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Area	3283	3275	1960	3437	3485	3485	3451	3434	3423	2918	3215

Table 6.40. Open drained area used for peat excavation in Poland (4/4)

Year	2023	2024
Area	3226	3243

Data source: Statistics Poland - Environmental Protection 1990-2024.

6.5.4. Methodological issues

6.5.4.1. Wetlands remaining wetlands

Since emissions from peatlands undergoing extraction differ substantially in scale and type from emissions from land being converted for peat extraction, countries with an active peat industry should separate their managed peatlands accordingly. Estimating CO₂ emissions from lands undergoing peat extraction has two basic elements: on-site emissions from peat deposits during the extraction phase, and off-site emissions from the horticultural (non-energy) use of peat. It is also assumed that when peat is removed in a new milling in a given extraction season, any potential living biomass should be also removed to provide and access to the available peat layers. In this particular case emissions as reported refers to any potential emissions linked to the carbon stock change in living biomass. It is, therefore, assumed that any peat excavation in existing peatlands is preceded by the biomass removal. In this case the amount of biomass removed was also assigned to the default factors available for grassland (B_{before} = 2.4 IPCC default tab 6.4. p. 6.27). Principle of conservativeness has been taken into consideration in this case. On site emission calculations are based on equation 7.6 of IPCC 2006 guidelines of the Volume 4. page 7.9.

Table 6.41. On site emission factors for CO₂-C

Symbol	Unit	Emission factor	Source
EF _{peatNrich}	[t C/ha* y ⁻¹]	1.1	table 7.4. page 7.13 IPCC 2006
EF _{peatNpoor}	[t C/ha*y ⁻¹]	0.2	

N₂O emission calculations are based on equation 7.7 of IPCC 2006 guidelines of the Volume 4.

Table 6.42. On site emission factors for N₂O emissions from managed peatlands

Symbol	Unit	Emission factor	Source
EF _{peatNrich}	[kgN ₂ O/ha*y ⁻¹]	1.8	table 7.6. page 7.16 IPCC 2006
EF _{peatNpoor}	[kgN ₂ O/ha*y ⁻¹]	0.1	

CO₂ emission calculations are based on equation 7.5 of IPCC 2006 guidelines of the Volume 4. For calculations default emission factors for cold climate were used.

6.5.4.3. Peatlands

A peatland is a wetland ecosystem with a relatively thick (>40 cm) soil layer of organic matter above a mineral substrate (Trettin et al., 2005). The utilization of peatland for peat production

(peat harvesting) is not common but these emissions, mainly from dead organic matter may have significant impact on overall sectoral GHG's balance. Peat from the uppermost and deeper peatland layers are used for different purposes. The uppermost peat layers of peatland are not as well decomposed and are suitable for environmental protection, gardening and agricultural purposes because of their physical, chemical and biological properties. The structure of low decomposed surface peat results in a great water storage capability. In addition, it can absorb nutrients, metals and gases.

Poland reports emissions (on-site and off-site) associated with industrial peat extraction in this category. Off-site CO₂-C emissions are associated to the horticultural (non-energy) use of peat extracted and removed. 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.

Off-site emission estimates from peatlands were derived by converting the annual peat production data (air-dry weight) to the weight of carbon (Equation 7.5 page 7.11 of the IPCC 2006). All carbon in horticultural peat is assumed to be emitted during the extraction year.

The rest of the area of wetlands is not managed (undrained) and CO₂ emissions are not calculated. Off-site CO₂-C emissions associated to the horticultural (non-energy) use of peat extracted and removed are reported using instant oxidation method (Tier 2 method). Data on peat extraction for horticulture purposes is taken directly from statistics using extrapolation method for the periods, when official data are not available. Carbon content in peat is considered 40% according to IPCC 2006 Guidelines, with its relative moisture content of air-dry peat of 40%.

Off-site emission estimates from peatlands were derived by converting the annual peat production data (air-dry weight) to the weight of carbon (Equation 7.5 page 7.11 of the IPCC 2006). Since all carbon in extracted horticultural peat is assumed to be emitted during the extraction year, peat production (extraction) data is considered as major factor of DOM emissions.

Table 6.43. Emission factors for the subcategory peatland remaining peatland

Symbol	Unit	Emission factor	Source
Cfraction wt_peat	[t C/t air-dry peat ⁻¹]	0.4	table 7.5. page 7.13 IPCC 2006

N₂O emissions from peatlands during peat extraction

Equation 7.7 of Section 7.2.1 of the IPCC 2006 describes the default approach to estimate N₂O emissions in this section.

6.5.4.3. Organic soils

The primary foundation for determining the area of histosols in this submission was derived from the Spatial Information System on Wetlands in Poland, a project undertaken between 2004 and 2006 by the Institute of Technology and Life Sciences. In this approach, vector layers from the available project were compared with Corine land cover data, which served as a proxy for validating and refining the estimates. The recent methodology [Walezak, et.al.] incorporates Corine Land Cover maps published for the years 1990, 2000, 2006, 2012, and 2018. The land cover classes from these maps were categorized into IPCC classifications, accounting for specific land uses. To ensure continuity between the years covered by Corine Land Cover maps, data was interpolated. For the years 1988-1989, where direct data was not

available, extrapolation was performed based on observed changes between 1990 and 2000. This meticulous approach involving a blend of historical data, contemporary mapping, and advanced interpolation techniques contributes to a more accurate and updated representation of cultivated organic soils in Poland.

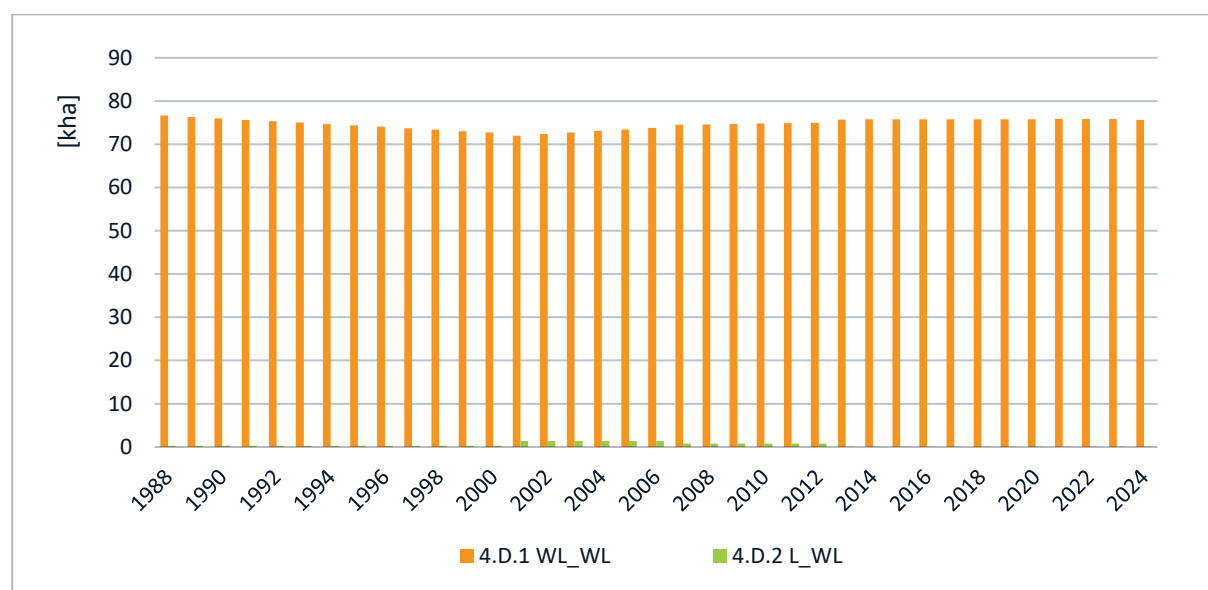


Figure 6.17. Organic soils area on wetlands (1988-2024)

Table 6.44. CO₂ emission factor for drained organic soils

Name	Volume	Unit
EF _{drainage}	1.1	[tC/ha*yr ⁻¹]

The same EF was applied for the estimation of CO₂ emissions on land subject to the categories 4.D.1 as well as for the land subject to the subcategory 4.D.2.

6.5.4.3. Land converted to Wetlands (CRT sector 4.D.2)

The Tier 1 methodology considers only emissions from biomass clearing. When the total area of managed peatlands increases, conversion to peatland is occurring. The conversion of peatlands for peat extraction involves clearing and removal of vegetation. The term ΔC_{WW}^{peat} of Equation 7.4 is estimated as $\Delta C_{conversion}$, using Equation 2.16 (Chapter 2 of Volume 4 of the IPCC 2006). Other changes in C stocks in living biomass on managed peat lands are assumed to be zero. For calculations default emission factors were used as presented below:

- carbon fraction of dry matter CF = 0.5 [IPCC 2006],
- living biomass in land immediately before conversion to flooded land B_{Before} = 13.6 t d.m./ha [IPCC 2006, page 6.8], living biomass immediately following conversion to flooded land B_{After} = 0 t d.m./ha [IPCC 2006, page 7.20].

Table 6.45. Emission factor

Emission factor	unit	value	Source
EF _{peatNrich}	[t C/ha*yr]	1.1	table 7.4. page 7.13 IPCC 2006

As described in the introduction of Section 7.2, the peat extraction cycle has three phases, the first one of which being the development or conversion for peat extraction, characterized by extensive drainage work (if the area was not already drained for other purposes), but little peat extraction. This conversion phase typically lasts for 2 to 5 years. In contrast with other land-use conversions and in accordance with the IPCC 2006 Guidelines, the recommended default transition period for land being converted for peat extraction is five years.

6.5.5. Uncertainties and time-series consistency

Detailed information contain chapter 6.6.5.

6.5.6. Category-specific QA/QC and verification

Detailed information contain chapter 6.5.6.

6.5.7. Recalculations

Detailed information contain chapter 6.6.7.

6.5.8. Planned improvements

The estimation of peatland associated emissions is part of an improvement plan aligned with the development of a national system to meet the accounting requirements specified in EU Regulation 2018/841 (as amended). According to this regulation, a tiered approach is mandated for greenhouse gas inventory methodologies over specific periods. For the period 2021-2025, each Member State is mandated to use at least Tier 1 methodologies following the 2006 IPCC guidelines for national greenhouse gas inventories. Exceptions are made for carbon pools that account for at least 25% of emissions or removals in a source or sink category, prioritized within a Member State's national inventory system due to its significant influence on the country's total greenhouse gas inventory in terms of absolute levels, trends, or uncertainty. In such cases, at least Tier 2 methodologies in accordance with the 2006 IPCC guidelines for national greenhouse gas inventories shall be used. Starting from the greenhouse gas inventory submission in 2028, Member States are obliged to use at least Tier 2 methodologies according to the 2006 IPCC guidelines. Furthermore, from the greenhouse gas inventory submission in 2030 onwards, and as early as possible, Tier 3 methodologies must be applied for all carbon pool emission and removal estimates falling in areas of high carbon stock land use units such as areas under protection or restoration and areas under high future climate risks. These requirements ensure a progressively refined and sophisticated approach to carbon stock estimation, aligning with evolving methodologies and addressing the complexities of specific land use contexts.

6.6. Settlements (CRT sector 4.E)

6.6.1. Source category description

Calculation for category 4.E is based on IPCC methodology described in the chapter 8. of IPCC 2006 guidelines of the Volume 4. GHG balance for this subcategory was identified as a net CO₂ source. Net CO₂ balance expressed in CO₂ eq. was equal to 15 436 kt of CO₂ eq. Overall trend in the reporting period is presented on graph below.

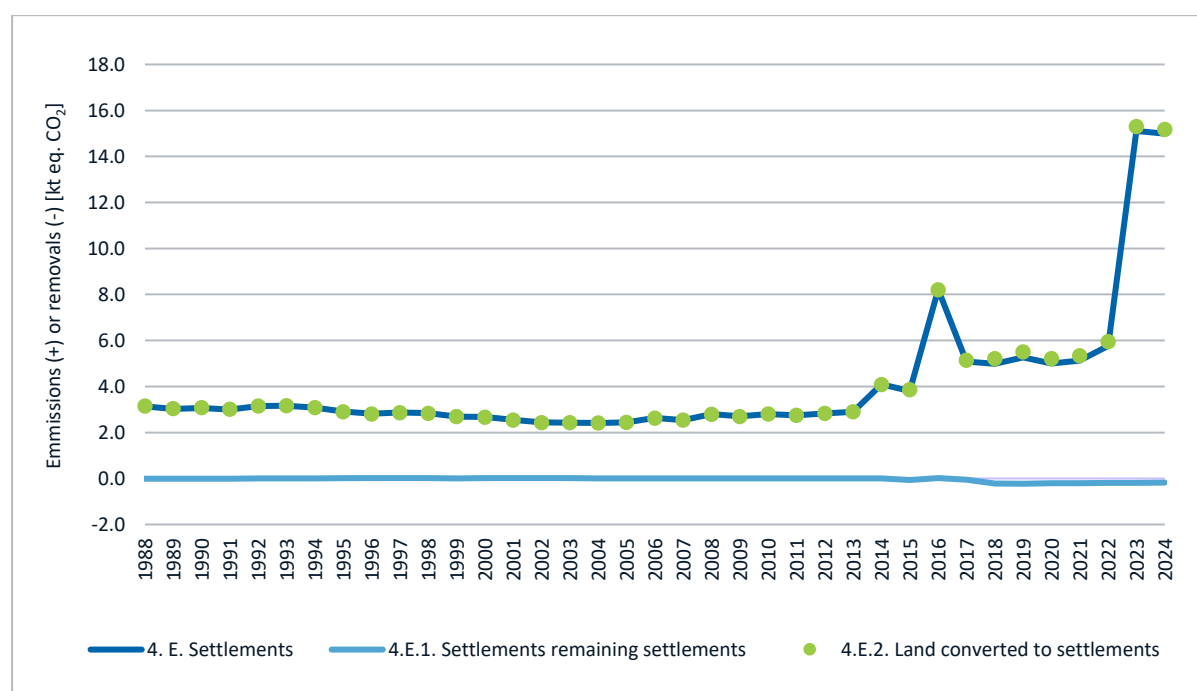


Figure 6.18. Trends in emissions/removals for the category 4.E. *Settlements*

The observed emissions and removals are driven by two major factors. Firstly, there is a significant increase in the conversion of forest land, which is primarily associated with the expansion of infrastructure to support a growing population. Infrastructure projects such as roads, railways, bridges, and airports contribute to the clearing of forests. The construction of these developments facilitates access to the forest frontier, leading to increased deforestation as settlers, with or without governmental support, colonize the forest for subsistence land. Poland has been allocating substantial resources to the development of its transport infrastructure. It is noteworthy that the notable increase in deforestation observed in 2016 and 2023 is considered somewhat unique and may be connected to the operationalization of programs designed to assess the complementarity of development interventions implemented.

Secondly, the method employed aligns with the approach outlined in the IPCC Guidelines (Section 8.3, Forest and Grassland Conversion). It estimates the amount of living aboveground biomass cleared for expanding settlements by multiplying the annually converted forest area to settlements by the difference in carbon stocks between the forest biomass before conversion (C_{Before}) and the biomass in the settlements after conversion (C_{After}). The rationale for the increasing emissions in the short term is directly tied to the rising percentage of strata within a land use category with high carbon content.

6.6.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

According to the description suggested in the chapter 3.3.1. of IPCC 2006 Guidelines of the Volume 4, Poland has selected Approach 2, considering the set of information's available in the register of land and buildings.

6.6.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings (Journal of Laws 2013 pos. 1551), agricultural land considered as settlements consists of:

- residential areas include land not used for agricultural and forest production, put under dwelling buildings, devices functionally related to dwelling buildings (yards, drives, passages, playgrounds adjacent to houses), as well as gardens adjacent to houses;
- industrial areas include land put under buildings and devices serving the purpose of industrial production;
- other built-up areas include land put under buildings and devices related to administration. not listed under residential and industrial areas;
- undeveloped urbanised areas include land that is not built over, allocated in spatial management plans to building development and excluded from agricultural and forest production;
- recreational and resting areas comprise the following types of land not put under buildings;
- areas of recreational centres, children playgrounds, beaches, arranged parks, squares, lawns (outside street lanes);
- areas of historical significance: ruins of castles, strongholds, etc.;
- sport grounds: stadiums, football fields, ski-jumping take-offs, toboggan-run, sports rifle-ranges, public baths etc.;
- area for entertainment purposes: amusement, grounds, funfairs etc.;
- zoological and botanical gardens;
- areas of non-arranged greenery, not listed under woodlands or land planted with trees or shrubbery;
- transport areas including land put under:
 1. roads: national roads; voivodship roads; poviast roads; communal roads; roads within housing estates; access roads to agricultural land and woodlands and to facilities of public utility; stopping and manoeuvring yards next to railway stations, bus stations and airports, maritime and river ports and other ports, as well as universal accesses to unloading platforms and storage yards;
 2. railway grounds;
 3. other transport grounds.

6.6.4. Methodological issues

6.6.4.1. Settlements remaining Settlements

GHG balance for this subcategory was identified as a net CO₂ sink. Net CO₂ balance was equal to 178 kt of CO₂ eq. removals.

Living biomass

The calculations for carbon stock changes in living biomass were conducted using the crown cover area method, with the data source being urban green area statistics from Statistics Poland in 2023 related to environmental protection. The assessment of carbon stock changes in living biomass followed the formula presented in Equation 8.2 on page 8.7 of the IPCC 2006 Guidelines [IPCC 2006]. For these calculations, a default accumulation rate of CRT=2.9 t C/ha [IPCC 2006, page 8.9], as specified in the IPCC 2006 guidelines on page 8.9, was employed. This methodology provides a systematic approach to estimating the changes in carbon stocks within the living biomass of urban green areas.

Organic soils

The main basis for establishing histosols area under this Submission was the project *Spatial Information System on Wetlands in Poland* elaborated in 2004-2006 by the Institute of Technology and Life Sciences. Here available vector layers were compared with Corine land cover data, used as a proxy. Recent approach utilises Corine Land Cover maps published for: 1990, 2000, 2006, 2012 and 2018. The land cover classes were divided into IPCC classification where particular land uses were taken into account. Data between years covered by CLC were interpolated, data for 1988-1989 were extrapolated based on changes between 1990-2000.

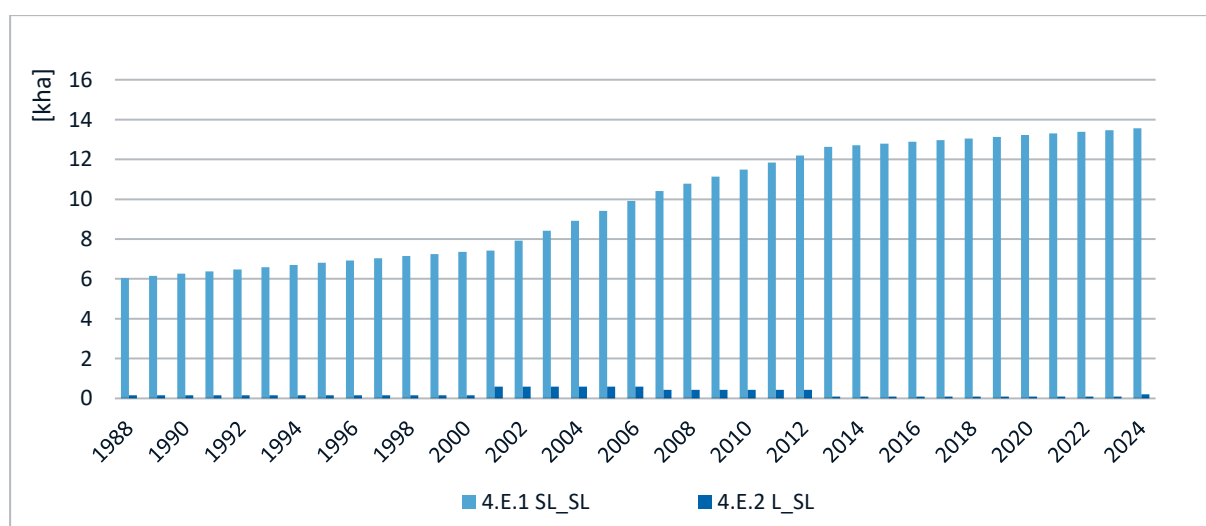


Figure 6.19. Organic soils area on settlements (1988-2024)

Table 6.46. CO₂ emission factor for drained organic soils

Name	Volume	Unit
EF _{drainage}	5.0	[tC/ha*y ⁻¹]

The same EF was applied for the estimation of CO₂ emissions on land subject to the categories 4.E.1 as well as for the land subject to the subcategory 4.E.2. N₂O emission from cultivation of histosols was estimated based on default emission factor for mid-latitude organic soils from [IPCC 2006]: 8 kg N₂O-N /ha. N₂O emission is reported in sector 4. *Agriculture* in subcategory 3.D.a.6. To estimate CO₂ emission from cultivated organic soils default emission factor for cropland was used (5 tC/ha*year). The principle of conservativeness was taken into account in this particular case.

6.6.4.2. Land converted to Settlements (CRT sector 4.E.2)

Forest land converted to Settlements (CRT sector 4.E.2.1)

In this subcategory, net emissions amount to 8 507 kt of CO₂. The methodology for estimating the change in carbon stocks associated with land-use conversions, specifically forest land converted to settlements, follows the same decision tree and basic method as explained in other sections covering conversions to forest land, cropland, and grassland. Due to limited involvement of remote sensing technology in the recent emission inventory, there is no challenge related to distinguishing harvesting or forest disturbance from deforestation. Harvesting and forest disturbance are events that always occur on forest land, whereas deforestation involves a cadastral change of land use from forest land to other land use categories. The distinction between areas affected by harvesting or disturbance and those undergoing deforestation is made based on legal obligations. For areas subjected to harvesting or disturbance, forest owners/administrators are legally obligated to maintain the land under the forest category and forestry regime. This includes adhering to forest management plans, implementing specified actions, and regenerating the land within a given timeframe, typically a maximum of 5 years. On the other hand, for areas undergoing deforestation, a legal procedure is followed, issuing approval for a new land use category, and the forestry regime is no longer applicable. This legal differentiation helps in accurately categorizing land-use changes and associated carbon stock impacts. Any deforestation in terms of land use change in the in-country land use scheme requires an official decision. Hence, no permanent loss of forest cover may occur prior to this approval, which is reflected in cadastral land use. In limited cases, a temporary loss of forest cover up to an area of 2 [ha] ha may occur as part of forest management operations on forest land (units of land subject to managed forests or afforested land), which is not qualified as deforestation in terms of LULUCF Reg. Nevertheless, forest owners (according to art. 13.1 of the *Act on forests* of September 28th, 1991 (*Journal of Laws of 1991 No. 101, item. 444, as amended*)) shall be obliged to ensure the permanent maintenance of forest cover, as well as continuity of utilization, and in particular:

- 1) to preserve forest vegetation (plantations) in forests, as well as natural marshlands and peatlands;
- 2) to reintroduce forest vegetation (plantations) in forest areas within five years of a stand being cleared;
- 3) to tend and protect forest, including against fire;
- 4) to convert and rebuild stands, where these are not in a condition to ensure achievement of the objectives of forest management set out in the Forest Management Plan, Simplified Forest Management Plan or Decision;
- 5) to make rational use of forests in a manner permanently ensuring optimal discharge of all the functions thereof, by means of:
 - a) the harvesting of wood within limits not exceeding a forest's productive capabilities,
 - b) the harvesting of raw materials and by-products of forest use, in a manner providing for biological renewal, and also ensuring protection of forest-floor vegetation.

The forest regime in Poland imposes a basic requirement that areas disturbed due to activities like harvesting or disturbance must be replanted within a maximum of 5 years, without specifying a minimum area. This legal obligation ensures that the restocking process occurs promptly, and the areas are subject to continuous planning and management. The replanting can take various forms, including plantations (often managed by state forests) or assisted

natural regeneration. The implementation of these requirements is overseen by the public authority responsible for forestry. It's important to note that these areas under the forest regime, which undergo restocking, should not be confused with deforested areas. The distinction lies in the fact that areas under the forest regime are subject to continuous planning and management practices, such as planting, gap filling, and maintenance, ensuring the sustainable regeneration of the forest ecosystem. Worth to note, all forests must be regenerated after clearing mature stands, as mandated by the Forestry Act. Regeneration typically involves a cut-and-regeneration sequence of operations, and areas that are cut in a given year may be void of mature trees for many years. For areas that were afforested or reforested after 1989, the same legal rules apply for regeneration after harvesting. These rules dictate that harvested forests must be regenerated within the fifth year following disturbance. Continuous surveillance by Forest Authorities ensures compliance with these regulations, and strict penalties are applied to those who violate relevant provisions. This legal framework emphasizes the commitment to sustainable forest management and ecosystem regeneration.

Living biomass

Annual change in carbon stocks in living biomass reservoir was estimated considering the changes in carbon stocks between biomass in the forest prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}). Estimations are based on the equation 2.16 contained in IPCC 2006 guidelines of the Volume 4.

Average gross merchantable volume used in the above mentioned equation is estimated on the basis of data from the most recent 5-year cycle of large-scale inventory and is published in the form of official statistics by the Statistics Poland. This method follows the approach in the IPCC Guidelines where the amount of living aboveground biomass that is cleared for expanding settlements is estimated by multiplying the forest area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}) which is equal to zero.

To estimate LB carbon stock change in Forest Land converted to Settlements, we have considered instant oxidation of carbon stock in living biomass and litter and dead wood.

Dead organic matter

Annual change in carbon stocks in dead wood reservoir was estimated considering the changes in dead wood resources on forest land all forms of ownership, using the information contained in the statistical yearbooks "Forestry". Estimations are based on the equation 2.19 contained in IPCC 2006 guidelines of the Volume 4.

Dead wood thickness used in the above mentioned equation is estimated on the basis of data from the most recent 5-year cycle of large-scale inventory and is published in the form of official statistics by the Statistics Poland.

This method follows the approach in the IPCC guidelines where the amount of living aboveground biomass dead organic matter that is cleared for expanding settlements is estimated by multiplying the forest area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (DOM_{t1}) and that in the settlements after conversion (DOM_{t2}) which is assumed to be equal to zero.

Mineral Soils

Annual change in carbon stocks in the carbon reservoir in soils was estimated using equation 2.25 as contained in the chapter 2 of the Volume 4 of the IPCC 2006 GL. In applying this equation, default reference values of SOC_{ref} were employed, which are associated with the dominant tree habitat areas undergoing land use conversion.

Table 6.47. Forest habitat types in Poland with the SOC_{ref} assignment

Forest habitat type	SOC_{ref} [tC*ha ⁻¹]
Dry coniferous	39.1
Fresh coniferous	51.5
Moist coniferous	52.0
Boggy coniferous	52.0
Mountain coniferous forest	63.4
High-mountain coniferous forest	95.6
Mountain alder forest	95.6
Fresh mixed coniferous–broadleaved	77.7
Moist mixed coniferous–broadleaved	119.2
Boggy mixed coniferous–broadleaved	197.1
Upland mixed coniferous–broadleaved	76.7
Mountain mixed coniferous–broadleaved	99.3
Fresh mixed forests	195.3
Moist mixed forests	213.2
Boggy mixed forests	101.6
Upland mixed forests	57.9
Mountain mixed forests	92.4
Fresh forests	92.4
Moist forests	213.2
Alder forest	153.3
Ash-alder carr	202.1
Mountain alder carr	202.1
Floodplain forest	385.2
Upland floodplain forest	134.9
Upland forest	158.9
Mountain forest	213.2
Mountain floodplain forest	153.3

Estimates of carbon stock changes in mineral soils followed IPCC default transition periods, specifically a 20-year duration [IPCC, 2006].

Cropland converted to Settlements (CRT sector 4.E.2.2)

Net emissions in this subcategory are equal to 2 278 kt of CO₂ emissions. The fundamental equation for estimating change in carbon stocks associated with land-use conversions has been explained in other sections covering conversions of land converted to forest land, cropland and grassland, respectively.

Living biomass

The annual alteration in carbon stocks within the carbon reservoir in living biomass was determined by comparing the changes in carbon stocks between biomass in the forest prior

to conversion (B_{Before}) and that in the settlements after conversion (B_{After}). These estimations are based on equation 2.16 found in the IPCC 2006 guidelines of Volume 4. The recent incorporation of notation key "IE" in terms of biomass losses, in this specific scenario, is prompted by the assumptions made for estimating living biomass losses. This considers the changes in carbon stocks between biomass in the land prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}), utilizing biomass peaks for the land prior to land use conversion. The estimation approach is based on equation 2.16 contained in IPCC 2006 guidelines of Volume 4. The default approach, which considers cropland biomass stock peaks, has been utilized in the aforementioned equation, reflecting any potential net changes of carbon stocks over the inventory year, considered relevant as of the end of the year (as of 31 Dec.).

This method follows the approach in the IPCC Guidelines where the amount of living aboveground biomass that is cleared for expanding settlements is estimated by multiplying the area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}) which is equal to zero. To estimate LB carbon stock change in Croplands converted to Settlements, we have considered instant oxidation of carbon stock in living biomass and litter and dead wood.

Mineral soils

Annual change in carbon stocks in the soil reservoir was estimated using equation 2.25 as contained in the chapter 2 of the Volume 4 of the IPC 2006. For the needs of equation application, reference values of SOC_{ref} as provided in the section 6.3.4.4 were considered. Furthermore, relevant SOC_{ref} factors were assigned to particular valuation classes subject to LU conversion. The percentage fraction of all soil types in croplands was calculated based on available data sets for cropland converted for non-forest and non-agricultural purposes.

Grassland converted to Settlements (CRT sector 4.E.2.3)

Net emissions in this subcategory are equal to 2 048kt of CO_2 emissions. The fundamental equation for estimating change in carbon stocks associated with land-use conversions has been explained in other sections covering conversions of land converted to forest land, cropland and grassland, respectively. The same decision tree and the same basic method were applied to estimate change in carbon stocks in forest land converted to settlements.

Living biomass

Annual change in carbon stocks in living biomass reservoir was estimated considering the changes in carbon stocks between biomass in the forest prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}). Estimations are based on the equation 2.16 contained in IPCC 2006 guidelines of the Volume 4. Recent application of notation key "IE" in terms of biomass losses in this particular case is triggered by estimation of living biomass losses, considering the changes in carbon stocks between biomass in the land prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}). Estimations are based on the equation 2.16 contained in IPCC 2006 guidelines of the Volume 4. Default approach considering grassland biomass stock peaks has been utilised in the above mentioned equation reflecting any potential net changes of carbon stocks over the inventory year (considered relevant as of the end of the year (as of 31 Dec)). This method follows the approach in the IPCC

Guidelines where the amount of living aboveground biomass that is cleared for expanding settlements is estimated by multiplying the area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (B_{Before}) and that in the settlements after conversion (B_{After}) which is equal to zero. To estimate LB carbon stock change in Grasslands converted to Settlements, we have considered instant oxidation of carbon stock in living biomass and litter and dead wood occurring within the year of conversion.

Soils

Annual change in carbon stocks in the carbon reservoir in soils was estimated using equation 2.25 as contained in the chapter 2 of the Volume 4 of the IPC 2006. For the needs of equation application, reference values of SOC_{ref} as provided in the section 6.4.4.3 were considered. Data of different soil types (high activity soils, low activity soils, sandy and wetland) were based on area of associated soil valuation classes subject to LU conversion. The percentage fraction of all soil types in grassland was calculated based on available data sets. Estimates of carbon stock changes in mineral soils followed IPCC default transition periods, specifically a 20-year duration [IPCC, 2006]

Wetland converted to Settlements (CRT sector 4.E.2.4)

Net emissions in this subcategory are equal to 123 kt of CO_2 emissions. The fundamental equation for estimating change in carbon stocks associated with land-use conversions has been explained in other sections covering conversions of land converted to forest land, cropland and grassland, respectively.

Mineral soils

Annual changes in soil carbon stocks were estimated using Equation 2.25 from Chapter 2, Volume 4 of the 2006 IPCC Guidelines. For wetland soils, default reference values (Sections 6.3.4.4 and 6.4.4.3) were applied to areas undergoing land use conversion. Estimates of carbon stock changes in mineral soils followed IPCC default transition periods, specifically a 20-year duration [IPCC, 2006]

6.6.5. Uncertainties and time-series consistency

The reference dataset is actually a combination of heterogeneous underlying sources offering indirect guarantee for complete and consistent land use capturing in time and space. Land registry is a major source of data, usually locally implemented cadastral database as ownership information, complemented by operational data in forestry, both backed by ground measurements. Additional information is provided by sectorial statistics in agriculture mostly based on municipality or owners/farmers' declarations. Notably, for the agricultural lands reported under agricultural statistics, errors can be particularly high when "activity area" is taken as a proxy for "land use", or when subjective methods are involved (e.g. non-rigorous implementation of land definition on owner declaration) or lack of rigorous checks and quality assurance/control procedures. Using such data for emissions reduction commitments on land is further strongly limited by non-spatially explicit nature of information and impossibility to be processed as a unique national database. The most significant weakness of reference dataset related to forest land is that it implements an exclusive forest definition, which is 'land administration oriented' thus focusing on forest administrated by the State Forests Holding,

instead of one based on quantitative thresholds which would be able to capture all forests and change no matter of their cadastral status.

Uncertainty of inventory annual estimate is dominated by forest sink, and apparently influenced by uncertainties of C pool changes. Our sensitivity analysis did not reveal uncertainty of land areas as a significant input, nor for stable land uses and for conversions.

For estimating the contribution of land datasets uncertainty to the overall uncertainty of the CO₂ emissions and removals Approach 1 (IPCC 2006) was applied to the inputs for year 2021 within the LUM spreadsheet. An input was defined as the mean value and its relative standard deviation of the mean CSC. Where data was available, standard error of the mean was used (e.g. C stock change in litter or biomass on lands in conversion to forests), otherwise a probability range of the mean as defined by the reference or based on expert assumption (assuming mean is normally distributed).

Uncertainty analysis for the year 2024 for IPCC sector 4. *Land-Use Change and Forestry* was estimated with use of approach 1 described in 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. In this submission uncertainty assumptions were applied directly to on activities and emission factors, instead of emission as in previous years. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in Annex 2. Recalculation of data for years 1988-2023 ensured consistency for whole time-series.

Table 6.48. Results of the sectoral uncertainty analysis in 2024

2023	CO ₂ [kt]	CH ₄ [kt]	N ₂ O [kt]	CO ₂ Emission uncertainty [%]	CH ₄ Emission uncertainty [%]	N ₂ O Emission uncertainty [%]
4. Land use, land-use change and forestry	-35827.78	0.37	11.93	36.9%	57.4%	89.4%
A. Forest land	-40301.18	0.30	0.41	30.4%	70.2%	70.2%
B. Cropland	-3240.79	-	-	75.2%	-	-
C. Grassland	-347.49	0.08	0.00	75.2%	70.2%	100.1%
D. Wetlands	1254.51	-	0.02	75.2%	-	100.1%
E. Settlements	11482.08	-	10.61	30.4%	-	100.1%
F. Other land	-	-	-	-	-	-
G. Harvested Wood Products	-4674.91	-	-	50.2%	-	-
4 (IV) Indirect N ₂ O emission from managed soils	-	-	0.84	-	-	100.1%

6.6.6. Category-specific QA/QC and verification

Basing on the current recommendations from the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories, following elements of quality assurance and control were defined for the inventory of national activities in this area:

- performing an inventory of institutions. is responsible for coordinating QA/QC,
- general procedures for quality control inventory QA/QC (using Tier 1),
- a detailed set for the category of sources. quality control procedures (using Tier 2).

Most of the input data used in the inventory process comes from official national statistics in the statistical studies of Statistics Poland, reports of Forest Management and Geodesy Bureau. In case of deviations from the trend, more detailed checks are carried out concerning data input. This situation has occurred in the year 2009 for the studies presented in the official statistical volume of forest resources as a result of changes in methodology for their

estimation. Presented data as a result of using National of State Forest Inventory of all forms of ownership become an official source of national statistics. In addition, for the annually calculated emissions are compared with the corresponding values from the previous years (trend of emissions), and in the event of any unexpected changes they are examined in more detail. For the detailed information see chapter QA/QC.

6.6.7. Recalculations

It has be noted, the approach applied by Poland to calculate the percentage change as well as the net effect (in the CO₂ eq.) of changes in methodologies, changes in the manner in which EFs and AD, or the inclusion of new sources or sinks which have existed since the base year, allows to maintain TACCC principle in relatively simple way. Despite the fact that recalculations of reported data, driven mainly by the ERT recommendations are frequent and sometimes substantial (see Annex I) but as long as the whole time series of data is updated this is not an issue for time consistency. Since the recalculations always affects all reported time series, we consider the recalculated values consistent with the trends in the activity data, and thus more accurate and comparable than before. Main reasons leading to recalculations in the LULUCF sector for the whole time-series are as follows:

- LUC matrix update;
- Biomass expansion factor update;
- Updated SOC assement in categories 4.A, 4.B, 4.C;
- Update of HWP production data (including historical production data for FAO data)

Recalculation of data for years 1988-2023 ensured consistency for whole time-series. Net effect of recalculations on emissions/removals is provided *CRT table 8 RECALCULATION - RECALCULATED DATA*.

6.6.8. Planned improvements

Recent efforts to advance inventory methodologies focus on improving monitoring capabilities for assessing natural resources, land use, and land cover over specified time frames with enhanced data accuracy. These activities require detailed and up-to-date geospatial information on land cover (LC), land use (LU), and their temporal changes. This information is essential for a wide range of applications, including land management, monitoring sustainable development in agriculture, forestry, and rural areas, biodiversity assessment, urban planning, and land use policy formulation. Furthermore, this data supports various reporting obligations, such as accounting for greenhouse gas (GHG) emissions and removals from the Land Use, Land Use Change, and Forestry (LULUCF) sector, long-term climate mitigation efforts, Common Agricultural Policy (CAP) greening initiatives, biodiversity conservation, urban planning frameworks, and the Energy Union agenda. To fulfill these expectations, a project involving a comprehensive analysis and utilization of cadastral data has been launched. The expected outcome is to provide maps that are accurate and tailored to specific needs. Furthermore, while products from the Copernicus Land Monitoring Service (CLMS) are utilized in national research projects, their integration into national mapping, reporting, and monitoring programs conducted by national and regional authorities remains limited. In this regard, the LIFE OrgFluX-PL project must be noted. The main goal of the LIFE OrgFluX-PL is to improve the quality of the GHG flux estimation and to evaluate the level of uncertainties in GHG flux estimates from organic soils under agricultural use by developing and implementing a comprehensive, centralised data platform for land use change monitoring

based on spatially explicit data, gathering country specific emission factors and modelling. In addition, the project will provide an interactive tool supporting the GHG fluxes verification in the context of implementation of carbon farming. It will facilitate the establishment of the operational linkages between the climate-relevant information collected under the certification schemes and the national greenhouse gas inventories. The project will facilitate the implementation of environmental climate policies, climate action and energy transition at local, regional and national scales. Specific objectives of the project:

1. Development and implementation of a comprehensive, centralised digital data platform for monitoring land use, land use changes and management intensity using spatially explicit national and EU datasets;
2. Improvement of the GHG fluxes estimation and evaluation of the level of uncertainties in organic soils under agricultural use
3. Providing reference data and developing an interactive tool for supporting the GHG fluxes verification in the context of implementation of carbon farming

Furthermore, available information on forest management practices, their characteristics, including the rules on forest use and the species-age structure of forests, is under examination to determine the need for FRL technical correction. The assessment covers domestic forest characteristic based on two general stratification layers justified by differences in the intensity and structure of the harvest, as well as in the availability and reliability of data on the condition and management of forests. The assessment conducted is taking into account National Forest Inventory (NFI) results and available detailed data for those two stratification layers (stratas) so called:

- Forests under the management of the State Forests National Forest Holding, covering most of the area and wood resources of Poland (approximately 77%), managed according to uniform practices based on methods contained in the instructions and internal regulations concerning forest management in force in the State Forests National Forest Holding.
- Forests outside the management of the State Forests National Forest Holding (so-called "other forests"), including forests of other forms of ownership, whose total area and volume of resources is approximately 23%. Other forests include privately owned forests, forests managed by national parks, the Agricultural Property Stock of the State Treasury, other forests of the State Treasury, and municipal forests. Privately owned forests dominate this group, while other properties account for a small percentage of Poland's forest area. This group is characterized by a different mode of forest management, e.g., by significantly lower ratios of harvest relation to forests managed by the State Forests National Forest Holding.

Finally, the assessment is being summarized by the modeling framework utilizing the implementation of the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) into the GHG inventory. This exercise considers growth curves based on forest inventory data (specifically WISL), which are utilized. The CBM-CFS3 implementation is part of an overarching inventory improvement plan that encompasses issues requiring further analysis related to the lack of activity data, emission factors, and potential changes or increases in the Tier methodology.

Worth to note, significant attention has been given to agricultural peat soils, which represent approximately 3% of the total agricultural land in Poland. Despite their relatively small area, these soils have a substantial impact on the country's total greenhouse gas emissions. While

current estimations of greenhouse gas emissions from managed peat soils appear reasonably accurate for present conditions, several factors may influence future emissions:

- changing European agricultural policies: New rules and regulations governing agriculture in Europe can significantly affect both the acreage and cultivation intensity of organic soils
- evolving energy strategies may impact the use and management of peat soils, potentially altering their greenhouse gas emission profiles
- the predicted higher temperatures in Poland will likely have a major effect on emission rates from this source. As temperatures rise, the decomposition of organic matter in peat soils may accelerate, potentially increasing greenhouse gas emissions

To address these issues, the inventory improvement plan considers building capacity to cover soil organic carbon-related aspects. This includes enhancing our understanding of estimation methodologies and requirements, as well as evaluating available data. Furthermore, the plan involves developing a national system to meet the accounting requirements specified in EU Regulation 2018/841 (as amended). According to this regulation, a tiered approach is mandated for greenhouse gas inventory methodologies over specific periods. For the period 2021-2025, each Member State is mandated to use at least Tier 1 methodologies following the 2006 IPCC guidelines for national greenhouse gas inventories. Exceptions are made for carbon pools that account for at least 25% of emissions or removals in a source or sink category, prioritized within a Member State's national inventory system due to its significant influence on the country's total greenhouse gas inventory in terms of absolute levels, trends, or uncertainty. In such cases, at least Tier 2 methodologies in accordance with the 2006 IPCC guidelines for national greenhouse gas inventories shall be used. Starting from the greenhouse gas inventory submission in 2028, Member States are obliged to use at least Tier 2 methodologies according to the 2006 IPCC guidelines. Furthermore, from the greenhouse gas inventory submission in 2030 onwards, and as early as possible, Tier 3 methodologies must be applied for all carbon pool emission and removal estimates falling in areas of high carbon stock land use units such as areas under protection or restoration and areas under high future climate risks. These requirements ensure a progressively refined and sophisticated approach to carbon stock estimation, aligning with evolving methodologies and addressing the complexities of specific land use contexts

6.7. Other land (CRT sector 4.F)

Emissions/removals from this subcategory were not estimated. It is included to match overall consistency of country land area.

6.8. Indirect Nitrous Oxide (N₂O) Emissions from Managed Soils (CRT 4(I))

The indirect nitrous oxide (N₂O) emissions from managed soil were calculated using Equation 11.10 with FSOM based on Equation 11.8.

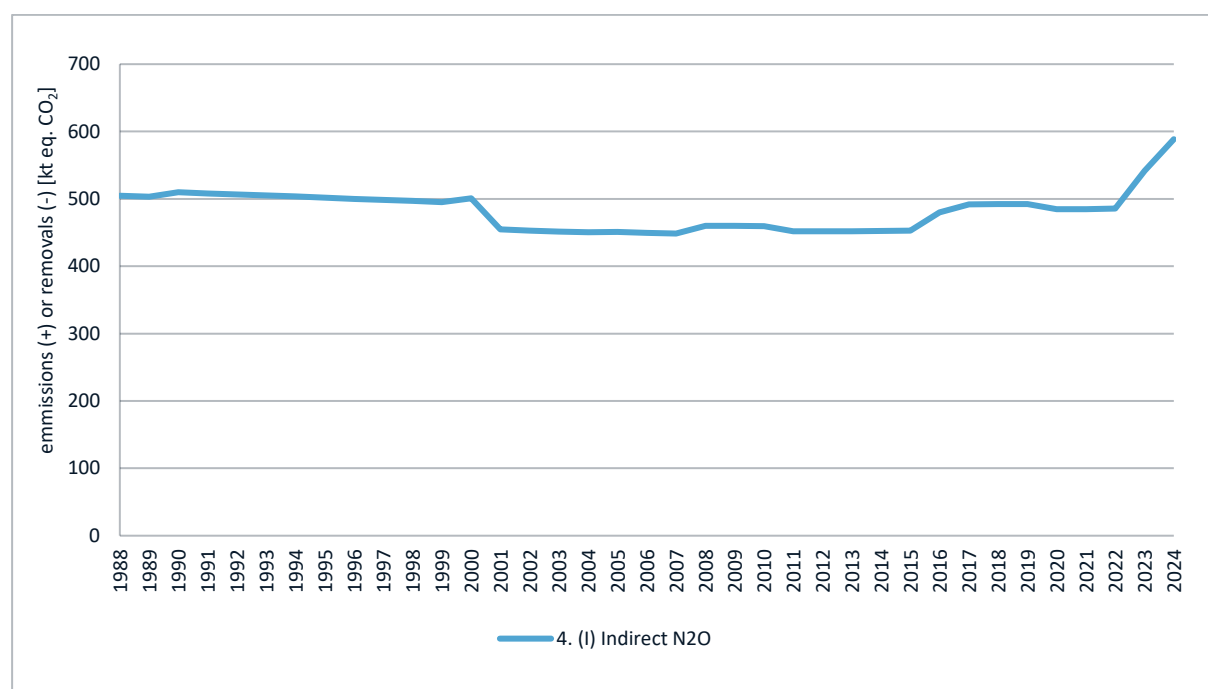


Figure 6.21. Trends in emissions/removals for the category 4.G. *Harvested wood products*

Table 6.49. Factors for conversion wood products to carbon

Compound	Value	Source
FracLEACH	0.30	Default – table 11.3 [IPCC 2006]
N ₂ O-N EF	0.0075	Default - ntable 11.3 [IPCC 2006]

Time series was calculated and included firstly in 2024 submission. The resulting values are reported in CRT Table 4(I) and Indirect N₂O emissions from Nitrogen Leaching and Run-off represented 222 kt eq. CO₂ in 2024.

6.9. Harvested wood products (CRT sector 4.G)

This chapter provides information on how the framework for calculating the carbon substitution effect in harvested wood products based on changes in the carbon pool and some historical information on assumptions related to the principle of instantaneous oxidation, was implemented. Calculation for category 4.G is based on IPCC methodology described in the chapter 8 of IPCC 2006 guidelines of the Volume 4. GHG balance for this subcategory was identified as a net CO₂ sink. Net CO₂ sink was equal to 3 784 kt of CO₂. Overall trend in the reporting period is presented on graph below.

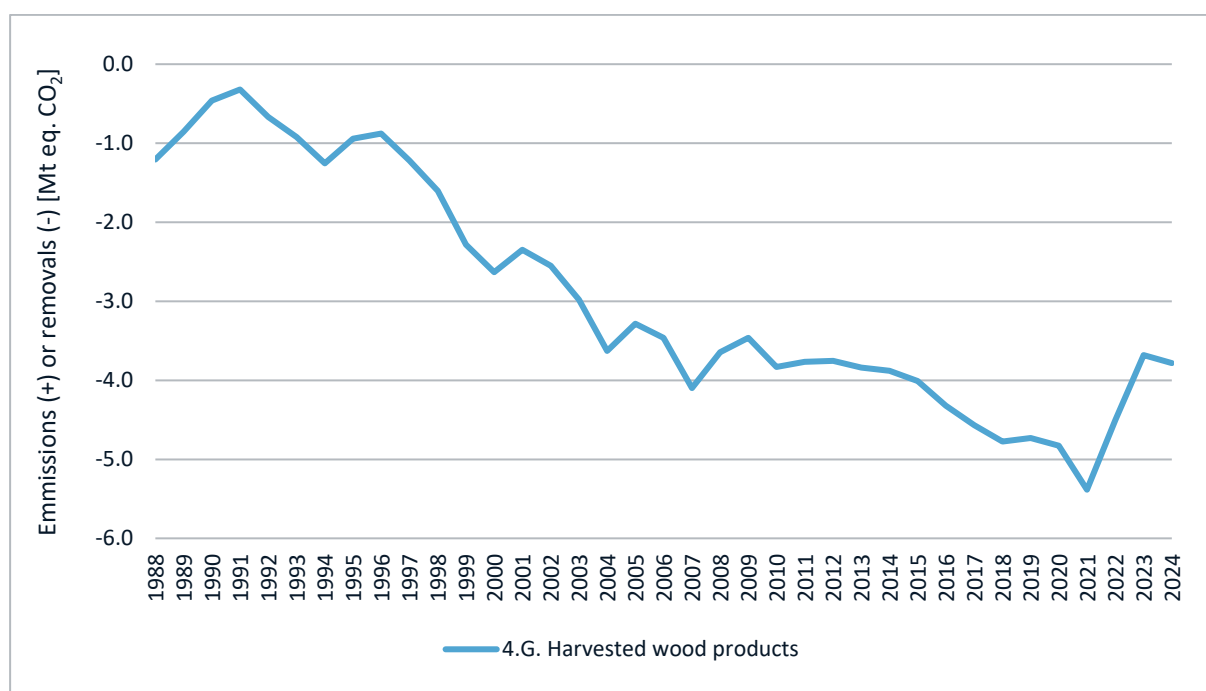


Figure 6.21. Trends in emissions/removals for the category 4.G. *Harvested wood products*

According to the relevant provisions (Regulation 2018/841), only carbon contained in wood products harvested from managed forest land should be included in the estimation. However, if it is not possible to differentiate between harvested wood products subject to Afforestation and Managed forests EU, Member State may choose to account for harvested wood products assuming that all emissions and removals occurred on land subject to Managed forests. As a consequence, time series of data reflecting the annual production of wood products have been allocated to the corresponding national forest land activity. This process consisted of three intermediate stages:

- estimation of the share of carbon in harvested wood products from domestic forests. For this purpose, the share of the relevant categories of raw materials (which also originate from domestic forests) of harvested wood products, such as "industrial round wood", "wood pulp" and "recovered paper" used (i.e. consumed) in the production process of the relevant wood products, such as "sawn timber", "wood-based panels" and "paper and board", was determined.
- an estimate of the annual fraction of raw materials for the wood products categories 'sawn timber', 'wood-based panels' and 'paper and board' originating in land category 4.A.1 *forest land remaining forest land*. Importantly, in accordance with the relevant requirements, harvested wood from deforested areas (in accordance with EU Reg. 2018/841) has been treated according to the principle of "instantaneous oxidation".

- c) in order to obtain annual fractions of harvested wood products derived from the reporting category/activity. the information obtained in steps a and b has been combined.

The estimation process itself uses the methodological guidelines contained in section 2.8.1.2 of the IPCC (2014)³. Following coefficients from Table 12.4 of 2006 Guidelines (default factors to convert from product units to carbon) were applied taking into account the conditions of our country and resulting the following factors for conversion to carbon:

Table 6.50. Factors for conversion wood products to carbon

Item	Value
Sawn wood	0.225
Wood panel	0.269
Paper and paper board	0.386

The half-live time parameters

According to the 2006 Guidelines. the half-live time parameters are: 35 years – sawn wood (decay rate $k=0.020$). 25 years – wood panels (decay rate $k=0.028$) and 2 years- paper products (decay rate $k=0.347$).

Data sources (FAO database)

When determining CO₂ emission balance. we resorted to consulting the FAO database (available at the following address: <http://faostat.fao.org>). Based on FAO classification. we retrieved data regarding the production and export of the following wood products: sawn wood. wood-based panels. paper and paperboard. wood pulp and recovered paper. Wood products import data has been excluded while assessing input data.

Estimating data for the period between 1900 and 1960

Due to the fact that FAO only supplies data beginning with 1961. we resorted to estimate production and export of wood products between 1900 and 1960 by equation 12.6, which takes into account the production and exports values for 1961 and U (the exchange rate in Europe, which amounts to 0.0151).

The variables (1.A. 1.B. 2.A. 2.B. 3. 4. 5) were determined in conformity with the provisions of the IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Agriculture, Forestry and Other Land Use. Chapter 12 Harvested Wood Products 2006. Calculation were run through all of the mentioned stages, and also by using the modified inventory worksheet as provided by the IPCC at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_12_Ch12_HWP_Worksheet.zip

Calculation

Step 1: Calculating variable 1.A (i.e. Annual change in carbon stock in “products in use”). It was calculated using formulas 12.1 and 12.2. for each product category (sawn wood. wood panels and paper products). inflow. k (decay rate), and the carbon stock at the beginning of the year ($C_{(i)}$).

³ The same information as provided in section 12.5.2.1 ("Compilation of activity data on the production approach") of the IPCC 2019 Refinement.

Step 2: Calculating variable 2.A (Annual change in carbon stock in "products in use" where wood came from harvest in the reporting country (includes exports)). It was calculated using formulas 12.1 and 12.3. accounting for the product category (solid wood or paper products), inflow, k (decay rate) and the stock of carbon at the beginning of the year ($C_{(i)}$).

Step 3: Calculating variable 1.B (Annual Change in stock of HWP in SWDS from consumption) and 2.B (annual Change in stock of HWP in SWDS produced from domestic harvest). When calculating the 1.B and 2.B variables, we didn't took into account the Waste Sector Tier 1 estimates, as laid out in the IPCC 2006 Guidelines.

In the interest of transparency, pursuant to CRT Table 4.Gs1. wood products for material use are divided into products that, following their production, are used in Poland, and products that are exported following their production. The carbon stored in wood in landfills is not taken into account.

The biomass of short-rotation plantations in Poland is used exclusively for energy purposes and thus that biomass is not reported under "harvested wood products" (HWP).

6.8.1. Uncertainties and time series consistency

Estimation of C stock change in HWP is under further refining. Estimate of uncertainty is going to be done with future submissions.

6.8.2. Category-specific QA/QC and verification if applicable

Comparable order of magnitude of currently submitted estimates with those submitted by Poland in the past (NFAP for forest reference level).

6.8.3. Recalculations

Updated HWP production data (including historical production data for FAO codes: 1875, 1876, 1874, 1872) triggers recalculation of CSC in HWP pool.

6.8.4. Planned improvements

Current approach is to enhance capacity to cover HWP, to better understand the estimation methodologies and requirements, as well as available data.

7. Waste (CRT sector 5)

7.1. Overview of sector

The GHG emission sources in waste sector involve: methane emission from 5.A *Solid Waste Disposal*, CH₄ and N₂O emissions from 5.B *Biological Treatment of Solid Waste* and 5.D *Wastewater Treatment and Discharge*.

Following subcategories from sector 5 have been identified as key category (excluding LULUCF):

IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)		
5.A Solid Waste Disposal	CH ₄		T	
5.D Wastewater Treatment and Discharge	CH ₄	L		

Share of subcategory 5.A in total Poland's GHG emissions amounts ca. 0.82%.

Total emission of GHG amounted to 4 494 kt of CO₂ equivalent in 2024 and decreased since 1988 by 78.36% (figure 7.1).

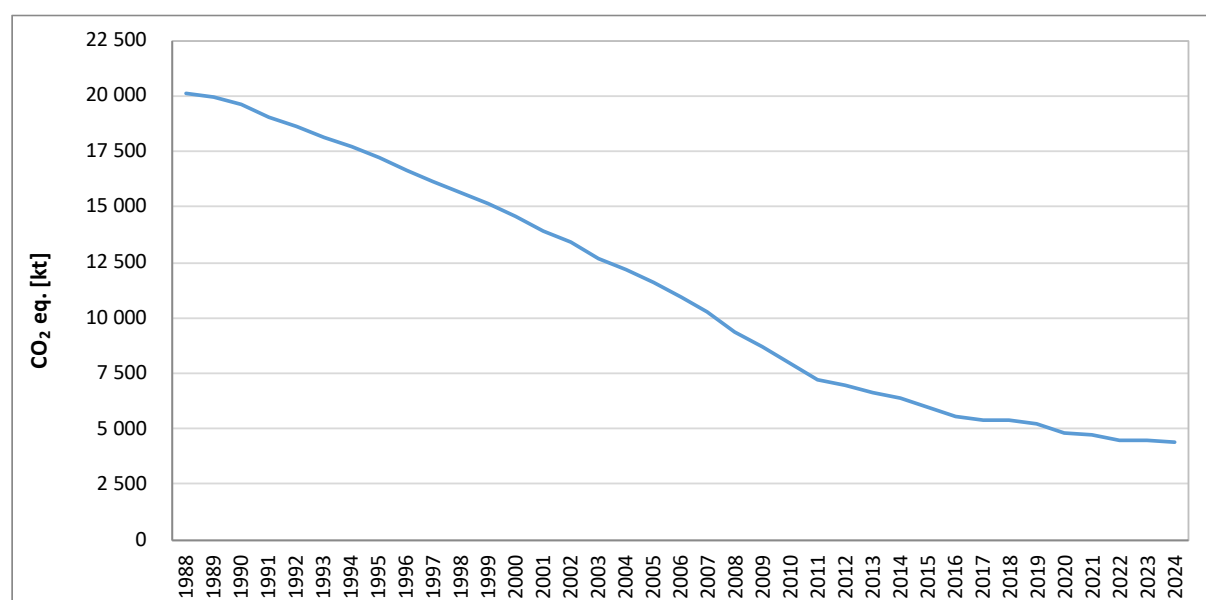


Figure 7.1. GHG emissions from waste sector in 1988-2024

Between years 1988 and 2024 decrease of GHG emissions appeared in subcategory 5.A (by 94.2%) and 5.D (by 38.8%) while emissions from sources gathered in subcategory 5.B increased since 1988 by 1 560.0%. The main reason of decrease of emissions from sector 5 is decrease of GHG emissions in subsector 5.A *Solid Waste Disposal on Land* and subsector 5.D *Wastewater Treatment and Discharge* (figure 7.2), the biggest (20.2% and 68.9% of emission respectively) contributors to emission from *Waste* sector.

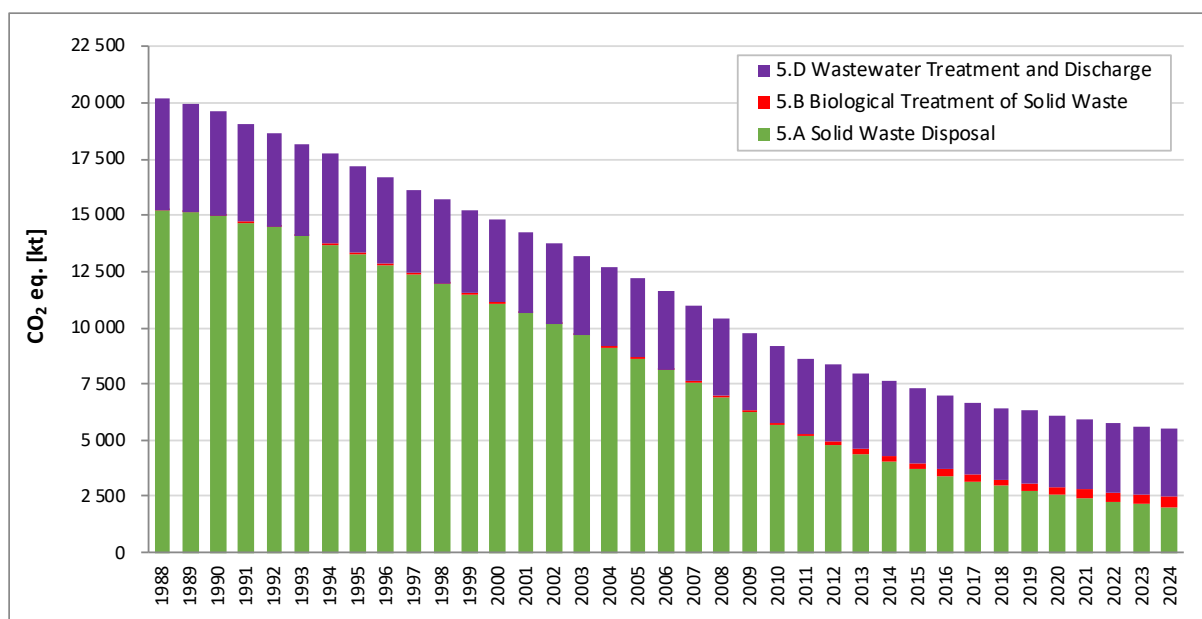


Figure 7.2. GHG emissions from waste sector divided to subsectors in 1988-2024

According to statistical data GUS (2025d) in 2024 collected municipal solid waste is utilized in four treatment pathways: incineration with energy recovery (26.4%), biological treatment (15.4%), recycling (22.1%) and landfilling (36.2%). The changes in shares of municipal solid waste treatment pathways since 2007 are presented in figure 7.3.

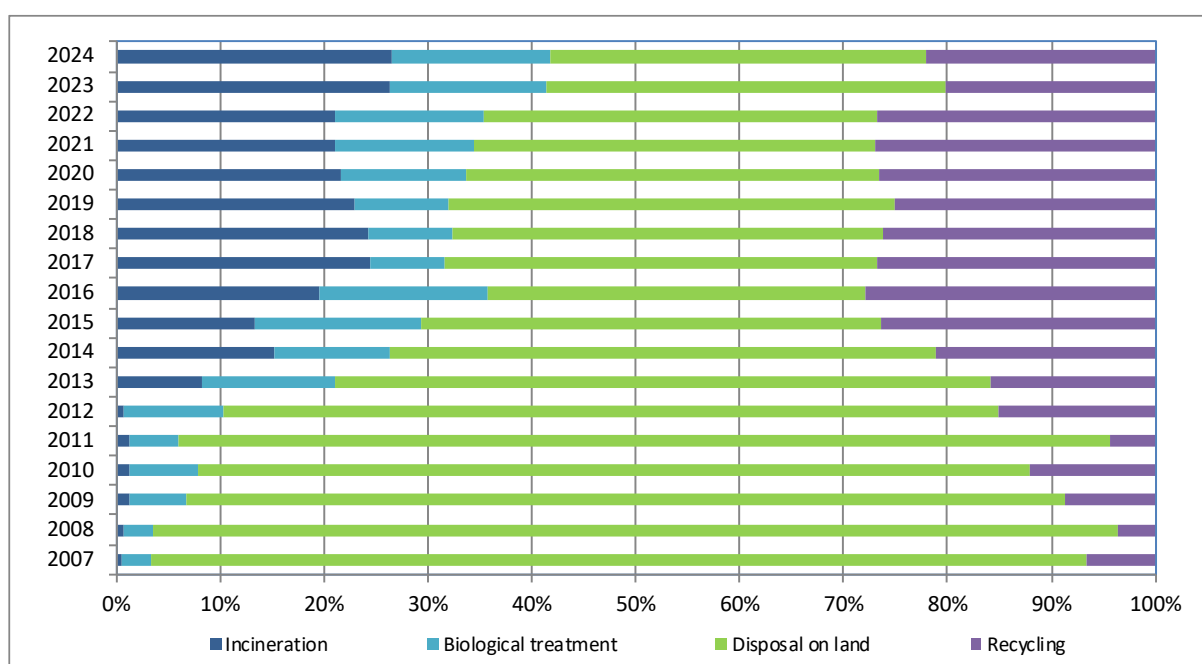


Figure 7.3. Municipal solid waste treatment pathways

Data from BDO Waste Database (BDO), applied in subcategories 5A and 5B are under constant verification by Marshal Offices, as facilities have 5 years to update their reports to base. Therefore it is expected that estimates basing on BDO data will be recalculated in upcoming reports.

7.2. Solid Waste Disposal (CRT sector 5.A)

7.2.1. Source category description

The 5.A *Solid Waste Disposal on Land* subcategory share in total waste sector amounts ca. 20.2% and it involves methane emissions from Managed Waste Disposal on Land (17.7% share of 5.A), Unmanaged Waste Disposal on Land deep (0.8% share of 5.A) and Uncategorized MSW Disposal on Land (1.7% share of 5.A). Managed Waste Disposal on Land includes methane emissions from disposal of sewage sludge (described in chapter 7.2.2.1) and industrial solid waste (described in chapter 7.2.2.2).

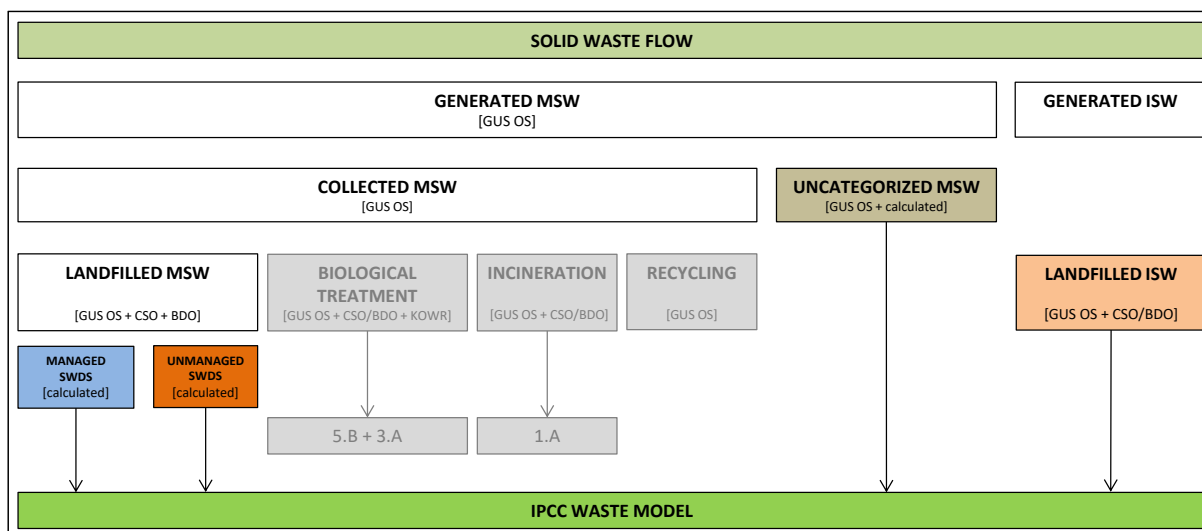


Figure 7.4. Solid waste flow scheme

The trend of emissions from sector 5.A is mostly conditioned by activity data – amounts of waste generated, collected and landfilled, composition of landfills waste and biogas recovery.

The trend of methane emission estimations is decreasing, mostly due to development of collection, segregation and landfilling system (what is the result of implementing recommendations of Landfill Directive 1999/31/EC, among others). During this period waste recycling was popularized and the recycling system was developed, what resulted in decrease of landfilled municipal waste. Moreover, new technologies were introduced on disposal sites what resulted in the decrease in amount of waste landfilled in unmanaged disposal sites.

Basic legal regulatory

The basic legal regulatory for waste management in Poland is the Act on waste (Dz.U. 2013/0/21 with later changes) describing the ways of waste treatment leading to human and environment protection.

Imported waste

Poland is importing solid waste but according to information from Chief Inspectorate of Environment Protection it is mostly hazardous waste for incineration (no municipal waste is imported) and it is included in data on incinerated waste used by Party for estimates from subsector 1.A.

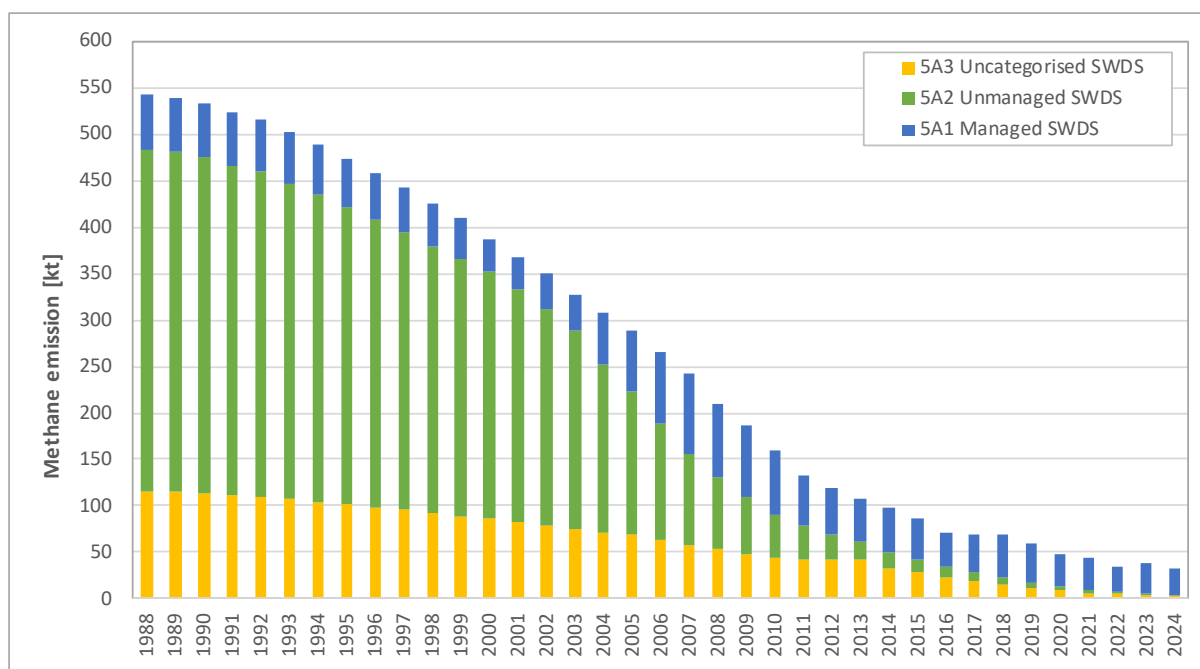


Figure 7.5. Methane emission from 5.A subsector divided to subcategories

7.2.2. Methodological issues

7.2.2.1 Method and factors applied

The methane emission estimates from waste disposal sites were calculated using IPCC (2019) *Tier 2* method. The choice of the method was supported by good quality country-specific historical and current activity data on waste disposal at SWDSs provided by Statistics Poland, national waste databases, and The Ministry of Climate and Environment.

The methane emissions estimates were calculated with application the IPCC Waste Model published in IPCC (2019). The model establishes multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH₄ is diminished by recapturing of this gas for energy purposes.

The following factors were used for estimation of CH₄ emissions:

- DOC – degradable organic carbon in the year of deposition,
- DOC_f – fraction of DOC that can decompose,
- MCF – CH₄ correction factor for aerobic decomposition in the year of deposition,
- k – reaction constant,
- F – fraction of CH₄ by volume, in generated landfill gas,
- OX – Oxidation Factor reflecting the amount of CH₄ from solid waste disposal sites that is oxidized in the soil or other material covering the waste.

Table 7.1. MCF indicators of organic carbon in disposed municipal and industrial waste

Unmanaged, shallow	Unmanaged, deep	Managed	Uncategorised
0.4	0.8	1	0.6

Estimation of unmanaged landfill depth based on area and amount of landfilled waste allowed to categorize unmanaged SWDSs to “shallow” in years 1950-1963 and since 1964 to “deep” group.

Table 7.2. DOC and DOC_f indicators

DOC	Municipal Waste			Industrial Waste	
	Range	Default	Adopted Value	Default	Adopted Value
Food	0.08-0.20	0.15	0.15	0.15	0.15
Garden	0.18-0.22	0.2	0.2	NO	NO
Paper	0.36-0.45	0.4	0.4	0.4	0.4
Wood and straw	0.39-0.46	0.43	0.43	0.43	0.43
Textiles	0.20-0.40	0.24	0.24	0.24	0.24
Nappies	0.18-0.32	0.24	IE	NO	NO
Rubber (and leather)	0.39	0.39	IE	0.39	0.39
DOC _f	0.5	0.5	0.5	0.5	0.5

Table 7.3. Methane generation rate (k) assumed for calculations

Methane generation rate constant (k)	Municipal Waste			Industrial Waste		
	Range	Default	Adopted Value	Range	Default	Adopted Value
Food waste	0.1–0.2	0.185	0.185	0.1–0.2	0.185	0.185
Garden	0.06–0.1	0.1	0.1	NO	NO	NO
Paper	0.05–0.07	0.06	0.06	0.05–0.07	0.06	0.06
Wood and straw	0.02–0.04	0.03	0.03	0.02–0.04	0.03	0.03
Textiles	0.05–0.07	0.06	0.06	0.05–0.07	0.06	0.06
Nappies	0.06-0.1	0.1	IE	0.06-0.1	0.1	NO
Rubber	IE	IE	IE	0.02–0.04	0.03	0.03

No data on shares of nappies, rubber and leather in municipal solid waste are available - reported under “textile” category.

Table 7.4. Factors F, OX and delay time assumed for calculations

Factor	Municipal Waste		Industrial Waste	
	Default	Value	Default	Value
Delay time (months)	6	6	6	6
Fraction of methane in developed gas (F)	0.5	0.5	0.5	0.5
Oxidation factor (OX)	0 or 0.1	0 and 0.1*	0 or 0.1	0

* OX = 0.1 applied for MSW in managed SWDS since 2003

Fraction of degradable organic carbon in bulk waste (DOC) was calculated with application of default IPCC (2019) method and country specific data on waste composition.

Sewage sludge

Emission from sewage sludge was estimated on the basis of IPCC (2019) methodology, using IPCC Waste Model. Emission factors are default IPCC (2019), presented in table 7.5. Other parameters were assumed as for municipal solid waste landfilled in managed waste disposal sites.

Table 7.5. Sewage sludge emission factors

DOC	Reaction constant (k)
0.05	0.185

Climatic zone

Party is applying IPCC (2019) values of methane generation rate (k) and half-life ($t_{1/2}$) default for cold temperate wet climatic zone, according to IPCC Good Practice Guidance for LULUCF, Chapter 3 (IPCC 2003).

7.2.2.2 Activity data

Activity data applied in IPCC Waste Model to estimate emissions of CH₄ from solid waste disposal are calculated on basis of following data:

- **generated MSW** – data for the years 1950-2004 were extrapolated in correlation with amount of collected MSW, since 2005 – data published in [GUS (2006-2025d)] (table 7.7);
- **collected MSW** – data for the years 1975-2024 were taken from National Statistics, for years 1950-1974 amounts of collected MSW equaled amounts of landfilled MSW according National Statistics (table 7.7);
- **landfilled MSW** – data for the years 1975-2005 were taken from National Statistics, data for the years 1950-1974 were extrapolated in correlation with data on average monthly salary per capita published in National Statistics, data for years 2006-2024 were taken from facility reports from Central Waste System (CSO) and BDO Waste Database (BDO) (table 7.7);
- **composition of landfilled MSW** – data calculated on basis of facility reports from Central Waste System (CSO) and BDO Waste Database (BDO) for years 2008-2024, Rosik-Dulewska Cz. (2000) for years 1950-1985 (table 7.8);
- **landfilled ISW and mining waste** – data for the years 1975-2007 were published in [GUS (1975d-2008d)], data for years 1950-1974 were extrapolated in correlation to GDP, data for years 2008-2024 were taken from facility reports from Central Waste System (CSO) and BDO Waste Database (BDO) (table 7.9);
- **composition of landfilled ISW** – data for years 1975-1985 are calculated on basis of data on landfilled waste from industries published in [GUS (1976d-1986d)], data for years 2008-2024 were taken from facility reports from Central Waste System (CSO) and BDO Waste Database (BDO), data for 1950-1974 were estimated with application of linear extrapolation (table 7.10).
- **landfilled municipal sewage sludge** – data for the years 1995-2008 were published in [GUS (1996d-2009d)], data for years 2009-2024 were taken from facility reports from Central Waste System (CSO) and BDO Waste Database (BDO), data for the years 1950-1994 were extrapolated in correlation with amounts of landfilled MSW (table 7.11);
- **landfilled industrial sewage sludge** – data for the years 1975-2009 were published in [GUS (1975d-2010d)], data for years 2010-2024 were taken from facility reports from Central Waste System (CSO) and BDO Waste Database (BDO), data for the years 1950-1974 were extrapolated in correlation with amounts of landfilled ISW (table 7.11);
- **managed SWDS** – data for years 2001-2011 are provided by Waste Management Department of Ministry of the Environment – MSW deposited on landfills fulfilling requirements of Landfill Directive 1999/31/EC (table 7.6), for years 1950-2000 calculated in accordance to elaboration [Gworek (2003)], since 2012 all SWDS are considered to be managed;
- **methane recovery** – calculated on basis of data on amounts of recovered landfill gas published in [GUS OZE (2001-2025)] (table 7.13).

Managed and unmanaged Solid Waste Disposal Sites (5.A.1 and 5.A.2)

Shares of managed and unmanaged SWDSs for years 1950-2001 was calculated in accordance to elaboration Gworek (2003). Since 2001, Poland was implementing the Landfill Directive (1999/31/EC), and gathering data on amounts of SDWSs which are fulfilling its requirements and are considered to be managed solid waste disposal sites. For years 2003-2011, it was provided for inventory purposes by Waste Management Department of Ministry of Environment (table 7.6). Since 2012 all solid waste disposal sites in Poland fulfill requirements of the Directive.

Table 7.6. Amount and share of waste landfilled on managed SWDS

Year	Landfilled MSW [kt]	MSW landfilled on managed SWDS [kt]	Share of managed SDWS
2001	data unavailable	data unavailable	20%*
2002	data unavailable	data unavailable	26%*
2003	9 609.10	3 074.91	32%
2004	9 193.60	5 332.29	58%
2005	8 623.10	5 173.86	60%
2006	8 987.00	6 740.25	75%
2007	9 098.00	7 278.40	80%
2008	7 881.77	6 699.51	85%
2009	7 274.77	6 256.30	86%
2010	7 154.50	6 582.14	92%
2011	5 742.69	5 225.85	91%

* interpolated values

IPCC 2019 GL Refinement Waste Model estimates aggregated methane emissions from managed, unmanaged and uncategorized solid waste disposal sites. Disaggregation of emissions to subcategories 5.A.1-3 is estimated in correlation with estimated amounts of waste aggregated on managed, unmanaged and uncategorized SWDS since year 1950. Sources of data on amounts of landfilled waste applied in estimations are listed in former subchapter.

Uncategorized Solid Waste Disposal Sites (5.A.3)

Emission factors and activity data applied to estimate emissions from uncategorized SWDSs are described in the NIR in chapter 7.2.2.1. Amount of municipal solid waste landfilled in Uncategorized SWDSs is calculated by subtracting amount of collected MSW from amount of generated MSW.

In Poland, disposal of waste outside Waste Management System (in Uncategorized Solid Waste Disposal Sites) is strictly prohibited by law and it is assumed that since 2014 no new waste is being landfilled in Uncategorized SWDSs. Still no data on treatment of waste disposed illegally before 2014 are available, therefore assumption that methane emissions from this source stopped is unjustifiable. For this reason emission of methane from waste landfilled before 2014 in Uncategorized Waste Disposal Sites is still estimated.

Municipal Waste

Data on landfilled municipal solid waste for the years 1950-1974 was extrapolated in correlation with data on average monthly salary per capita published in National Statistics GUS W (2016). Correlation of those factors is acknowledged by researches and described in papers, eg. Gellynck (2011).

Table 7.7. Generated, collected and landfilled municipal solid waste

Years	Generated MSW [kt]	Data source	Collected MSW [kt]	Data source	Landfilled MSW [kt]	Data source
1950	669.90	extrapolation	529.46	extrapolation	529.46	extrapolation
1955	1 225.51	extrapolation	968.60	extrapolation	968.60	extrapolation
1960	1 896.62	extrapolation	1 499.02	extrapolation	1 499.02	extrapolation
1965	2 269.87	extrapolation	1 794.02	extrapolation	1 794.02	extrapolation
1970	2 717.28	extrapolation	2 147.64	extrapolation	2 147.64	extrapolation
1975	4 278.09	extrapolation	3 381.25	GUS (1986d)	3 381.25	GUS (1986d)
1980	12 721.86	extrapolation	10 054.90	GUS (1986d)	10 054.90	GUS (1986d)
1985	14 027.64	extrapolation	11 086.95	GUS (1986d)	11 086.95	GUS (1986d)
1988	15 289.40	extrapolation	12 084.18	GUS (1989d)	12 072.09	GUS (1989d)
1989	14 665.63	extrapolation	11 591.23	GUS (1990d)	11 988.95	GUS (1990d)
1990	14 041.98	extrapolation	11 098.28	GUS (1996d)	11 087.18	GUS (1996d)
1991	13 459.72	extrapolation	10 637.98	GUS (1996d)	10 627.34	GUS (1996d)
1992	13 463.54	extrapolation	10 641.32	GUS (1996d)	10 610.38	GUS (1996d)
1993	13 468.19	extrapolation	10 644.66	GUS (1996d)	10 551.85	GUS (1996d)
1994	13 936.67	extrapolation	11 014.64	GUS (1996d)	10 899.98	GUS (1996d)
1995	14 318.39	extrapolation	11 317.93	GUS (2005d)	10 783.84	GUS (2005d)
1996	14 705.09	extrapolation	11 621.22	GUS (1997d)	11 402.00	GUS (1997d)
1997	15 119.37	extrapolation	11 948.50	GUS (1998d)	11 964.00	GUS (1998d)
1998	15 523.90	extrapolation	12 275.77	GUS (1999d)	11 988.00	GUS (1999d)
1999	15 594.65	extrapolation	12 316.90	GUS (2000d)	12 035.00	GUS (2000d)
2000	15 471.00	extrapolation	12 226.00	GUS (2005d)	11 888.04	GUS (2005d)
2001	14 019.64	extrapolation	11 109.00	GUS (2005d)	10 637.57	GUS (2005d)
2002	13 359.47	extrapolation	10 508.70	GUS (2005d)	10 161.93	GUS (2005d)
2003	12 535.09	extrapolation	9 924.61	GUS (2005d)	9 609.10	GUS (2005d)
2004	12 208.76	extrapolation	9 759.31	GUS (2005d)	9 193.60	GUS (2005d)
2005	12 169.00	GUS (2012d)	9 352.12	GUS (2006d)	8 623.10	GUS (2006d)
2006	12 235.00	GUS (2009d)	9 876.59	GUS (2007d)	8 987.00	CSO
2007	12 264.00	GUS (2010d)	10 082.58	GUS (2011d)	9 098.00	CSO
2008	12 194.00	GUS (2011d)	10 036.41	GUS (2011d)	7 881.77	CSO
2009	12 053.00	GUS (2012d)	10 053.50	GUS (2012d)	7 274.77	CSO
2010	12 038.00	GUS (2012d)	10 040.11	GUS (2012d)	7 154.50	CSO
2011	12 128.80	GUS (2012d)	9 827.64	GUS (2012d)	5 742.69	CSO
2012	12 085.00	GUS (2013d)	9 580.87	GUS (2013d)	5 207.30	CSO
2013	11 295.00	GUS (2014d)	9 473.83	GUS (2014d)	3 833.25	CSO
2014	10 330.41	GUS (2015d)	10 330.41	GUS (2015d)	3 621.65	CSO
2015	10 863.50	GUS (2016d)	10 863.50	GUS (2016d)	2 056.53	CSO
2016	11 654.00	GUS (2017d)	11 654.00	GUS (2017d)	2 001.73	CSO
2017	11 969.00	GUS (2018d)	11 969.00	GUS (2018d)	2 009.19	CSO
2018	12 485.42	GUS (2019d)	12 485.42	GUS (2019d)	2 056.53	CSO
2019	12 752.78	GUS (2020d)	12 752.78	GUS (2020d)	2 782.58	BDO
2020	13 116.90	GUS (2021d)	13 116.90	GUS (2021d)	2 630.70	BDO
2021	13 673.58	GUS (2022d)	13 673.58	GUS (2022d)	2 708.21	BDO
2022	13 420.30	GUS (2023d)	13 420.30	GUS (2023d)	2 315.21	BDO
2023	13 447.91	GUS (2024d)	13 447.91	GUS (2024d)	2 103.72	BDO
2024	14 158.39	GUS (2025d)	14 158.39	GUS (2025d)	2 020.93	BDO

Composition of municipal waste for years 1950-1985 was calculated on the basis of publication Rosik-Dulewska Cz. (2000). Data for 2006-2024 are based on facility reports from Central Waste System (CSO) and BDO Waste Database (BDO) (table 7.8). Data on composition in years 1986-2005 were estimated with assumption of linear changes. Data on composition of landfilled municipal solid waste are applied in IPCC Waste Model to calculate weight of each fraction of waste deposited at SWDSs, and amounts of CH₄ generated by each fraction.

Table 7.8. Composition of municipal solid waste

Year	Food	Garden	Paper	Wood	Textile	Plastics, and other inert
1950	30%	3%	14%	5%	2%	46%
1955	30%	3%	14%	5%	2%	46%
1960	30%	3%	14%	5%	2%	46%
1965	30%	3%	14%	5%	2%	46%
1970	30%	3%	14%	5%	2%	46%
1975	30%	3%	14%	5%	2%	46%
1980	30%	3%	14%	5%	2%	46%
1985	30%	3%	14%	5%	2%	46%
1988	24%	3%	11%	4%	2%	57%
1989	23%	3%	11%	4%	2%	59%
1990	24%	3%	11%	4%	2%	58%
1991	23%	3%	11%	4%	2%	58%
1992	22%	3%	10%	3%	1%	60%
1993	21%	2%	10%	3%	1%	63%
1994	19%	2%	9%	3%	1%	66%
1995	18%	2%	8%	3%	1%	68%
1996	15%	2%	7%	2%	1%	72%
1997	13%	2%	6%	2%	1%	76%
1998	12%	2%	6%	2%	1%	78%
1999	11%	2%	5%	2%	1%	80%
2000	10%	1%	5%	2%	1%	82%
2001	10%	2%	4%	2%	1%	82%
2002	9%	1%	4%	1%	1%	84%
2003	8%	1%	4%	1%	1%	86%
2004	6%	1%	3%	1%	0%	88%
2005	5%	1%	2%	1%	0%	90%
2006	3%	1%	2%	1%	0%	93%
2007	2%	1%	1%	0%	0%	96%
2008	0%	1%	0%	0%	0%	99%
2009	0%	1%	0%	0%	0%	99%
2010	0%	1%	0%	0%	0%	98%
2011	0%	2%	0%	0%	0%	98%
2012	0%	2%	0%	0%	0%	98%
2013	0%	3%	0%	0%	0%	97%
2014	0%	3%	0%	0%	0%	97%
2015	0%	5%	0%	0%	0%	95%
2016	0%	4%	0%	0%	0%	95%
2017	0%	5%	0%	0%	0%	95%
2018	0%	5%	0%	0%	0%	95%
2019	0%	4%	0%	0%	0%	96%
2020	0%	5%	0%	0%	0%	95%
2021	0%	4%	0%	0%	0%	96%
2022	0%	5%	0%	0%	0%	95%
2023	0%	5%	0%	0%	0%	95%
2024	0%	4%	0%	0%	0%	96%

Industrial Waste

Activity data on landfilled industrial waste for the years 1975-2007 were taken from Statistics Poland (GUS) *Environment* annuals, and data for years 2008-2024 were taken from facility reports from Central Waste Management System (CSO) and BDO Waste Database (BDO). Data for the years 1950-1974 were extrapolated in correlation to GDP of Poland.

Table 7.9. Landfilled industrial waste

Years	Landfilled industrial waste [kt]	Data source
1950	6 748.82	extrapolation
1955	7 705.85	extrapolation
1960	8 866.97	extrapolation
1965	10 444.54	extrapolation
1970	12 212.42	extrapolation
1975	15 686.30	GUS (1976d)
1980	15 964.70	GUS (1981d)
1985	32 937.70	GUS (1986d)
1988	37 834.60	GUS (1989d)
1989	29 212.20	GUS (1990d)
1990	25 454.10	GUS (1996d)
1991	20 313.10	GUS (1996d)
1992	19 289.00	GUS (1996d)
1993	17 044.90	GUS (1996d)
1994	15 507.20	GUS (1996d)
1995	13 502.90	GUS (2005d)
1996	12 695.30	GUS (1997d)
1997	12 133.95	GUS (1998d)
1998	11 572.60	GUS (1999d)
1999	9 018.30	GUS (2000d)
2000	9 001.00	GUS (2005d)
2001	9 365.20	GUS (2005d)
2002	7 767.70	GUS (2005d)
2003	8 843.70	GUS (2005d)
2004	7 918.70	GUS (2005d)
2005	7 071.80	GUS (2006d)
2006	7 628.00	GUS (2007d)
2007	8 924.30	GUS (2008d)
2008	9 664.70	CSO
2009	9 467.30	CSO
2010	11 160.69	CSO
2011	12 474.81	CSO
2012	12 980.15	CSO
2013	13 731.91	CSO
2014	14 713.27	CSO
2015	15 649.02	CSO
2016	15 470.14	CSO
2017	15 308.98	CSO
2018	12 141.63	CSO
2019	10 617.69	BDO
2020	12 193.18	BDO
2021	12 282.33	BDO
2022	12 649.99	BDO
2023	9 282.60	BDO
2024	8 741.55	BDO

According to 2019 IPCC Refinement to IPCC 2006 GL following types of industrial waste generate CH₄ emission:

- paper and cardboard,
- food,
- wood,
- tobacco,
- textiles and rubber and leather (only synthetic).

Data on composition of landfilled industrial waste for the years 1975-1985 are calculated on basis of data on landfilled waste from industries published in GUS (1976d-1986d). Waste from

manufacturing of furniture is not included in the inventory due to lack of information on content of wood, plastic, metal and other materials in disposed furniture. Data for years 2008-2024 were taken from facility reports from Central Waste System (CSO) and BDO Waste Database (BDO), and data for 1950-1974 were estimated with application of linear extrapolation.

Waste from mining and quarrying is excluded from the calculations as the amounts are large and the DOC and fossil carbon contents are likely to be negligible (IPCC 2019).

Table 7.10. Composition of landfilled industrial waste

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert
1950	8.28%	0.98%	0.66%	0.42%	0.20%	89.46%
1955	11.16%	1.17%	0.89%	0.45%	0.47%	85.86%
1960	13.89%	1.37%	0.73%	0.51%	0.72%	82.77%
1965	15.89%	1.47%	0.64%	0.52%	0.90%	80.58%
1970	16.22%	1.53%	0.58%	0.53%	1.15%	79.99%
1975	17.94%	1.52%	0.52%	0.45%	1.29%	78.27%
1980	25.07%	1.33%	0.59%	0.63%	1.30%	71.07%
1985	10.70%	0.91%	0.19%	0.25%	0.55%	87.40%
1988	4.03%	1.10%	0.29%	0.37%	0.48%	93.74%
1989	4.35%	1.73%	0.38%	0.25%	0.58%	92.71%
1990	4.87%	1.64%	0.37%	0.17%	0.40%	92.56%
1991	6.96%	2.04%	0.33%	0.20%	0.39%	90.08%
1992	4.91%	1.91%	0.13%	0.28%	0.43%	92.35%
1993	6.34%	2.03%	0.11%	0.20%	0.22%	91.11%
1994	5.60%	1.82%	0.13%	0.14%	0.14%	92.17%
1995	5.38%	1.83%	0.27%	0.20%	0.15%	92.18%
1996	6.51%	2.20%	0.25%	0.24%	0.16%	90.63%
1997	5.38%	2.23%	0.20%	0.21%	0.15%	91.83%
1998	5.52%	4.20%	0.19%	0.19%	0.07%	89.83%
1999	5.53%	8.68%	0.29%	0.15%	0.06%	85.29%
2000	4.77%	7.47%	0.25%	0.16%	0.05%	87.30%
2001	4.00%	6.24%	0.21%	0.16%	0.05%	89.34%
2002	4.17%	6.49%	0.22%	0.21%	0.05%	88.85%
2003	3.06%	4.73%	0.17%	0.20%	0.04%	91.80%
2004	2.77%	4.25%	0.15%	0.24%	0.04%	92.55%
2005	2.36%	3.56%	0.13%	0.29%	0.03%	93.63%
2006	1.49%	2.19%	0.09%	0.28%	0.02%	95.93%
2007	0.68%	0.93%	0.04%	0.25%	0.01%	98.08%
2008	0.09%	0.00%	0.01%	0.24%	0.01%	99.64%
2009	0.06%	0.00%	0.00%	0.12%	0.01%	99.81%
2010	0.05%	0.00%	0.00%	0.15%	0.00%	99.78%
2011	0.04%	0.00%	0.00%	0.09%	0.02%	99.85%
2012	0.04%	0.00%	0.00%	0.06%	0.01%	99.89%
2013	0.05%	0.00%	0.00%	0.06%	0.00%	99.89%
2014	0.04%	0.00%	0.00%	0.07%	0.01%	99.88%
2015	0.03%	0.00%	0.00%	0.06%	0.01%	99.91%
2016	0.02%	0.00%	0.00%	0.10%	0.01%	99.87%
2017	0.02%	0.00%	0.00%	0.14%	0.01%	99.83%
2018	0.00%	0.00%	0.00%	0.18%	0.03%	99.79%
2019	0.05%	0.00%	0.00%	0.45%	0.03%	99.48%
2020	0.00%	0.00%	0.00%	0.32%	0.02%	99.66%
2021	0.00%	0.00%	0.00%	0.32%	0.02%	99.66%
2022	0.00%	0.00%	0.00%	0.38%	0.03%	99.59%
2023	0.01%	0.00%	0.00%	0.46%	0.05%	99.48%
2024	0.00%	0.00%	0.00%	0.43%	0.05%	99.52%

Sewage sludge

Data on amounts of landfilled municipal and industrial sewage sludge for years 1950-2024 and its sources are presented in Table 7.11.

Table 7.11. Sewage sludge activity data (dry basis)

Year	Amount of sewage sludge disposed on landfills [kt]			
	Municipal	Data source	Industrial	Data source
1950	10.60	extrapolation	392.13	extrapolation
1955	19.38	extrapolation	447.73	extrapolation
1960	30.00	extrapolation	515.20	extrapolation
1965	35.90	extrapolation	606.86	extrapolation
1970	42.98	extrapolation	709.58	extrapolation
1975	67.66	extrapolation	800.00	GUS (1975d)
1980	201.21	extrapolation	1100.80	GUS (1981d)
1985	221.86	extrapolation	366.10	GUS (1986d)
1988	241.57	extrapolation	660.00	GUS (1990d)
1989	239.91	extrapolation	796.80	GUS (1990d)
1990	221.86	extrapolation	552.00	GUS (1991d)
1991	212.66	extrapolation	399.60	GUS (1992d)
1992	212.32	extrapolation	264.60	GUS (1993d)
1993	211.15	extrapolation	346.50	GUS (1994d)
1994	218.12	extrapolation	255.60	GUS (1995d)
1995	245.88	GUS (1996d)	397.60	GUS (1996d)
1996	227.79	interpolation	558.06	GUS (1997d)
1997	209.70	interpolation	534.74	interpolation
1998	191.61	GUS (1999d)	511.43	GUS (1999d)
1999	204.43	GUS (2000d)	617.40	GUS (2000d)
2000	151.62	GUS (2001d)	322.91	GUS (2001d)
2001	198.63	GUS (2005d)	276.74	GUS (2005d)
2002	192.49	GUS (2005d)	276.99	GUS (2005d)
2003	164.88	GUS (2005d)	288.20	GUS (2005d)
2004	162.73	GUS (2005d)	290.61	GUS (2005d)
2005	150.70	GUS (2006d)	248.43	GUS (2006d)
2006	147.06	GUS (2007d)	234.22	GUS (2007d)
2007	124.54	GUS (2008d)	172.62	GUS (2008d)
2008	91.61	GUS (2009d)	117.10	GUS (2009d)
2009	63.05	CSO	52.46	GUS (2010d)
2010	36.49	CSO	39.85	CSO
2011	31.55	CSO	41.20	CSO
2012	33.76	CSO	46.79	CSO
2013	19.66	CSO	27.95	CSO
2014	17.70	CSO	16.78	CSO
2015	21.56	CSO	24.38	CSO
2016	0.84	CSO	23.38	CSO
2017	0.61	CSO	21.87	CSO
2018	2.56	CSO	24.02	CSO
2019	0.43	BDO	27.88	BDO
2020	0.00	BDO	24.14	BDO
2021	0.00	BDO	30.71	BDO
2022	0.02	BDO	16.64	BDO
2023	0.00	BDO	17.51	BDO
2024	0.00	BDO	18.27	BDO

IPCC 2019 methodology of estimation of methane emissions is based on dry weight of landfilled sludge. Statistics Poland *Environment* yearbooks present dry matter of landfilled sludges, while data taken from CSO and BDO databases are collected mostly on wet mass basis. Calculations of dry matter of sludge were based on country specific dry matter content, estimated on basis of CSO and BDO data on wet and dry weight of sludge generated in

municipal wastewater treatment plants.

Table 7.12. Sewage sludge dry matter content

MSW component	Dry matter content in % of wet weight
Municipal sewage sludge	32%

Methane recovery

Data on amounts of recovered landfill gas are published in elaboration *Energy from renewable sources* GUS OZE (2001-2025). Amount of recovered methane is calculated with application of IPCC (2019) default net calorific value (50.4 MJ/kt).

The data on recovered methane are plant specific, based on responses to questionnaires of Statistics Poland on energy combustion. Recovered gas is combusted for energy purposes or flared (no data on amounts available).

Table 7.13. Methane recovery data

Year	Recovered landfill gas [TJ]	Data source	Recovered methane [kt]
2000	423.00	GUS OZE (2001)	4.62
2001	544.00	GUS OZE (2002)	5.94
2002	628.00	GUS OZE (2003)	6.85
2003	704.00	GUS OZE (2004)	7.68
2004	636.00	GUS OZE (2005)	6.94
2005	649.10	GUS OZE (2006)	7.08
2006	791.32	GUS OZE (2007)	8.64
2007	879.00	GUS OZE (2008)	9.59
2008	1 432.00	GUS OZE (2009)	15.63
2009	1 487.00	GUS OZE (2010)	16.23
2010	1 811.00	GUS OZE (2011)	19.76
2011	2 323.00	GUS OZE (2012)	25.35
2012	2 249.00	GUS OZE (2013)	24.54
2013	2 157.00	GUS OZE (2014)	23.54
2014	2 051.00	GUS OZE (2015)	22.38
2015	2 125.00	GUS OZE (2016)	23.19
2016	2 412.00	GUS OZE (2017)	26.32
2017	2 010.61	GUS OZE (2018)	21.94
2018	1 626.64	GUS OZE (2019)	32.27
2019	1 756.00	GUS OZE (2020)	34.84
2020	2 078.51	GUS OZE (2021)	41.24
2021	1 992.00	GUS OZE (2022)	39.52
2022	2 180.89	GUS OZE (2023)	43.27
2023	1 811.39	GUS OZE (2024)	35.94
2024	1 904.61	GUS OZE (2025)	37.79

7.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2024 for IPCC sector 5. *Waste* was estimated with use of approach 1 described in 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 2.

Recalculation of data for years 1988-2023 ensured consistency for whole time-series.

2024	CO ₂ [kt]	CH ₄ [kt]	N ₂ O [kt]	CO ₂ Emission uncertainty [%]	CH ₄ Emission uncertainty [%]	N ₂ O Emission uncertainty [%]
5. Waste	-	110.51	4.80	-	60.1%	110.4%
A. Solid waste disposal	-	31.49	-	-	90.3%	-
B. Biological treatment of solid waste	-	10.93	0.64	-	101.2%	153.0%
D. Wastewater treatment and discharge	-	68.08	4.16	-	86.7%	125.1%

7.2.4. Source-specific QA/QC and verification

Activity data concerning solid waste disposals and sewage sludge come from Statistics Poland (GUS) and CSO/BDO databases. GUS and Ministry of Climate and Environment are responsible for QA/QC of collected and published data. In some cases of solid waste comparison is made between national statistical data and National Waste Management Plan. Country specific emission factors involved in estimation of GHG emissions from waste water treatment are based on external expert's analysis of questionnaires from individual entities.

The attempt has been undertaken to ensure internal consistency between different treatment pathways of waste and sewage sludge. Calculations in waste sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 4.

7.2.5. Source-specific recalculations

Recalculations details:

- change of range of OX = 0.1 value from whole trend and all types of landfilled waste and SWDS to MSW in managed SWDS,
- update of data from BDO in years 2020-2023,
- assignment of methane recovery to 5A1 only.

Table 7.14. Change in methane emissions in result of recalculations in sector 5.A

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
kt CH ₄	54.36	54.02	53.36	52.46	51.63	50.23	48.95	47.39	45.77	44.30	42.63	41.08
%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
kt CH ₄	39.62	37.94	36.23	30.22	26.44	23.53	20.34	17.35	15.86	13.81	12.55	12.44
%	11%	11%	12%	10%	9%	9%	8%	8%	8%	8%	9%	10%

Change	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CH ₄	11.30	10.35	8.96	8.34	8.21	6.79	5.46	5.15	5.37	4.59	4.75	3.94
%	10%	11%	10%	11%	13%	11%	9%	10%	13%	12%	16%	12%

7.2.6. Source-specific planned improvements

No improvements are planned.

7.3. Biological Treatment of Solid Waste (CRT sector 5.B)

7.3.1. Source category description

In the following section are presented estimations of emissions of CH₄ and N₂O from aerobic digestion in composting facilities (subcategory 5.B.1) and CH₄ from anaerobic digestion in biogas facilities (subcategory 5.B.2). Emissions of N₂O from anaerobic digestion are assumed to be negligible according to IPCC (2019) GLs.

Estimates of methane emissions from anaerobic digestion of manure, slurry and bird spawn are reported under sector 3. *Agriculture*.

The 5.B subcategory share in total *Waste* sector is 10.9%.

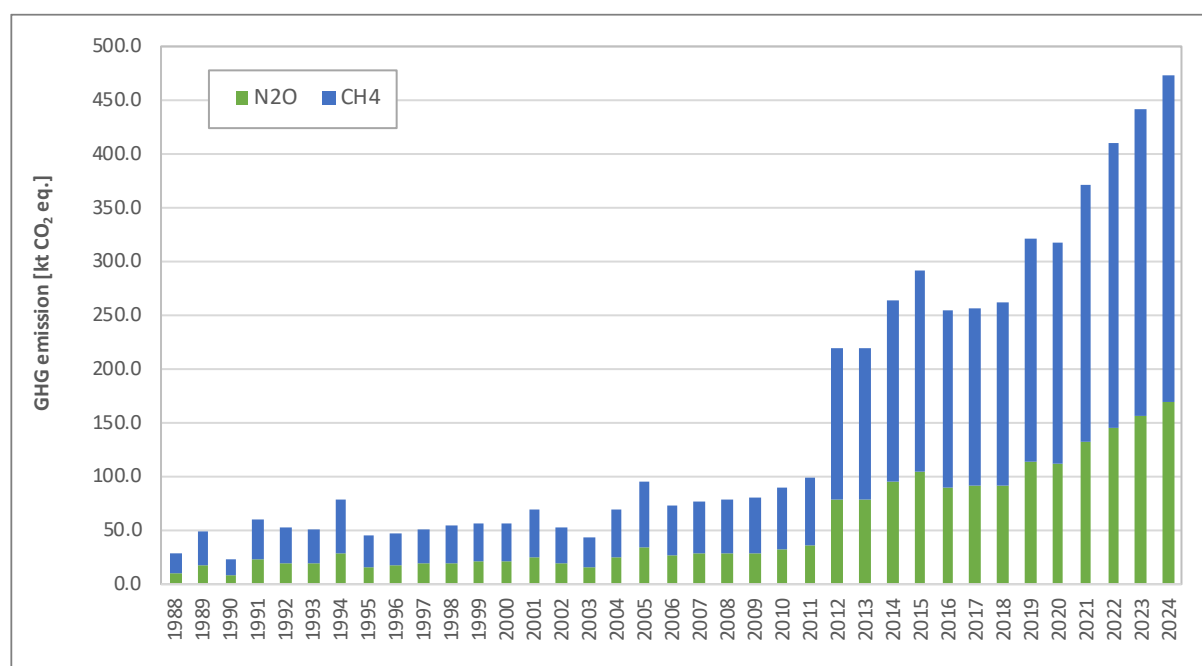


Figure 7.6. GHG emission from 5.B subsector

Increase of amounts of estimated GHG emissions since 2012 is result of significant increase of amount of operating composting and biogas facilities resulting in increase of amount of treated waste. Increase of the amount of waste composted in 2019 is result of increase of amount of collected biogenic waste, caused by prohibition of biomass household burning, increase of waste treatment awareness in society, and enhanced monitoring of waste management.

7.3.2. Methodological issues

7.3.2.1 Method and factors applied

Calculations are based on *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* methodology, *Tier 1*, choice of which justifies lack of country-specific method of estimation and research allowing application of CS *Tier 2* emission factors (as IPCC 2019 GL do not provide default *Tier 2* EFs). Default emission factors applied in inventory are presented in table 7.15.

Table 7.15. Emission factors (g d.m./kg waste)

Type of biological treatment	CH ₄	N ₂ O
Composting	10	0.6
Anaerobic digestion at biogas facilities	2	-

7.3.2.2 Activity data

Activity data on amounts of composted waste and its sources are presented in table 7.16. Data on amounts of waste composted in years 1993-2005 are taken from statistical yearbooks, apart from the year 1997 where, due to lack of data, interpolation was applied. For the years 1988-1992 activity data were estimated by linear extrapolation. Data on amounts of waste composted in years 2006-2024 are taken from facility data from Central Waste Management System (CSO) and BDO Waste Database (BDO).

Data on dry weight basis are estimated assuming a moisture content of 60% in wet waste.

Table 7.16. Amounts of composted waste and data sources (dry weight basis)

Year	Municipal waste [kt]	Data source	Other waste [kt]	Data source
1988	12.80	extrapolation	52.32	GUS (1989d)
1989	15.83	extrapolation	95.21	GUS (1990d)
1990	19.56	extrapolation	31.26	GUS (1996d)
1991	24.19	extrapolation	112.57	GUS (1996d)
1992	29.90	extrapolation	88.88	GUS (1996d)
1993	36.96	GUS (1994d)	77.72	GUS (1996d)
1994	45.69	GUS (1997d)	130.88	GUS (1996d)
1995	80.26	GUS (1997d)	19.84	GUS (2005d)
1996	87.46	GUS (1998d)	19.53	GUS (1997d)
1997	88.08	interpolation	26.28	interpolation
1998	88.70	GUS (2002d)	33.04	GUS (2002d)
1999	90.08	GUS (2003d)	38.72	GUS (2003d)
2000	99.32	GUS (2003d)	29.48	GUS (2003d)
2001	123.60	GUS (2004d)	34.44	GUS (2004d)
2002	85.92	GUS (2004d)	33.12	GUS (2004d)
2003	51.56	GUS (2004d)	46.12	GUS (2004d)
2004	93.64	GUS (2007d)	63.24	GUS (2007d)
2005	127.16	GUS (2007d)	87.84	GUS (2007d)
2006	115.76	CSO	49.35	CSO
2007	113.19	CSO	62.44	CSO
2008	85.60	CSO	93.71	CSO
2009	89.91	CSO	91.94	CSO
2010	109.77	CSO	94.70	CSO
2011	118.96	CSO	105.21	CSO
2012	180.76	CSO	313.35	CSO
2013	294.54	CSO	198.16	CSO
2014	406.99	CSO	190.00	CSO
2015	444.99	CSO	212.55	CSO
2016	390.03	CSO	175.67	CSO
2017	380.20	CSO	190.09	CSO
2018	423.92	CSO	154.22	CSO
2019	455.21	BDO	255.43	BDO
2020	479.12	BDO	227.34	BDO
2021	497.62	BDO	329.15	BDO
2022	597.17	BDO	318.45	BDO
2023	681.06	BDO	302.72	BDO
2024	723.65	BDO	335.78	BDO

Anaerobic waste treatment facilities are collected in three methodological groups:

5.B.2.a Municipal facilities (1),

5.B.2.b Other:

- Agricultural facilities (2),
- Facilities in wastewater treatment plants (3).

Agricultural biogas facilities operate in Poland since year 2005, first municipal biogas plant started operating in 2011, and data on biogas facilities in wastewater treatment plants are available since 2002. Activity data on amounts of waste treated anaerobically are presented in table 7.17.

Table 7.17. Amounts of waste treated anaerobically in biogas facilities (dry weight basis)

Year	5.B.2.a Municipal facilities [kt]	Data source	5.B.2.b Other [kt]			
			agricultural facilities	Data source	WWTP facilities	Data source
2002	NO	-	NO	-	1.19	CSO
2003	NO	-	NO	-	1.94	CSO
2004	NO	-	NO	-	2.29	CSO
2005	NO	-	0.001	KOWR	2.26	CSO
2006	NO	-	0.001	KOWR	4.00	CSO
2007	NO	-	0.001	KOWR	2.23	CSO
2008	NO	-	0.004	KOWR	1.93	CSO
2009	NO	-	0.01	KOWR	4.61	CSO
2010	NO	-	0.03	KOWR	7.55	CSO
2011	5.10	CSO	0.29	KOWR	10.46	CSO
2012	22.08	CSO	0.82	KOWR	13.01	CSO
2013	29.45	CSO	1.73	KOWR	9.34	CSO
2014	37.52	CSO	2.44	KOWR	8.30	CSO
2015	53.24	CSO	3.02	KOWR	11.57	CSO
2016	79.48	CSO	3.90	KOWR	16.58	CSO
2017	100.00	CSO	4.20	KOWR	16.80	CSO
2018	126.08	CSO	5.42	KOWR	16.47	CSO
2019	143.26	BDO	5.64	KOWR	15.68	BDO
2020	123.97	BDO	6.73	KOWR	16.33	BDO
2021	142.86	BDO	7.67	KOWR	15.93	BDO
2022	137.47	BDO	9.63	KOWR	17.81	BDO
2023	142.87	BDO	11.60	KOWR	17.21	BDO
2024	137.69	BDO	12.61	KOWR	19.18	BDO

Dry matter contents in % of wet weight and sources of data are presented in table 7.18. Analysis on results of CS studies on substrates treated in agricultural facilities provided information on moisture of wastes from KOWR reports applied as activity data in the inventory.

Table 7.18. Dry matter content in treated waste

Biogas facilities	Source	Dry matter content in % of wet weight
Municipal facilities	IPCC 2019	40%
Agricultural facilities	CS	substrates*
WWTP facilities	IPCC 2019	40%

* dry matter contents are based on CS studies results and applied separately for each type of substrate

7.3.3. Uncertainties and time-series consistency

See chapter 7.2.3.

7.3.4. Source-specific QA/QC and verification

See chapter 7.2.4.

7.3.5. Source-specific recalculations

Recalculations details:

- update of data from BDO in years 2019-2023.

Table 7.19. Change in GHG emissions in result of recalculations in sector 5.B

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
kt CO ₂ eq.	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%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
kt CO ₂ eq.	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%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Change	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-22.27	-60.23	2.41	11.30	13.03
%	0%	0%	0%	0%	0%	0%	0%	-6%	-16%	1%	3%	3%

7.3.6. Source-specific planned improvements

No improvements are planned.

7.4. Incineration and Open Burning of Waste (CRT sector 5.C)

According to *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* estimates of GHG emissions from municipal, industrial and medical waste and sewage sludge incineration are reported under category 1A, as analysis of facility data from Central Waste System (CSO) and BDO Waste Database (BDO), report Waszczyłko (2021) and information from *Association of Employers of Industrial and Medical Waste Thermal Processing Plants for Health and Environmental Protection* confirmed that those facilities incinerate waste with energy recovery.

Polish law strictly prohibits open burning of waste. Therefore no data on open burning are present in national statistics and no estimation of emissions of GHG from this subsector is calculated.

Study on trend of split between with and without energy recovery assigned to 1A *Fuel Combustion Activities* and 5C *Waste Incineration* is planned.

7.5. Waste Water Handling (CRT sector 5.D)

7.5.1. Source category description

The 5.D category share in emission of GHG from waste sector in 2024 is 68.9%. It involves CH₄ and N₂O emissions from domestic (53.8% and 29.7% share of 5.D) and industrial (9.5% and 7.0% share of 5.D) wastewater treatment plants.

The emission from sector 5.D decreased ca. 38.8% since the base year, mostly because of significant development of national wastewater collection and treatment system. The main contributor and driver of emission change in 5.D is the *Domestic Wastewater* subsector (5.D.1) – responsible of ca. 83.5% of emission of GHG from sector 5.D in 2024.

Emission of GHG from subsector 5.D.2 *Industrial Wastewater* is ca. 18.6% of emission of GHG from sector 5.D in 2024 and it is constantly decreasing due to reduction of wastewater production by industries.

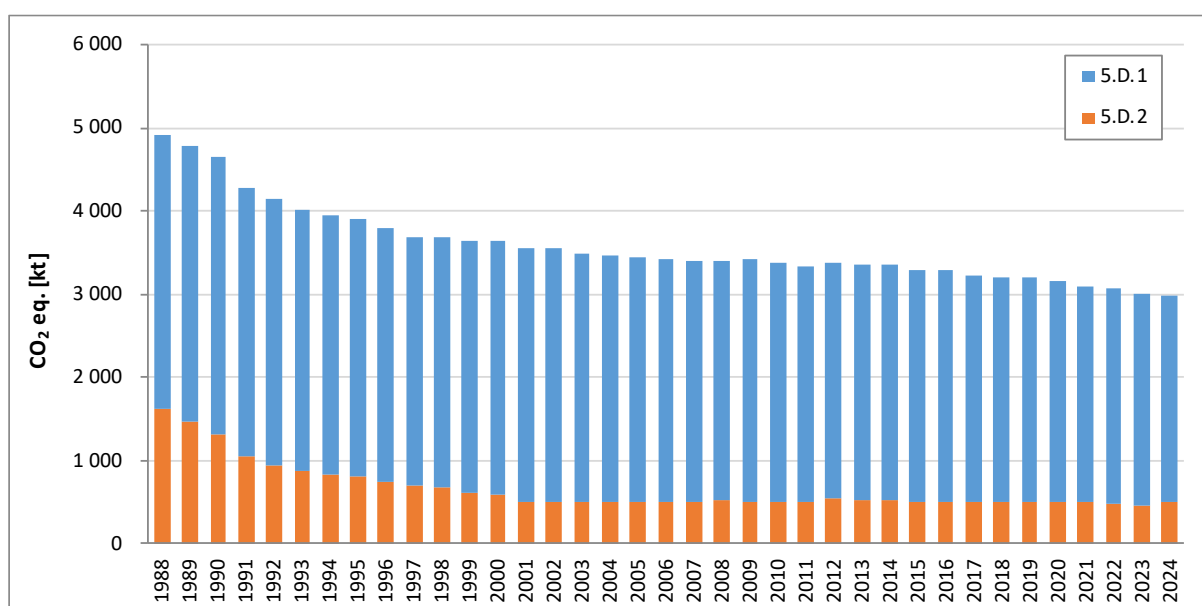


Figure 7.6. GHG emission from 5.D subsector

7.5.2. Methodological issues

7.5.2.1. Domestic Wastewater (CRT sector 5.D.1)

Methane emission

Estimation of CH₄ emissions from sector 5.D.1 *Domestic Wastewater* was based on methodology *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tier 2* – which choice is justified by availability of country specific activity data. Amounts of degradable organic components were estimated basing on the data on population of Poland in GUS (2024), and rural and urban population using different sewage treatment pathways in GUS (2024d). Country specific degrees of utilisation of treatment or discharge pathway or method for each income group are presented in table 7.25.

The methodology of estimating AD on latrines (amount of people using latrines) is based on data published by Statistics Poland, based on national censuses on population and housing. The censuses were conducted in 2002, 2011 and 2021. The data for the years before, between, and after the censuses were extra- and interpolated.

Table 7.25. Rural and urban population using given sewage treatment pathways

Year	Urban population shares in treatment pathway						Rural population shares in treatment pathway					
	Sewer - primary	Sewer - secondary	Sewer - tertiary	Septic tanks	Latrines	Discharge	Sewer - primary	Sewer - secondary	Sewer - tertiary	Septic tanks	Latrines	Discharge
1988	19.05%	52.90%	0.20%	26.76%	0.00%	1.08%	0.38%	1.06%	0.00%	51.53%	12.71%	34.32%
1989	18.66%	53.11%	0.32%	26.86%	0.00%	1.05%	0.37%	1.06%	0.01%	52.43%	12.53%	33.60%
1990	18.61%	52.51%	0.52%	27.33%	0.00%	1.03%	0.37%	1.04%	0.01%	53.37%	12.35%	32.86%
1991	19.32%	54.02%	0.89%	24.76%	0.00%	1.01%	0.33%	0.91%	0.02%	51.27%	13.35%	34.12%
1992	19.84%	54.94%	1.50%	22.75%	0.00%	0.98%	0.35%	0.96%	0.03%	49.61%	14.25%	34.81%
1993	20.20%	55.36%	2.49%	21.02%	0.00%	0.94%	0.36%	0.97%	0.04%	48.45%	15.10%	35.07%
1994	20.35%	55.19%	4.11%	19.47%	0.00%	0.88%	0.36%	0.99%	0.07%	47.71%	15.93%	34.93%
1995	20.14%	53.99%	6.66%	18.04%	0.00%	1.17%	0.54%	1.44%	0.18%	47.21%	16.70%	33.94%
1996	18.93%	52.25%	10.69%	16.71%	0.00%	1.42%	0.72%	1.98%	0.41%	47.08%	17.48%	32.33%
1997	17.61%	48.02%	17.87%	14.84%	0.00%	1.67%	0.98%	2.67%	0.99%	47.15%	18.22%	29.99%
1998	13.40%	49.65%	20.21%	14.88%	0.00%	1.86%	0.87%	3.23%	1.32%	47.90%	19.12%	27.56%
1999	11.36%	48.04%	24.37%	14.29%	0.00%	1.93%	0.92%	3.90%	1.98%	48.81%	19.99%	24.39%
2000	5.74%	47.74%	30.47%	14.06%	0.00%	1.98%	0.60%	4.97%	3.17%	49.97%	20.86%	20.45%
2001	5.10%	44.79%	34.56%	13.59%	0.00%	1.96%	0.63%	5.55%	4.28%	50.44%	21.33%	17.76%
2002	4.36%	41.50%	38.98%	13.37%	0.00%	1.79%	0.62%	5.86%	5.50%	51.34%	21.86%	14.83%
2003	4.34%	35.85%	44.45%	13.14%	0.00%	2.22%	0.71%	5.84%	7.24%	49.90%	21.26%	15.05%
2004	4.00%	33.02%	48.05%	12.74%	0.00%	2.19%	0.75%	6.19%	9.00%	49.72%	21.08%	13.26%
2005	3.73%	27.46%	54.06%	12.41%	0.00%	2.34%	0.78%	5.73%	11.29%	48.97%	20.53%	12.69%
2006	3.59%	25.42%	57.03%	11.87%	0.00%	2.09%	0.84%	5.95%	13.35%	48.97%	20.17%	10.72%
2007	0.81%	25.95%	60.00%	11.36%	0.00%	1.89%	0.21%	6.80%	15.72%	48.62%	19.55%	9.10%
2008	0.24%	18.49%	68.27%	11.06%	0.00%	1.94%	0.07%	5.31%	19.61%	47.88%	18.64%	8.49%
2009	0.11%	17.41%	70.73%	10.69%	0.00%	1.05%	0.04%	5.50%	22.33%	49.15%	18.38%	4.61%
2010	0.10%	16.29%	72.33%	9.91%	0.00%	1.36%	0.04%	5.66%	25.11%	46.84%	16.68%	5.68%
2011	0.10%	14.00%	75.23%	9.12%	0.00%	1.55%	0.04%	5.31%	28.55%	43.95%	16.18%	5.97%
2012	0.14%	14.59%	76.24%	8.18%	0.00%	0.85%	0.06%	6.12%	32.01%	41.59%	17.14%	3.08%
2013	0.11%	15.00%	77.43%	7.38%	0.00%	0.08%	0.05%	6.93%	35.77%	39.14%	17.85%	0.26%
2014	0.03%	14.14%	78.95%	6.82%	0.00%	0.05%	0.02%	6.90%	38.54%	36.23%	18.14%	0.17%
2015	0.03%	14.18%	79.42%	6.22%	0.00%	0.15%	0.02%	7.32%	41.03%	33.13%	18.07%	0.44%
2016	0.03%	14.43%	79.85%	5.63%	0.00%	0.05%	0.02%	7.88%	43.59%	30.42%	17.97%	0.13%
2017	0.03%	14.97%	79.83%	5.13%	0.00%	0.04%	0.02%	8.50%	45.34%	28.14%	17.90%	0.10%

Year	Urban population shares in treatment pathway						Rural population shares in treatment pathway					
	Sewer - primary	Sewer - secondary	Sewer - tertiary	Septic tanks	Latrines	Discharge	Sewer - primary	Sewer - secondary	Sewer - tertiary	Septic tanks	Latrines	Discharge
2018	0.03%	14.36%	80.80%	4.74%	0.00%	0.06%	0.02%	8.42%	47.34%	26.19%	17.86%	0.17%
2019	0.02%	14.40%	80.90%	4.40%	0.00%	0.28%	0.01%	8.66%	48.61%	24.32%	17.71%	0.68%
2020	0.02%	15.04%	80.34%	4.15%	0.00%	0.44%	0.01%	9.28%	49.55%	22.61%	17.52%	1.02%
2021	0.02%	15.51%	80.13%	3.85%	0.00%	0.49%	0.02%	9.85%	50.88%	20.95%	17.23%	1.07%
2022	0.02%	14.79%	81.39%	3.63%	0.00%	0.17%	0.02%	9.61%	52.88%	19.86%	17.27%	0.37%
2023	0.02%	15.14%	81.29%	3.36%	0.00%	0.18%	0.02%	10.10%	54.21%	18.41%	16.89%	0.38%
2024	0.02%	15.43%	81.17%	3.12%	0.00%	0.27%	0.02%	10.54%	55.44%	17.03%	16.46%	0.52%

Default value of organic load in biochemical oxygen demand: 60 g BOD/person/day taken from IPCC (2019) was applied in calculations.

Methane Correction Factors (MCF) for various treatment pathways are taken from IPCC (2019).

MCF, I (correction factor for additional industrial BOD), K_{rem} (sludge factor) B_o (maximum CH_4 producing capacity), F (fraction of the population managing their septic tank in compliance with the sludge removal instruction of their septic system) and TOW (total organics in wastewater) applied in the inventory are presented in table 7.26.

Table 7.26. Methane correction factors MCF, I, K_{rem} , B_o , F and TOW values

emission factor		measure	value
K_{rem}	Sewer - primary	kg BOD/kg sludge	0.5
	Sewer - secondary		0.8
	Sewer - tertiary		1.0
TOW_{rem}	Sewer - primary	-	0.4
	Sewer - secondary		0.85
	Sewer - tertiary		0.9
	Septic tanks		0.625
	Latrines		0.7
MCF	Sewer	-	0.03
	Septic tanks		0.5
	Latrines		0.7
	Discharge		0.11
B_o		kg CH_4 /kg BOD	0.6
I		-	1
F		-	0.5

Methane recovery

Data on amounts of energy from biogas are published in elaboration *Energy from renewable sources* GUS OZE (2002-2025). AD for years 1990-2000 are provided by ARE database, and extrapolated for 1988-1990. Amount of recovered methane is calculated with application of IPCC (2019) default net calorific value.

Table 7.27. Methane recovery data

Year	Energy from biogas [TJ]	Data source	Recovered methane [kt]
1988	no data	Extrapolation	5.65
1989	no data	extrapolation	5.38
1990	393.00	ARE database	7.80
1991	190.00	ARE database	3.77
1992	230.00	ARE database	4.56
1993	62.00	ARE database	1.23
1994	255.00	ARE database	5.06
1995	433.00	ARE database	8.59
1996	587.00	ARE database	11.65
1997	580.00	ARE database	11.51
1998	689.00	ARE database	13.67
1999	732.00	ARE database	14.52
2000	788.00	ARE database	15.63
2001	933.00	GUS OZE (2002)	18.51
2002	725.00	GUS OZE (2003)	14.38
2003	896.00	GUS OZE (2004)	17.78
2004	1 297.00	GUS OZE (2005)	25.73
2005	1 586.00	GUS OZE (2006)	31.47

Year	Energy from biogas [TJ]	Data source	Recovered methane [kt]
2006	1 803.00	GUS OZE (2007)	35.77
2007	1 802.00	GUS OZE (2008)	35.75
2008	2 486.00	GUS OZE (2009)	49.33
2009	2 429.00	GUS OZE (2010)	48.19
2010	2 652.00	GUS OZE (2011)	52.62
2011	2 775.00	GUS OZE (2012)	55.06
2012	3 321.00	GUS OZE (2013)	65.89
2013	3 572.00	GUS OZE (2014)	70.87
2014	3 810.00	GUS OZE (2015)	75.60
2015	4 043.00	GUS OZE (2016)	80.22
2016	5 014.00	GUS OZE (2017)	99.48
2017	4 815.60	GUS OZE (2018)	95.55
2018	4 860.81	GUS OZE (2019)	96.44
2019	5 049.00	GUS OZE (2020)	100.18
2020	5 068.69	GUS OZE (2021)	100.57
2021	4 989.30	GUS OZE (2022)	98.99
2022	5 416.86	GUS OZE (2023)	107.48
2023	5 537.41	GUS OZE (2024)	109.87
2024	5 958.81	GUS OZE (2025)	118.23

Organic component removed as sludge

Data for the years 2003-2024 are provided by GUS (2004-2025d). For the 1988-2002 period amount of removed sludge was calculated with application of extrapolation in correlation with amount of discharged domestic wastewater.

Table 7.28. Removed sludge (kt dry matter)

Year	Removed sludge	Data source
1988	196.77	extrapolation
1989	199.22	extrapolation
1990	200.91	extrapolation
1991	249.13	extrapolation
1992	255.13	extrapolation
1993	268.73	extrapolation
1994	280.86	extrapolation
1995	294.09	extrapolation
1996	300.18	extrapolation
1997	347.52	extrapolation
1998	340.04	extrapolation
1999	354.40	extrapolation
2000	359.82	extrapolation
2001	397.22	extrapolation
2002	435.74	extrapolation
2003	446.54	GUS (2004d)
2004	476.05	GUS (2005d)
2005	486.14	GUS (2006d)
2006	501.34	GUS (2007d)
2007	533.37	GUS (2008d)
2008	567.32	GUS (2009d)
2009	563.12	GUS (2010d)
2010	526.72	GUS (2011d)
2011	519.19	GUS (2012d)
2012	533.34	GUS (2013d)
2013	540.29	GUS (2014d)
2014	555.98	GUS (2015d)
2015	568.02	GUS (2016d)
2016	568.33	GUS (2017d)
2017	584.45	GUS (2018d)

Year	Removed sludge	Data source
2018	583.07	GUS (2019d)
2019	574.64	GUS (2020d)
2020	568.86	GUS (2021d)
2021	584.75	GUS (2022d)
2022	580.66	GUS (2023d)
2023	549.70	GUS (2024d)
2024	556.59	GUS (2025d)

N₂O emission

Estimations of N₂O emissions from domestic wastewater treatment plants were calculated according to default method IPCC (2019). Population of Poland was provided by Statistics Poland in GUS (2025) and is presented in table 7.30. Amounts of animal and vegetal protein consumption per capita per year was taken from FAO database. For year 2024 protein consumption was assumed on the level of 2023 data – newer data were not available.

Values of F_{npr} (fraction of nitrogen in protein), $EF_{effluent}$ (emission factor for N₂O emissions from wastewater discharged to aquatic systems), EF_j (emission factor for treatment/discharge pathway or system), $F_{non-con}$ (factor for nitrogen in non-consumed protein), $F_{ind-com}$ (factor for industrial and commercial co-discharged protein), FPC (fraction of protein consumed), N_{HH} (additional nitrogen from household products) and N_{REMj} (fraction of total wastewater nitrogen removed during wastewater treatment) applied in the inventory are provided in table 7.29.

Table 7.29. Emission factors and parameters

emission factor		measure	value
F_{npr}		kg N/kg proteins	0.16
$EF_{effluent}$		kg N ₂ O-N/kg N	0.005
EF_j	Sewer	kg N ₂ O-N/kg N	0.016
	Discharge		0.005
$F_{non-con}$		-	1.0
$F_{ind-com}$		-	1.0
FPC		-	0.85
N_{HH}		-	1.08
N_{REMj}	Sewer - primary	-	0.1
	Sewer - secondary		0.4
	Sewer - tertiary		0.8
	Septic tanks		0.15
	Latrines		0.12
	Discharge		0

Degree of utilisation of treatment system (T_j), protein consumption and population of Poland are presented in table 7.30.

Table 7.30. Consumption of proteins, T_j and population of Poland

Year	Protein consumption [kg/person]	Source	Population [in 1000s]	Source	T _j					
					Sewer - primary	Sewer - secondary	Sewer - tertiary	Septic tanks	Latrines	Discharge
1988	32.79	FAOSTAT	37 885	GUS	8%	22%	0%	42%	8%	21%
1989	32.46	FAOSTAT	37 988	GUS	8%	22%	0%	42%	7%	20%
1990	31.33	FAOSTAT	38 073	GUS	8%	22%	0%	43%	7%	20%
1991	31.77	FAOSTAT	38 144	GUS	8%	23%	0%	40%	8%	20%
1992	31.69	FAOSTAT	38 203	GUS	9%	24%	1%	38%	8%	20%
1993	31.26	FAOSTAT	38 239	GUS	9%	25%	1%	36%	8%	20%
1994	30.18	FAOSTAT	38 265	GUS	10%	26%	2%	35%	9%	19%
1995	30.52	FAOSTAT	38 284	GUS	10%	27%	3%	33%	9%	18%
1996	30.62	FAOSTAT	38 294	GUS	10%	27%	6%	32%	9%	17%
1997	30.13	FAOSTAT	38 290	GUS	10%	27%	10%	30%	9%	15%
1998	30.82	FAOSTAT	38 277	GUS	8%	28%	11%	30%	9%	14%
1999	30.93	FAOSTAT	38 263	GUS	7%	28%	14%	30%	9%	12%
2000	30.97	FAOSTAT	38 254	GUS	3%	29%	18%	30%	9%	10%
2001	30.91	FAOSTAT	38 242	GUS	3%	28%	21%	30%	9%	9%
2002	31.21	FAOSTAT	38 219	GUS	3%	26%	25%	30%	9%	7%
2003	31.34	FAOSTAT	38 191	GUS	3%	23%	29%	29%	9%	8%
2004	30.75	FAOSTAT	38 174	GUS	3%	22%	32%	28%	9%	7%
2005	30.62	FAOSTAT	38 157	GUS	2%	18%	36%	28%	9%	7%
2006	30.63	FAOSTAT	38 125	GUS	2%	17%	39%	27%	8%	6%
2007	30.90	FAOSTAT	38 116	GUS	1%	18%	42%	26%	8%	5%
2008	30.39	FAOSTAT	38 136	GUS	0%	13%	49%	26%	7%	5%
2009	31.23	FAOSTAT	38 167	GUS	0%	13%	52%	25%	7%	2%
2010	31.42	FAOSTAT	38 530	GUS	0%	12%	55%	24%	6%	3%
2011	31.74	FAOSTAT	38 538	GUS	0%	11%	58%	22%	6%	3%
2012	31.50	FAOSTAT	38 533	GUS	0%	12%	60%	20%	6%	2%
2013	31.48	FAOSTAT	38 496	GUS	0%	12%	63%	18%	6%	0%
2014	34.00	FAOSTAT	38 479	GUS	0%	12%	65%	17%	6%	0%
2015	34.22	FAOSTAT	38 437	GUS	0%	12%	66%	16%	6%	0%
2016	35.10	FAOSTAT	38 432	GUS	0%	12%	67%	14%	6%	0%
2017	35.41	FAOSTAT	38 434	GUS	0%	13%	68%	13%	6%	0%
2018	35.59	FAOSTAT	38 411	GUS	0%	12%	69%	12%	6%	0%
2019	36.48	FAOSTAT	38 383	GUS	0%	12%	70%	11%	6%	0%
2020	36.98	FAOSTAT	38 089	GUS	0%	13%	70%	10%	6%	1%
2021	37.13	FAOSTAT	37 908	GUS	0%	14%	70%	10%	6%	1%

Year	Protein consumption [kg/person]	Source	Population [in 1000s]	Source	Tj					
					Sewer - primary	Sewer - secondary	Sewer - tertiary	Septic tanks	Latrines	Discharge
2022	37.19	FAOSTAT	37 766	GUS	0%	13%	72%	9%	6%	0%
2023	36.53	FAOSTAT	37 637	GUS	0%	13%	72%	9%	6%	0%
2024	36.53	-	37 489	GUS	0%	14%	72%	8%	6%	0%

7.5.2.2. Industrial Wastewater (CRT sector 5.D.2)

Methane emission

Estimates of emissions of methane from industrial wastewater treatment sector are based on IPCC 2019 Refinement to IPCC 2006 Guidelines *Tier 2* method and domestic case study Przewłocki (2007). For branches, where default COD EF were not available, country specific data were used [Przewłocki (2007), Rueffer (1998)].

Total organic product is derived from amount of wastewater from each industry, COD concentration in organic wastewater and wastewater produced per unit product by industry.

Data on employment in the mining, metal, fertilizer, machinery and equipment industries, as well as on production in the wood and paper industries were taken from the statistical yearbooks of the Statistics Poland for years 1989-2005. Information on the total amount of wastewater from individual industries and biologically treated organic wastewater was adopted on the basis of the studies of the Statistics Poland *Environment* yearbooks from the same period.

Due to the lack of reliable national information on the quality of raw industrial wastewater (BOD, COD and suspended solids) from the late 1980s, data for the period 1988-1990 were adopted on the basis of *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Workbook*. In the absence of average values for some industries, incidentally averaged literature data were also taken into account.

The characteristics of wastewater from the food industry for the 1990s were adopted on the basis of Przewłocki survey data from the first half of the decade and a detailed inventory from 2001. The most reliable information in this regard concerns the first half of the decade 2000-2004, for which there are detailed data from own inventories of water pollution loads from the food industry. The latter source also provided information on the methods of wastewater treatment as well as the parameters and conditions (overloads) of operation of the treatment plants.

Due to the fragmentation of this type of information for other industrial sectors from 1991-2004, the characteristics of wastewater from 1988 were extrapolated, with its possible correction according to development trends in the volume of production and water consumption and detailed industry studies. An exception in this regard is the wood and paper industry, for which pollutant loads in the entire period of 1988-2004 were analyzed in detail, based on the production volume and unit pollutant loads of raw sewage.

The source of information on the share of aerobic and anaerobic treatment methods and possible overloads (oxygen deficits) of the biological parts of the treatment plant for the food industry in the period 1988 - 1999 and for other industry sectors in the entire period under consideration (1988 - 2004) is the expert knowledge of the authors of Przewłocki (2007).

Emissions of methane from untreated industrial wastewater were estimated on basis of methodology [Przewłocki (2007) and IPCC (2019)] and AD from GUS (1988-2025d).

Decreasing trend of methane emissions in years 1988-2002 (ca. 230%) is driven by closing of industrial facilities after decline of communism in Poland.

Evolution of industrial wastewater management for period 1988-2004 is included in methodology Przewłocki (2007). Since year 2005 party implemented conservative methodological approach and applied 2004 parameters and annual data on amounts of treated industrial wastewater from separate branches.

Methane recovery

Data on recovery of methane in industrial wastewater are published in national statistics GUS OZE (2001-2025). Recovered biogas is reported in aggregated values for municipal and industrial WWTP, therefore Party applied these data only in subcategory 5D1.

Table 7.31. Emission factors applied in 2024 inventory

Industry sector	COD concentration in organic wastewater	MCF methane correction factor from wastewater	B ₀ maximum CH ₄ producing capacity from wastewater	EF methane emission factor for wastewater
	kg/m ³	-	kg CH ₄ /kg ChZT	kg CH ₄ /kg ChZT
Mining and quarrying	0.60	0.10	0.25	0.025
Iron and steel	0.77	0.10	0.25	0.025
Non-iron metals	0.60	0.10	0.25	0.025
Synthetic fertilizers	0.98	0.10	0.25	0.025
Food products: Meat & Poultry	3.00	0.20	0.25	0.050
Food products: Fish Processing	2.50	0.145	0.25	0.036
Food products: Vegetables & Fruits	2.82	0.20	0.25	0.050
Food products: Vegetable Oils	0.79	0.34	0.25	0.085
Food products: Dairy Products	2.88	0.16	0.25	0.041
Food products: Sugar	2.51	0.52	0.25	0.130
Food products: Soft Drinks	1.49	0.10	0.25	0.025
Food products: Beer & Malt	3.81	0.10	0.25	0.025
Food products: Other	2.77	0.22	0.25	0.055
Textiles	0.90	0.12	0.25	0.030
Leathers	3.31	0.29	0.25	0.073
Wood and Paper	2.27	0.11	0.25	0.028
Petroleum Refineries	0.37	0.15	0.25	0.038
Organic Chemicals	3.00	0.15	0.25	0.036
Plastics & Resins	3.70	0.15	0.25	0.036
Other non-metallic	1.55	0.10	0.25	0.025
Manufacturing of Machinery and Transport Equipment	27.43	0.10	0.25	0.025
Other	0.79	0.10	0.25	0.025

Data on amount of treated industrial wastewater from separate branches presented in table 7.32 were taken from national statistics [GUS (1988-2025d)].

Table 7.32. Amount of treated industrial wastewater by industry [million m³]

Year	Mining and quarrying	Iron and steel	Non-iron metals	Synthetic fertilizers	Food products: Meat & Poultry	Food products: Fish Processing	Food products: Vegetables & Fruits	Food products: Vegetable Oils	Food products: Dairy Products	Food products: Sugar	Food products: Soft Drinks	Food products: Beer & Malt	Food products: Other	Textiles	Leathers	Wood and Paper	Petroleum Refineries	Organic Chemicals	Plastics & Resins	Other non-metallic	Manufacturing of machinery and transport equipment	Other
1988	548.1	94.2	48.7	123.2	3.8	1.4	13.1	3.3	19.6	23.7	0.9	4.0	7.1	14.2	6.3	195.2	43.2	125.6	17.4	58.2	53.6	90.9
1989	533.4	96.1	44.2	107.8	3.2	1.3	12.0	3.1	19.7	22.1	0.9	4.2	4.9	12.7	5.5	189.8	40.9	116.5	17.5	55.8	50.7	96.4
1990	518.7	98.0	39.7	92.4	2.6	1.2	11.0	2.9	19.7	20.4	0.9	4.3	2.6	11.1	4.7	184.3	38.6	107.4	17.6	53.3	47.8	101.8
1991	469.5	72.6	67.8	58.4	3.2	1.0	9.3	2.4	17.6	13.9	0.9	4.0	5.7	8.2	4.2	167.6	40.0	120.3	15.8	43.9	39.8	91.8
1992	452.8	46.7	73.4	53.5	5.3	0.9	7.4	2.2	16.2	11.4	1.8	4.0	7.6	9.1	3.0	146.1	36.5	107.9	15.7	30.9	32.6	71.6
1993	391.6	44.2	64.8	48.5	4.6	0.9	8.0	2.1	15.2	11.0	2.2	3.7	7.5	7.5	2.6	131.6	33.6	97.7	15.1	28.0	30.7	74.9
1994	382.0	40.4	135.2	51.3	3.9	0.7	7.4	1.2	14.2	7.9	2.5	2.8	7.0	7.2	1.7	129.0	32.6	101.0	14.5	29.5	29.4	96.6
1995	377.7	41.6	138.1	41.5	4.0	0.3	8.3	1.0	13.2	7.7	2.5	2.0	6.0	6.4	1.6	120.8	33.2	98.6	12.6	29.3	27.1	88.3
1996	361.8	41.7	145.2	48.5	4.3	0.4	7.8	3.5	12.5	6.5	2.6	1.7	5.2	5.7	1.3	116.9	28.1	94.4	6.7	28.7	25.8	109.2
1997	368.6	33.3	167.6	50.4	4.1	0.3	8.7	3.0	12.4	6.3	2.7	1.7	5.9	5.2	1.1	111.7	26.2	78.8	8.5	28.3	25.5	112.4
1998	375.4	24.9	190.0	52.3	3.9	0.1	9.5	2.5	12.3	6.1	2.7	1.6	6.6	4.7	0.8	106.5	24.3	63.1	10.3	27.9	25.1	115.6
1999	362.3	12.5	186.7	52.6	4.0	0.0	7.5	3.2	11.4	4.9	2.7	1.4	4.6	3.1	0.7	90.4	20.3	55.8	8.3	29.9	21.9	111.5
2000	349.7	13.5	185.6	51.7	3.6	0.1	7.5	2.4	11.4	4.0	2.5	1.3	4.6	2.7	1.1	81.7	17.8	47.6	7.8	32.2	12.0	115.9
2001	331.6	14.3	188.8	49.7	3.4	0.0	7.2	0.7	11.7	2.9	2.0	1.3	4.2	2.1	1.2	76.8	18.1	42.4	4.7	34.2	10.4	125.4
2002	293.4	12.9	197.2	50.3	3.4	0.0	6.4	0.3	11.3	2.7	2.1	1.5	4.4	1.7	0.9	77.1	16.8	42.0	2.7	37.9	9.1	108.9
2003	271.6	9.3	155.7	46.0	3.4	0.0	7.8	0.2	11.5	2.7	3.1	1.3	5.3	1.5	0.8	71.5	17.4	38.4	2.5	31.8	7.9	116.1
2004	261.2	7.8	136.1	49.4	4.1	0.0	6.8	0.3	13.1	2.2	2.0	1.2	6.4	2.7	0.6	70.9	19.6	36.0	2.5	37.4	6.8	123.7
2005	266.9	6.1	133.1	48.6	4.2	0.0	6.6	0.3	13.5	1.8	2.1	1.3	6.2	1.6	0.7	68.9	19.3	38.4	2.4	36.3	7.0	124.1
2006	272.4	7.1	133.3	50.8	4.5	0.0	7.0	0.4	13.8	1.5	2.0	1.7	6.0	1.3	0.6	69.7	20.7	38.5	2.2	43.2	4.5	123.7
2007	271.1	10.6	133.2	52.6	4.9	0.0	6.8	0.4	14.4	1.9	1.8	1.4	5.5	0.8	0.6	67.5	23.0	39.0	2.3	39.3	4.2	145.0
2008	242.6	8.3	131.6	54.6	5.0	0.0	6.0	0.6	14.2	2.7	1.5	1.5	5.5	0.6	0.4	64.7	20.9	35.4	2.0	46.1	3.7	138.0
2009	252.9	12.3	128.9	52.6	5.8	0.0	6.1	0.8	14.2	3.2	1.8	1.1	2.0	0.4	0.5	67.0	21.3	29.3	1.8	39.9	2.2	168.3
2010	283.1	16.1	147.7	49.7	6.6	0.0	5.8	0.7	14.5	2.6	1.6	1.4	2.9	0.1	0.4	64.2	23.1	35.7	2.1	46.8	3.0	183.2

Year	Mining and quarrying	Iron and steel	Non-iron metals	Synthetic fertilizers	Food products: Meat & Poultry	Food products: Fish Processing	Food products: Vegetables & Fruits	Food products: Vegetable Oils	Food products: Dairy Products	Food products: Sugar	Food products: Soft Drinks	Food products: Beer & Malt	Food products: Other	Textiles	Leathers	Wood and Paper	Petroleum Refineries	Organic Chemicals	Plastics & Resins	Other non-metallic	Manufacturing of machinery and transport equipment	Other
2011	286.2	13.0	166.7	48.0	6.4	0.0	5.8	0.6	13.8	3.1	2.2	1.3	2.1	0.1	0.3	66.3	23.0	38.1	2.4	48.1	2.7	164.7
2012	279.9	12.5	133.4	53.9	6.6	0.0	7.0	0.7	13.8	3.7	3.1	1.3	3.0	0.1	0.2	69.4	23.8	35.3	2.2	40.1	2.3	142.1
2013	259.0	13.5	134.5	51.1	6.9	0.0	6.8	0.8	14.6	3.6	3.0	1.3	2.2	0.1	0.2	71.5	24.0	37.2	1.8	20.0	1.8	140.8
2014	257.1	12.1	128.7	52.0	7.5	0.0	7.2	0.8	14.7	3.1	2.8	1.3	3.2	0.0	0.3	71.1	22.4	37.3	1.4	22.8	1.9	126.9
2015	247.6	13.8	124.2	50.8	8.1	0.0	7.1	0.8	15.7	2.9	2.5	1.1	3.0	0.1	0.2	73.3	22.0	34.6	1.5	21.5	1.9	142.0
2016	260.1	15.9	115.1	48.0	9.2	0.0	7.4	0.6	16.4	2.8	2.6	1.2	3.4	0.3	0.2	77.3	20.9	33.0	1.2	20.5	1.5	135.0
2017	247.3	17.7	115.6	49.1	9.5	0.0	7.3	0.8	17.6	3.2	2.1	1.0	3.8	0.3	0.2	80.0	23.9	33.9	1.4	20.1	1.6	139.1
2018	232.3	16.3	121.5	47.6	9.9	0.0	7.8	0.7	18.2	3.8	2.7	1.2	3.7	0.3	0.2	79.5	23.7	33.0	1.4	21.9	1.7	129.2
2019	207.3	19.2	114.9	49.2	10.1	0.0	7.1	0.7	18.3	3.5	3.0	1.3	3.7	0.3	0.1	78.6	23.0	34.0	1.4	24.2	1.4	132.6
2020	210.3	15.1	112.6	49.6	9.9	0.0	6.9	0.8	18.7	4.1	2.7	1.2	3.9	0.2	0.1	80.8	21.0	34.3	4.1	25.2	1.4	134.0
2021	229.7	15.3	113.6	51.6	9.7	0.1	7.1	0.9	18.2	4.1	2.8	1.2	3.7	0.3	0.1	80.5	22.6	35.7	2.7	27.9	1.2	144.7
2022	223.6	15.3	5.2	47.1	10.6	0.0	7.5	0.8	18.4	3.2	2.8	1.2	4.0	0.3	0.1	80.4	21.1	32.3	1.8	29.7	1.1	143.7
2023	199.5	12.5	4.3	41.1	11.3	0.0	7.2	0.6	19.1	3.7	2.6	1.1	4.1	0.3	0.1	78.0	22.0	28.2	1.9	15.2	1.1	144.4
2024	180.3	12.6	4.6	43.0	12.6	0.0	7.2	0.7	20.1	5.7	2.7	1.2	3.7	0.3	0.1	83.6	24.8	29.3	1.9	16.4	1.1	160.0

N₂O emission

Estimations of N₂O emissions from industrial wastewater treatment plants were calculated according to default methodology IPCC (2019).

Values of TN (total nitrogen in wastewater), EF (emissions factor), N_{REMj} (fraction of total wastewater nitrogen removed) and EF_{effluent} (emission factor for N₂O emissions from wastewater discharged to aquatic systems) applied in the inventory are provided in table 7.29.

EF for aerobic WWTP was estimated on basis of values from IPCC (2019) Annex 6A.5 *Estimation of default emission factors for N₂O in domestic wastewater treatment plants* taking into account types of treatment processes applied in those plants.

Table 7.33. Default IPCC (2019) emission factors and parameters

emission factor		measure	value
TN	alcohol refining	kg/m ³	2.4
	beer & malt		0.055
	fish processing		0.60
	iron and steel manufacturing		0.25
	meat & poultry		0.19
	nitrogen fertiliser		0.5
	plastics & resins		0.6
	starch production		0.9
N_{REMj}	primary	-	0.1
	secondary		0.4
	tertiary		0.8
	untreated		0.0
EF	aerobic	kg N ₂ O-N/kg N	0.012
	anaerobic		0
	untreated		0.005
EF_{effluent}		kg N ₂ O-N/kg N	0.005

Data on amount of treated industrial wastewater from separate branches in division by treatment method presented in table 7.34 were taken from national statistics [GUS (1988d-2025d)].

Table 7.34. Amount of treated industrial wastewater by industry and treatment method [million m³]

	Alcohol refining				Beer & malt				Fish processing				Iron and steel manufacturing				Meat & poultry				Nitrogen fertiliser				Plastics & resins				Starch production			
	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated
1988	0.1	0.8	0.0	2.7	1.1	2.9	0.0	0.5	1.2	0.1	0.0	0.3	93.1	1.0	0.0	40.1	1.6	1.2	0.0	2.3	48.0	8.3	0.0	3.9	10.2	1.2	0.0	4.5	0.5	0.9	0.0	1.3
1989	0.1	0.8	0.0	2.5	1.2	3.0	0.0	0.5	1.2	0.1	0.0	0.2	96.1	0.9	0.0	25.6	1.5	1.1	0.0	1.8	42.6	7.4	0.0	4.6	10.8	1.1	0.0	4.4	0.5	0.9	0.0	1.2
1990	0.1	0.8	0.0	2.2	1.2	3.1	0.0	0.4	1.1	0.1	0.0	0.2	99.0	0.8	0.0	11.0	1.3	1.0	0.0	1.2	37.1	6.4	0.0	5.2	11.3	1.0	0.0	4.2	0.5	0.8	0.0	1.1
1991	0.1	0.8	0.0	1.4	1.3	2.8	0.0	0.9	0.9	0.1	0.0	0.2	69.1	0.4	0.0	7.1	1.7	1.0	0.0	2.5	29.0	3.1	0.0	6.0	11.0	0.9	0.0	4.1	0.3	0.8	0.0	0.9
1992	0.3	1.9	0.0	0.8	1.1	2.5	0.0	0.4	0.6	0.1	0.0	0.1	46.0	0.6	0.0	2.1	2.1	2.5	0.0	1.9	22.2	5.4	0.0	3.1	8.8	2.9	0.0	11.7	0.2	0.7	0.0	0.8
1993	0.3	1.9	0.0	0.5	1.1	2.6	0.0	0.3	0.6	0.1	0.0	0.1	43.8	0.3	0.0	2.3	1.2	2.4	0.0	1.3	15.4	7.6	0.0	0.1	7.8	2.7	0.0	8.6	0.2	0.7	0.0	0.7
1994	0.4	2.1	0.0	0.5	0.8	2.0	0.0	0.4	0.5	0.0	0.0	0.1	40.5	0.3	0.0	2.7	0.8	2.2	0.0	1.4	13.3	8.0	0.0	0.7	8.2	2.5	0.0	9.7	0.1	0.7	0.0	0.6
1995	0.2	2.3	0.0	0.4	0.6	1.5	0.0	0.5	0.2	0.1	0.0	0.4	37.2	0.2	0.0	3.1	0.4	2.7	0.0	1.2	3.6	9.7	0.0	1.6	8.4	2.4	0.0	11.7	0.0	0.7	0.0	0.6
1996	0.3	2.3	0.0	0.4	0.4	1.3	0.0	0.7	0.1	0.2	0.0	0.3	41.3	0.3	0.0	2.7	0.4	3.0	0.0	0.9	7.5	7.5	0.0	1.9	5.0	1.1	0.0	13.8	0.0	0.7	0.0	0.6
1997	0.2	2.5	0.0	0.3	0.4	1.3	0.0	0.5	0.1	0.2	0.0	0.2	33.0	0.3	0.0	1.7	0.3	3.2	0.0	0.6	6.9	6.6	0.0	1.0	5.2	1.0	0.0	8.5	0.0	0.7	0.0	0.6
1998	0.1	2.6	0.0	0.2	0.4	1.2	0.0	0.3	0.0	0.1	0.0	0.0	24.6	0.2	0.0	0.6	0.1	3.3	0.0	0.3	6.3	5.6	0.0	0.1	5.3	0.9	0.0	3.2	0.0	0.8	0.0	0.5
1999	0.1	2.6	0.0	0.2	0.4	1.0	0.0	0.2	0.0	0.0	0.0	0.0	12.3	0.2	0.0	0.5	0.2	3.5	0.2	0.2	4.3	5.1	0.0	0.2	4.2	0.8	0.0	5.1	0.0	0.6	0.0	0.4
2000	0.2	2.3	0.0	0.2	0.5	0.8	0.0	0.2	0.0	0.1	0.0	0.0	13.3	0.2	0.0	0.1	0.2	3.1	0.3	0.1	8.0	3.6	0.0	0.1	3.7	0.7	0.0	5.0	0.0	0.6	0.0	0.4
2001	0.2	1.6	0.2	0.2	0.5	0.8	0.0	0.1	0.0	0.0	0.0	0.0	14.2	0.1	0.0	0.1	0.2	2.6	0.6	0.1	7.7	2.0	1.8	0.1	3.3	0.6	0.0	2.2	0.0	0.6	0.0	0.4
2002	0.3	1.5	0.3	0.1	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	0.1	0.0	0.5	0.1	2.5	0.8	0.1	9.0	1.7	0.9	1.1	2.5	0.2	0.0	2.0	0.0	0.5	0.0	0.4
2003	0.9	1.8	0.4	0.1	0.4	0.8	0.1	0.0	0.0	0.0	0.0	0.0	9.2	0.1	0.0	0.6	0.2	2.5	0.7	0.1	9.2	1.8	1.3	0.9	2.3	0.2	0.0	1.5	0.0	0.6	0.0	0.4
2004	0.9	0.8	0.3	0.1	0.0	1.1	0.1	0.0	0.0	0.0	0.0	0.0	7.7	0.1	0.0	0.6	0.2	3.0	0.9	0.1	11.8	1.7	1.7	0.7	2.3	0.2	0.0	1.2	0.0	0.6	0.0	0.4
2005	1.0	1.0	0.1	0.3	0.0	1.0	0.3	0.0	0.0	0.0	0.0	0.0	6.0	0.1	0.0	0.2	0.2	3.1	0.8	0.1	9.2	1.7	0.8	1.1	2.2	0.2	0.0	1.1	0.1	0.6	0.0	0.4
2006	0.9	0.8	0.3	0.4	0.0	1.4	0.3	0.0	0.0	0.0	0.0	0.0	6.9	0.2	0.0	0.2	0.2	3.4	0.8	0.1	9.3	1.6	1.1	1.4	2.0	0.2	0.0	0.9	0.1	0.5	0.0	0.4
2007	0.7	0.9	0.2	0.3	0.0	1.1	0.3	0.0	0.0	0.0	0.0	0.0	10.4	0.2	0.0	0.2	0.2	3.7	0.9	0.1	9.8	1.6	1.4	1.7	2.1	0.2	0.0	0.8	0.1	0.6	0.0	0.4
2008	0.4	0.9	0.2	0.3	0.0	1.4	0.1	0.0	0.0	0.0	0.0	0.0	8.1	0.1	0.0	0.1	0.2	4.1	0.6	0.1	13.5	1.9	0.0	0.8	1.5	0.5	0.0	1.0	0.0	0.6	0.0	0.4
2009	0.5	1.1	0.2	0.2	0.0	0.9	0.2	0.0	0.0	0.0	0.0	0.0	12.2	0.1	0.0	0.2	0.1	4.3	1.2	0.1	12.2	1.8	0.0	0.6	1.5	0.3	0.0	0.6	0.1	0.5	0.0	0.4
2010	0.5	0.9	0.2	0.2	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.1	0.0	0.2	0.1	4.8	1.4	0.1	8.6	1.5	0.0	0.3	1.9	0.2	0.0	0.8	0.1	0.5	0.0	0.4
2011	0.9	1.1	0.2	0.2	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.1	0.0	0.0	0.1	4.8	1.4	0.1	6.0	1.5	0.0	0.1	1.8	0.6	0.0	0.8	0.1	0.5	0.0	0.3
2012	1.0	1.5	0.6	0.2	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	12.4	0.1	0.0	0.2	0.1	5.1	1.3	0.1	8.7	1.4	0.0	0.0	1.6	0.6	0.0	0.9	0.1	0.6	0.0	0.4
2013	1.0	1.5	0.5	0.3	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.1	0.0	0.1	0.1	5.0	1.7	0.1	11.2	1.5	0.0	0.0	1.2	0.6	0.0	1.0	0.1	0.6	0.0	0.4
2014	0.9	1.4	0.5	0.5	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	12.1	0.1	0.0	0.0	0.1	5.0	2.3	0.1	12.1	1.6	0.0	0.0	0.9	0.5	0.0	1.1	0.1	0.6	0.0	0.4
2015	0.9	1.1	0.5	0.5	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	13.7	0.1	0.0	0.0	0.1	5.4	2.5	0.1	19.4	1.1	3.5	0.2	0.9	0.5	0.0	0.9	0.1	0.6	0.0	0.4
2016	1.0	1.0	0.6	0.5	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	15.7	0.1	0.0	0.0	0.1	6.1	3.0	0.1	18.8	1.3	3.5	0.1	0.9	0.4	0.0	2.0	0.1	0.8	0.0	0.6
2017	0.4	0.5	1.2	0.4	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	17.3	0.1	0.0	0.0	0.1	6.0	3.2	0.1	20.3	1.4	3.5	0.1	1.0	0.4	0.0	2.1	0.0	0.9	0.0	0.6

	Alcohol refining				Beer & malt				Fish processing				Iron and steel manufacturing				Meat & poultry				Nitrogen fertiliser				Plastics & resins				Starch production			
	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated	primary	secondary	tertiary	untreated
2018	0.6	0.8	1.3	0.4	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	15.8	0.1	0.0	0.0	0.1	6.5	3.3	0.0	20.5	1.4	3.7	0.1	0.9	0.5	0.0	2.9	0.0	1.0	0.0	0.6
2019	0.7	1.0	1.3	0.4	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	18.6	0.1	0.0	0.0	0.1	6.7	3.4	0.1	20.2	1.3	4.2	0.1	1.0	0.4	0.0	3.8	0.0	0.9	0.0	0.6
2020	0.5	1.1	1.1	0.4	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0.1	0.0	0.0	0.1	6.1	3.6	0.1	21.3	1.2	4.7	0.1	3.7	0.4	0.0	0.2	0.1	0.9	0.0	0.6
2021	0.5	1.0	1.3	0.3	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	14.9	0.1	0.0	0.4	0.1	6.0	3.6	0.1	21.0	1.2	4.1	0.1	2.3	0.4	0.0	0.3	0.1	0.9	0.0	0.6
2022	0.6	1.0	1.2	0.3	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.1	0.0	0.6	0.1	6.2	4.3	0.1	20.1	1.1	5.2	0.1	1.5	0.4	0.0	0.3	0.1	0.9	0.0	0.7
2023	0.6	0.9	1.1	0.3	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.1	0.0	0.5	0.1	6.6	4.6	0.0	18.1	0.8	4.8	0.1	1.4	0.4	0.0	0.4	0.1	1.0	0.0	0.7
2024	0.6	1.0	1.1	0.4	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	12.2	0.0	0.0	0.1	0.5	6.6	4.8	0.1	18.2	0.7	4.5	0.1	1.5	0.4	0.0	0.3	0.1	1.0	0.0	0.7

7.5.3. Uncertainties and time-series consistency

See chapter 7.2.3.

7.5.4. Source-specific QA/QC and verification

See chapter 7.2.4.

7.5.5. Source-specific recalculations

Recalculations details:

- implementation of recommendation from observation PL-5D-2025-0004 on application of default 2019 IPCC emission factors and AD division based on stages of wastewater treatment.

Table 7.35. Change in emissions in result of recalculations in sector 5.D

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
kt CO ₂ eq.	-1354.43	-1318.78	-1277.47	-1032.65	-1016.78	-956.39	-896.13	-810.32	-765.36	-643.51	-485.52	-366.89
%	-22%	-22%	-22%	-19%	-20%	-19%	-18%	-17%	-17%	-15%	-12%	-9%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
kt CO ₂ eq.	-266.86	-188.17	-104.34	-85.00	-52.39	-10.93	43.57	64.88	115.70	213.99	183.65	201.02
%	-7%	-5%	-3%	-2%	-1%	0%	1%	2%	4%	7%	6%	6%

Change	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
kt CO ₂ eq.	288.99	337.07	364.48	345.25	324.79	276.39	265.05	250.17	212.65	168.74	200.26	157.18
%	9%	11%	12%	12%	11%	9%	9%	8%	7%	6%	7%	6%

7.5.6. Source-specific planned improvements

Planned improvements:

- study on split between industrial wastewater treated in situ and treated in WWTP.

8. Other (CRT sector 6)

No other emissions were identified in the Polish GHG inventory apart from those given in CRT categories 1-5.

9. Indirect CO₂ and nitrous oxide emissions

The indirect CO₂ emissions from the atmospheric oxidation of NMVOC are described in the Chapter 4.5.2.3.1 and reported separately to the IPPU sector, in the CRT Table 6.

As relates to indirect N₂O emissions, resulted from livestock manure management as well as from managed soils (atmospheric deposition and Nitrogen leaching and run-off) – these are reported within the Agricultural sector, see Chapter 5 of the NID as well as in CRT Tables 3.B(b) and 3.D.

10. Recalculations and improvements within the GHG inventory

10.1. Explanations and justifications for recalculations, including in response to the review process

Recalculations made in 2026 consists mostly of further improvements in calculation methods based on the IPCC 2006 Guidelines and country specific ones but also relate to AD update and ERT recommendations implementation. Detail sectoral information on recalculations made are given in Chapters 3-7 dedicated to source/sink categories.

The percentage change caused by recalculation with respect to the previous submission, has been calculated as follows:

$$\text{Change} = 100\% \times [(\text{LS}-\text{PS})/\text{PS}]$$

where:

LS = Latest Submission (for 1988–2023 inventory submitted in NID 2026)

PS = Previous Submission (for 1988–2023 inventory submitted in NID 2025)

10.2. Implications for emission and removal levels

Recalculations of CO₂ emissions are generally insignificant for period 1988-2021 and are related mostly to update of energy balances. In 2022 and 2023 distinct update of statistical data on fuel use were introduced in Transport sector (Fig. 10.1). CO₂ emission change in the IPPU sector in 2023 was mainly related to the recalculation in subsector 2.B.1 resulting from the correction of the amount of natural gas used for ammonia production. The volume of natural gas was supplemented by the amount of natural gas reported as consumed for the production of hydrogen used for ammonia production.

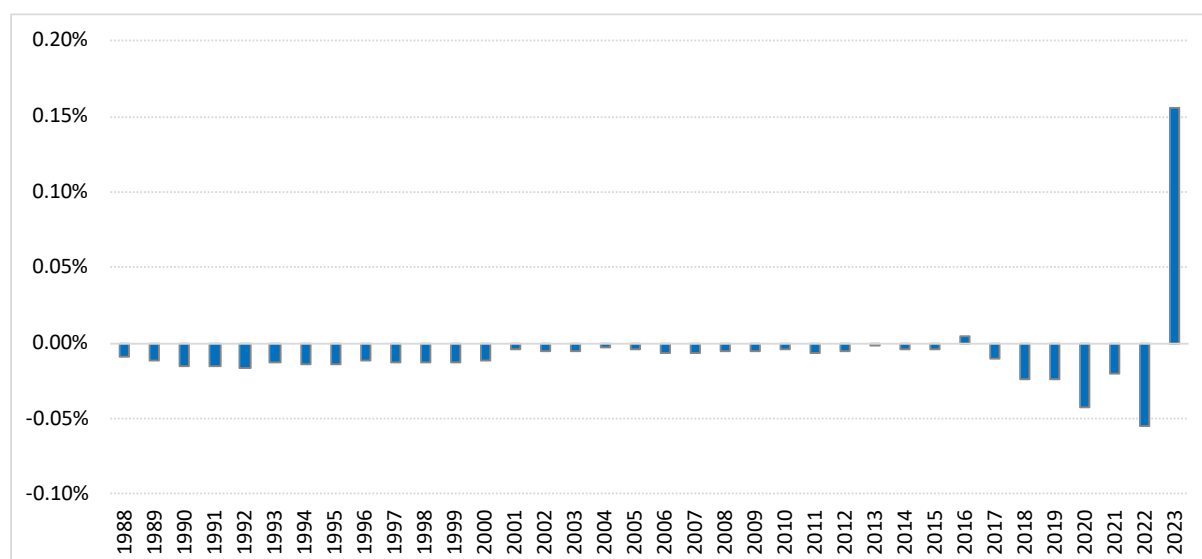


Figure 10.1. Recalculation of CO₂ for entire time series made in CRT 2026 comparing to CRT 2025

In the case of CH₄ the biggest recalculations occurred in Transport sector, some recalculations were made related to use updated Eurostat database (changes occurred in road transport, pipelines transport and aviation), the update data on number of vehicles and vehicles

mileages in road transport based on new and updated data from Polish Central Vehicle and Driver Register database, and the update of meteorological data according to Institute of Meteorology and Water Management – National Research Institute (Fig. 10.2).

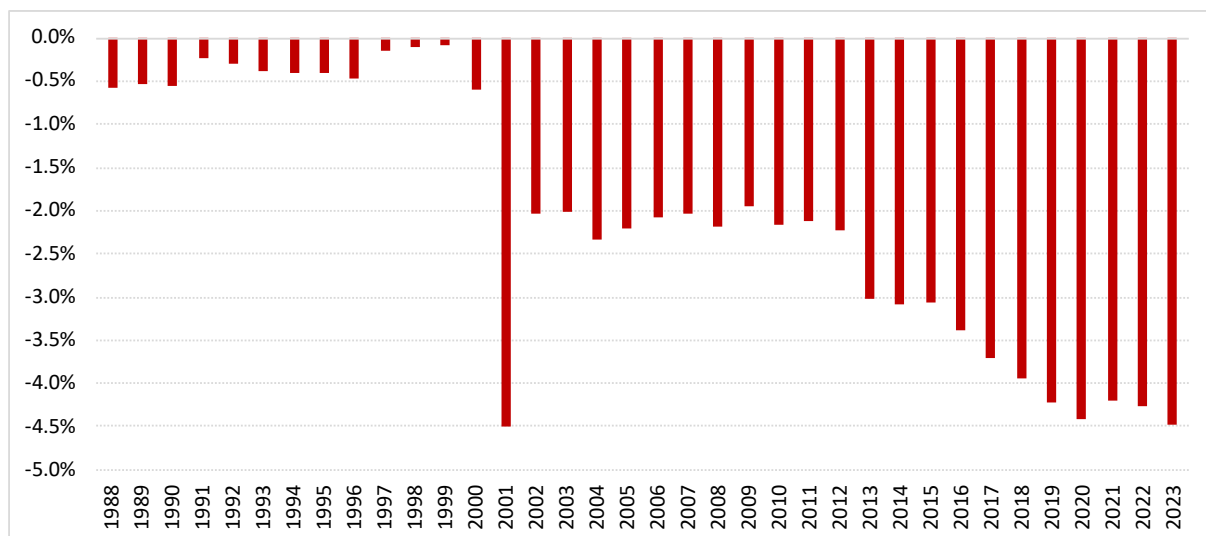


Figure 10.2. Recalculation of CH₄ for entire time series made in CRT 2026 comparing to CRT 2025

Certain changes occurred in N₂O emissions between submissions 2026 and 2025 (Fig. 10.3), because of some recalculations in N₂O emissions in Transport sector, that were triggered by revised Eurostat data on fuel use (especially in road transport), refreshed vehicle numbers and mileage from the Polish Central Vehicle and Driver Register, and updated meteorological data in trend.

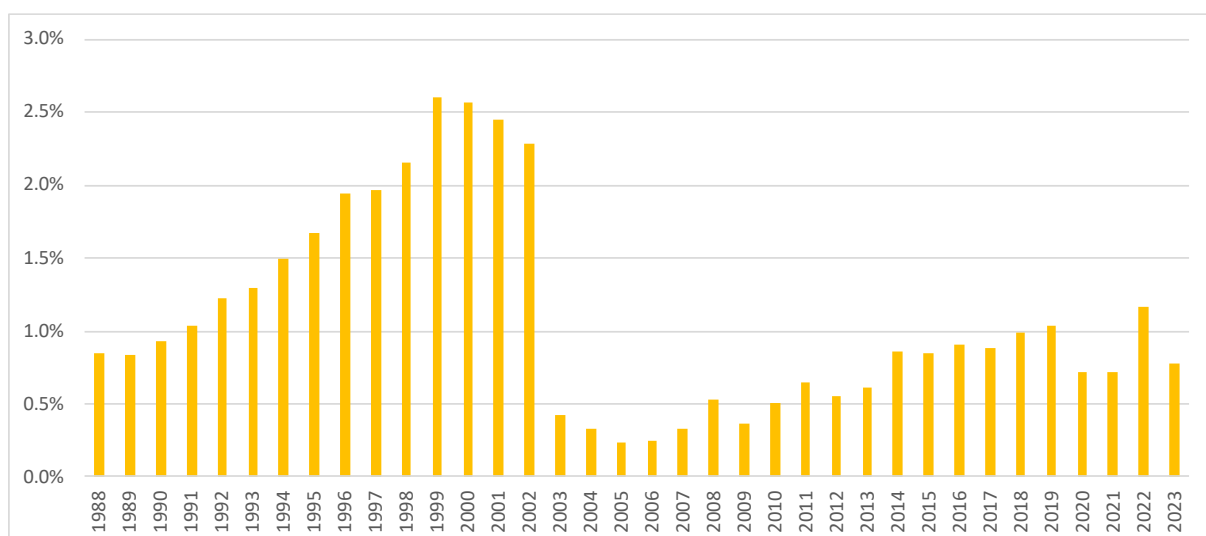


Figure 10.3. Recalculation of N₂O for entire time series made in CRT 2026 comparing to CRT 2025

10.3. Implications for emission and removal trends, including time series consistency

GHG emissions changes reported in 2026 in relation to previous submission 2025 range between -0.5% in 2001 up to $+0.1\%$ in 1999. The trend for both submissions is given in Figure 10.7, while differences between submissions – in Figure 10.8.

The highest influence on these changes had recalculations in 1.A.3 and 2.B.1 sectors what is explained in chapter 10.2 (Fig. 10.7).

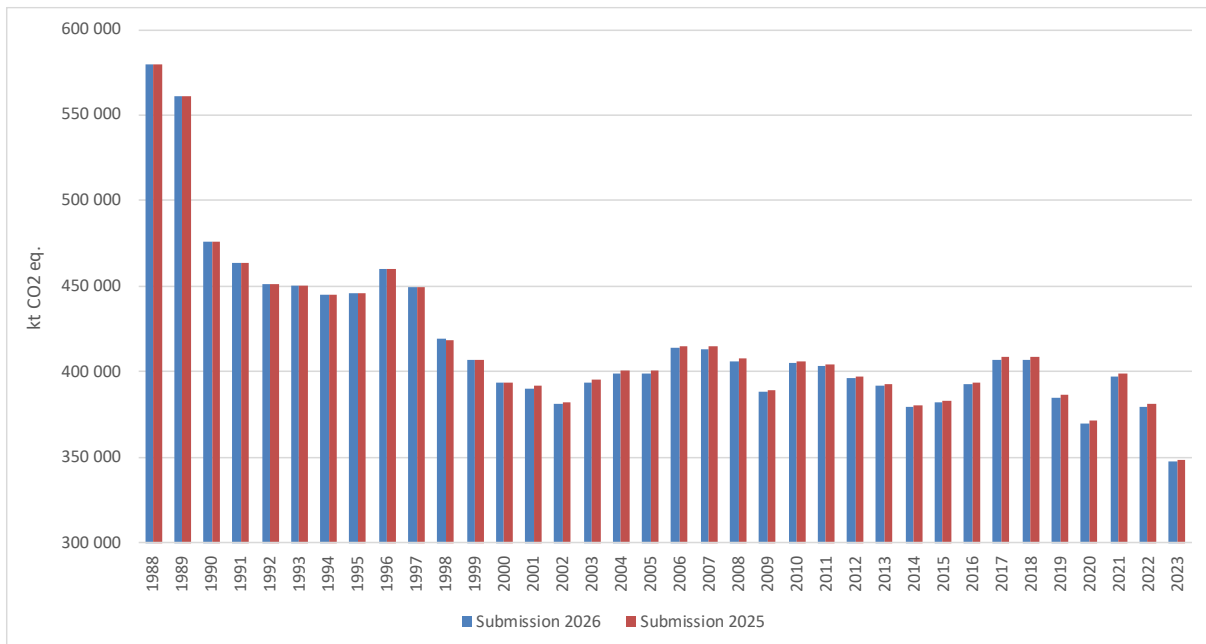


Figure 10.7. GHG emission trends according to submissions made in 2026 and 2025

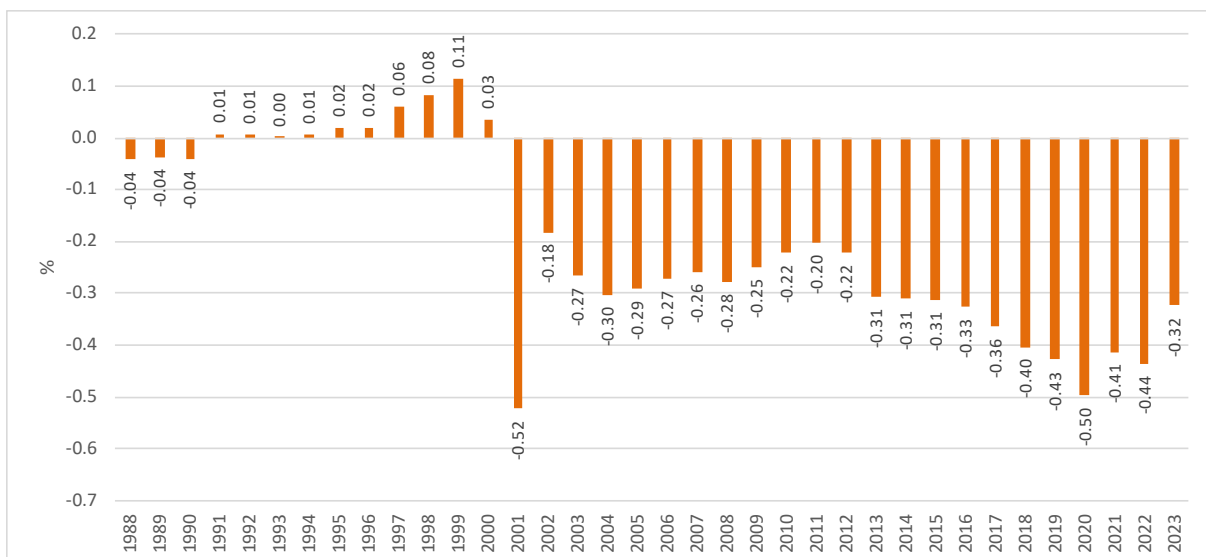


Figure 10.8. Differences between GHG submissions made in 2026 and 2025

10.4. Areas of improvement and/or capacity building related to the review process

The following list of recommendations (and its implementation status) comes from the individual review of the annual submission of Poland submitted in 2022 (ARR 2022). Only “addressing” and “not resolved” issued are presented in the table. Most of the recommendations, affecting improvements in the GHG inventories, has been resolved and implemented in 2023 and following submissions.

Table 10.4.1. Status of issues raised by latest UNFCCC Technical Expert Review Teams

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
TABLE 3					
CRF tables (G.8, 2020) Convention reporting adherence	Present in the next submission the national total emissions including and excluding indirect CO2 emissions. Not resolved. The Party did not report in its CRF tables the national total emissions including and excluding indirect CO2 emissions. National total emissions including indirect CO2 emissions were reported as “NA”, while the reported national total emissions excluding indirect CO2 emissions actually included indirect CO2 emissions. During the review, the Party clarified that it prefers to report indirect CO2 emissions as part of the CRF sectoral tables, which allows allocation to the relevant categories. It also explained that owing to the functionality of CRF Reporter, the national totals in this case cannot be reported including and excluding indirect CO2 emissions. During the review, the Party provided the ERT with estimates of national totals including and excluding indirect CO2 emissions. While the ERT agrees that reporting national totals including and excluding indirect CO2 emissions in the CRF tables is not possible if indirect CO2 emissions are reported under the relevant categories, it considers that this is possible if indirect CO2 emissions are reported at the level of sectoral tables. Moreover, the ERT considers that the Party could have reported national totals including and excluding indirect CO2 emissions in its NIR. The ERT considers that the recommendation has not yet been addressed.	G.1	Implemented since the submission 2023		Chapter 9
Notation keys (G.7, 2020) Accuracy	Estimate and report N2O emissions from FM (category 4(KP-II)3.B.1) and CO2 emissions from coal mining and handling (subcategory 1.B.1.a) or provide in the NIR an explanation for reporting them as “NE” along with estimates to justify that the corresponding emissions are insignificant in line with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. Provide a detailed explanation as to the use of “NE”, in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, for all categories for which the notation key “NE” Addressing. CO2 emissions for subcategory 1.B.1.a coal mining and handling and N2O emissions from FM (activity reported in CRF table 4(KP-II)3.B.1) were reported as “NE”. The Party did not report any information on these emissions in CRF table 9. In its NIR (chap. 1.7, p.26), Poland explained that “NE” was reported for CO2 emissions for subcategory 1.B.1.a coal mining and handling owing to a lack of data. In its NIR (chap. 10.4.1, p.342), the Party clarified that N2O emissions from FM (reported in CRF table 4(KP-II)3.B.1) are considered not to occur, as organic carbon stocks in mineral soils increased over the reporting period, and in accordance with the 2006 IPCC Guidelines, if there is no loss of soil organic carbon, no N2O emissions occur. During	G.2	Implemented as relates to CO2 emission from coal mining, see response to the question “1.B.1.a Coal mining and handling – CO2 and CH4”; Emissions related to KP-LULUCF has been resolved up to 2022 review and are no longer valid		Chapter 3.3.1.2

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	the review, the Party further clarified that reporting CO₂ emissions for subcategory 1.B.1.a coal mining and handling was not possible, as no information on the non-energy-related flaring of CH₄ from coal mines was available. However, data on total CH₄ emitted from coal mines were reported within the Party's GHG inventory and are likely to be overestimated, as the share of CH₄ which is flared, leading to CO₂ emissions, was not excluded from the reporting. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet reported CO₂ emission estimates for subcategory 1.B.1.a or included in the NIR a clear justification as to why there is no underestimation or missing estimates resulting from reporting as "NE" the CO₂ emissions arising from the non-energy-related flaring of CH₄ under subcategory 1.B.1.a. However, it also considers that the reported vented CH₄ emissions constitute a conservative estimate as they include the share of CH₄ flared from which CO₂ emissions would result, and the amount of these CO₂ emissions, having a lower global warming potential, represent a much lower amount of emissions in terms of CO₂ eq than the share of CH₄ flared. The ERT further considers that the recommendation has not yet been fully addressed because the Party, even though it provided a justification in the NIR stating that N₂O emissions from FM (reported in CRF table 4(KP-II)3.B.1) do not occur owing to positive changes in carbon stocks, did not use the corresponding notation key "NO" in CRF table 4(KP-II)3. The ERT considers that the use of "NE" by the Party is not fully correct in both cases, and in particular in the case of N₂O emissions from FM, but concluded that these potential problems of a mandatory nature either do not affect N₂O emission estimates (for FM, reported in CRF table 4(KP-II)3.B.1) or lead to a possible overestimate in CH₄ emissions (for subcategory 1.B.1.a coal mining and handling) and therefore do not influence the Party's ability to fulfil its commitments for the second commitment period of the Kyoto Protocol and that any possible underestimate, in particular for N₂O emission estimates for FM (reported in CRF table 4(KP-II)3.B.1), would be below the significance threshold for Poland (188.02 kt CO₂ eq) for application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11 and therefore this issue was not included in the possible list of potential problems and further questions raised by the ERT.				
Energy					
1.A.1 Energy industries – CH ₄ (E.4, 2020) (E.9, 2018) (E.9, 2016) (E.9, 2015) (34, 2014) (40, 2013) Accuracy	Apply a tier 2 method to estimate CH₄ emissions from stationary combustion (solid fuels and biomass). Addressing. The Party has not yet applied a tier 2 method to estimate CH₄ emissions from stationary combustion (solid fuels and biomass). Details of the progress of the development of country-specific CH₄ EFs for coal, lignite and biomass have been provided in the NIR (chap. 3.1.1, p.46). A study mentioned in the NIR (p.46) on the development of country-specific CH₄ EFs for the combustion of hard coal, lignite and biomass was undertaken to develop CH₄ EFs for the various types of boilers used in the Polish energy industry. Utilizing the EFs from this study and national data on the structure of the boilers that are used in large combustion plants sourced from the national emission database developed by KOBiZE made it possible to establish technology-specific CH₄ EFs for combustion sources under category 1.A.1 energy industries. This allowed a tier 2 method for coal, lignite and biomass combustion to be applied for category 1.A.1. During the review, the Party clarified that it plans to implement these new CH₄ EFs in its next annual submission. The ERT considers that the recommendation has not yet been fully addressed, because the tier 2 method has not yet been applied in the calculations, but the basis	E.2	Country specific CH ₄ EFs for coal, lignite and biomass in 1.A.1 IPCC category has been implemented since Submission 2023		Chapter 3.1.1 and Annex 5.3 (Table 28)

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	for this improvement has been established. Nevertheless, it also considers that the issue of not applying a tier 2 method to estimate CH ₄ emissions for this category does not lead to an underestimation of emissions.				
1.A.3.b Road transportation – liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.6, 2020) (E.16, 2018) Completeness	Include in the NIR information on how combustion of lubricants is considered in the inventory and, if it is insignificant, provide a justification based on the likely level of emissions in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. Addressing. The Party reported information in its NIR (chap. 3.2.8.2.2, p.88) regarding the estimation and allocation of AD and CO₂ emissions from lubricants. The Party indicated that CO₂ emissions from lubricant use are calculated using the COPERT V model with the energy portion of emissions allocated to subcategory 1.A.3.b road transportation (under motorcycles and mopeds) and the non-energy emissions to category 2.D.1 lubricant use. The Party also indicated that CO₂ emissions account for less than 1 per cent of CO₂ emissions for subcategory 1.A.3.b, and for 2020 these emissions accounted for 0.195 per cent, but it did not provide a justification on insignificance in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. Nevertheless, the ERT noted that emissions from lubricants were not reported in the CRF tables under subcategory 1.A.3.b.iv motorcycles or elsewhere under subcategory 1.A.3.b road transportation. During the review, the Party provided estimates showing that in 2020, CO₂ emissions from lubricant use for subcategory 1.A.3.b road transportation as estimated using COPERT V were 122.29 kt, or 0.03 per cent of the national total emissions excluding LULUCF, which is below the level of significance for Poland (188.02 kt CO₂ eq) as calculated in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The ERT noted that no estimates or explanation for CH₄ and N₂O emissions were provided in the NIR or during the review, but acknowledges that these emissions, if calculated, would not add any level of significance to the CO₂ emission estimate for lubricant use. The ERT estimated that these CH₄ and N₂O emissions would amount to approximately 2.97 kt CO₂ eq. Therefore, the ERT did not include this issue in the possible list of potential problems and further questions raised by the ERT.	E.4	Recommendation has been implemented. The information provided during the review has been included since the NIR 2023		Chapter 3.2.8.2.2. Road Transportation (CRF sector 1.A.3.b) p. 80
1.A.3.b Road transportation – liquid fuels – N ₂ O (E.10, 2020) Transparency	Include in the next NIR justification for, and more detailed information on, the use of a COPERT V EF, including a comparison and explanation of the differences between the emissions obtained using COPERT V and the lower-tier methods provided in the 2006 IPCC Guidelines. Addressing. The Party provided justification and additional detailed information in the NIR on its use of the COPERT V model (chap. 3.2.8, pp.80–82) for estimating N₂O emissions for subcategory 1.A.3.b road transportation. It included a comparison and some explanations of the differences between the N₂O IEFs obtained using COPERT V and the default values provided in the 2006 IPCC Guidelines. The Party noted that these differences are insignificant and that N₂O EFs as used by COPERT V are standard EU factors and are therefore representative of Poland's vehicle fleet. The ERT partly agrees with this statement, taking into account the fact that Poland's vehicle fleet is not yet fully equivalent to the western European vehicle fleet and therefore standard EU N₂O EFs used by COPERT V are not yet fully applicable to Poland's conditions. In that sense, the ERT considers that the recommendation has not yet been fully addressed. During the review, Poland acknowledged the need for additional research into the N₂O EFs as applied in the COPERT V model to provide additional transparency in its estimates.	E.5	Recommendation has been implemented. The information provided during the review has been included since the NIR 2023.		Chapter 3.2.8.2.2. Road Transportation (CRF sector 1.A.3.b) p. 74
1.A.4 Other sectors – liquid fuels – CO ₂ ,	Explain in the NIR (e.g. in a footnote to tables 11 and 12 in annex 2) whether or not consumption of motor gasoline occurs under the subcategories off-road vehicles (1.A.4.a(ii)) and machinery	E.7	Recommendation has been implemented. The corresponding		Chapter 3.1.1

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
CH4 and N2O (E.7, 2020) (E.17, 2018) Transparency	(1.A.4.b(ii)), and use the documentation box in CRF table 1.A(a) (sheet 4) and CRF table 9 to explain the inclusion of emissions (related to all fuels) from off-road vehicles and machinery in the road transport emissions. Addressing. The Party included confirmation in its NIR (chap. 3.2.9.2, pp.99–101) and CRF table 9 that it does not include fuel consumption for off-road vehicles (1.A.4.a(ii)) and machinery (1.A.4.b(ii)) within the total activity for category 1.A.4 other sectors. Additional information on the consumption and allocation of gasoline from activities under category 1.A.4 in subcategory 1.A.3.b was supplied in footnotes to tables 11 and 12 of annex 2 to the NIR (pp.450–455) and via comments in the relevant cells in CRF table 1.A(a) (sheet 4) and CRF table 9. The ERT considers that the recommendation has not been fully addressed because the Party did not fully explain the allocation of emissions relating to all fuels and did not provide an explicit explanation for the consumption of motor gasoline in its NIR.		explanatory paragraph has been inserted since the NIR 2023		
Industry					
2.B.4 Caprolactam, glyoxal and glyoxylic acid production – N2O (I.15, 2020) Transparency	Include in the next submission the outcome of the analysis of the EF for caprolactam production and, if the EF is revised, provide a consistent time series of emissions and an explanation of the recalculations performed. Addressing. The Party included in its NIR (table 4.3.2, p.138) information on the new EFs for caprolactam production for 2015–2020, but not the outcome of their analysis. The value of the EF from 1998 to 2014 was 4.74 kg N2O/t, decreasing to 0.6 kg N2O/t in 2020, as reported in the NIR and CRF table 2(I).A-H (sheet 1). The ERT noted that the default EF value in the 2006 IPCC Guidelines (vol.3, chap. 3, table 3.5, p.3.36) is 9.0 kg N2O/t, which is greater than the EF values used by the Party. During the review, the Party indicated that N2O emissions occur at the stage of production of ammonium nitrite, which is an intermediate stage in the production of hydroxylamine sulphate in the caprolactam production process. Emission reduction is achieved through the use of N2O reduction catalysts. A significant reduction in the N2O EF value was achieved thanks to the development of increasingly effective catalysts as a result of the cooperation of the caprolactam producers with the Łukasiewicz Research Network – Institute of New Chemical Syntheses in Puławy, which included research on and testing of new catalysts for the reduction of N2O emissions. Caprolactam producers are obliged to submit annual reports on production and N2O emissions to the national database on GHG and other substance emissions managed by KOBiZE, which can be accessed by the Polish inventory team (https://www.kobize.pl/en/article/national-database-on-greenhouse-gases-and-other-substances-emissions/id/1232/general-information). The ERT considers that the recommendation has not yet been fully addressed because the Party did not explain in the NIR the very low EF values for caprolactam production or provide the information provided during the review on the outcome of their analysis.	I.5	Recommendation has been implemented. The information provided during the review has been included since the NIR 2023		Chapter 4.3.2.4
2.B.7 Soda ash production – CO2 (I.16, 2020) Transparency	Include in the next submission the explanation provided during the review as the rationale for reporting CO2 emissions from coke used in soda ash production under the energy rather than the IPPU sector, and to change the notation key reported for category 2.B.7 from “NO” to “IE”. Addressing. The Party changed the notation key from “NO” to “IE” for reporting CO2 emissions for category 2.B.7 soda ash production in CRF table 2(I).A-H (sheet 1) and provided an explanation for reporting of “IE” in CRF table 9. However, the Party did not provide an	I.6	Recommendation has been implemented. The explanation has been included since the NIR 2023		Chapter 4.3.2.7

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	explanation in the chapter of the NIR addressing soda ash production (chap. 4.3.2.7, p.138) for reporting CO₂ emissions from coke used in soda ash production under the energy rather than the IPPU sector. As noted in the previous review report, the Party explained that national statistics provide only an aggregate value for coke used in the production of all chemicals, which is reported under subcategory 1.A.2.c chemicals in the energy sector, and that this makes it difficult to distinguish emissions from the consumption of coke for soda ash production separately. During the review, the ERT and Poland agreed that this information is missing from the NIR. The ERT considers that the recommendation has not yet been fully addressed.				
2.C.4 Magnesium production – SF6 (I.2, 2020) (I.3, 2018) (I.8, 2016) (I.8, 2015) (58, 2014) Accuracy	Implement the new data from the Polish Geological Institute and ensure the consistent reporting of SF6 arising from magnesium production across the time series. Addressing. The Party reported in the NIR (chap. 4.7.2, p.172) that it continued to use for its estimates the last verified AD available from 2007. During the review, the Party explained that it checked whether it could use the data from the Polish Geological Institute, but found that this was not possible because the Institute has no data that could be implemented as AD for magnesium foundries owing to a different methodological approach and identified data gaps. The Party also indicated that magnesium production stopped in 2018. The ERT considers that the recommendation has not yet been fully addressed because the Party still has not implemented a consistent reporting of SF6 emissions arising from magnesium production across the time series. Nevertheless, it considers that this issue does not represent an underestimation of emissions for this category, as a comparison with emissions data of Germany based on population figures showed that it can be assumed that the emissions are below the threshold of significance for Poland. The ERT concluded that any possible underestimate would be below the significance threshold for the application of an adjustment in accordance with decision 22/CMP.1, annex, paragraph 80(b), in conjunction with decision 4/CMP.11 (188.02 kt CO₂ eq) and therefore this issue was not included in the possible list of potential problems and further questions raised by the ERT.	I.7	Addressing.	Data from the Institute mentioned in the recommendation is not available. New source of data is being investigated.	-
2.F Product uses as substitutes for ozone-depleting substances – HFCs (I.4, 2020) (I.10, 2018) Comparability	Change the notation key reported in CRF table Summary 3 (sheet 1) to “NO” for SF6 and NF3 under “method applied” and “emission factor” for this category. Not resolved. The ERT noted that in CRF table Summary 3 (sheet 1) for SF6 and NF3 under “method applied” and “emission factor”, the cells remain blank and the notation key “NO” is missing. During the review, the Party informed the ERT that it tried to fix this issue in the CRF tables but did not succeed. The Party confirmed that emissions of SF6 and NF3 do not occur under this category.	I.11	Recommendation has been implemented since 2023 submission		CRF Summary 3
2.F.1 Refrigeration and air conditioning – HFCs (I.6, 2020) (I.12, 2018) Transparency	Include in the NIR sufficient information to explain the trends and significant inter-annual changes observed for HFCs remaining in products at decommissioning for subcategories 2.F.1.e and 2.F.1.f, including information on the assumed lifetime for different types of equipment in line with the information provided to the ERT during the review. Addressing. The Party included in its NIR (chap. 4.7.2, p.163) an explanation of the trends and inter-annual changes in HFCs remaining in products at decommissioning for subcategory 2.F.1.f mobile air conditioning and on the assumed lifetime for different types of equipment of mobile air-conditioning equipment. However, the Party did not provide an explanation of the trend and inter-annual changes and the assumed lifetimes for subcategory 2.F.1.e stationary air conditioning.	I.13	Recommendation has been implemented in the NIR since submission 2023		Chapter 4.7.2

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
2.F.1 Refrigeration and air conditioning – HFCs (I.20, 2020) Transparency	Provide transparent information in both the CRF tables and the NIR on the inclusion of HFC emissions from industrial refrigeration (2.F.1.c) under commercial refrigeration (2.F.1.a). Addressing. The Party reported in CRF table 9 that the HFC emissions from industrial refrigeration are reported under commercial refrigeration. However, it did not explain in the NIR why it cannot allocate HFC emissions from industrial refrigeration under the corresponding subcategory 2.F.1.c industrial refrigeration. Information explaining the allocation of HFC emissions for this subcategory is still missing from the NIR. During the review, the Party indicated that the main source of the information for F-gases is the national F-gas register implemented by the EU F-gas regulation. It also indicated that the disadvantage of the register is that the units used in commercial and industrial refrigeration are reported under one single category, which does not allow disaggregation. The ERT considers that the recommendation has not yet been fully addressed, but notes that including the explanation in the NIR on the aggregation of the national F-gas register and other relevant detailed information would help to resolve this issue.	I.16	Recommendation has been implemented in the NIR since submission 2023. Information that industrial refrigeration is reported in commercial refrigeration is provided in the NIR and CRF		Chapter 4.7.2
2.F.1 Refrigeration and air conditioning – HFCs (I.21, 2020) Transparency	Report on the shares of substances and blends used in air conditioning and refrigeration and include a description of the definition of the reported shares of different substances used in blends in air conditioning and refrigeration equipment in line with the information provided during the review in the next NIR. Not resolved. The Party continued to report in the NIR (tables 4.72–4.7.7, pp.165–168) the shares of the different substances in blends used in air conditioning and refrigeration, which do not sum up to 100 per cent. The Party also did not include a description of the definition of the reported shares of different substances used in these blends. During the review, the Party acknowledged this unresolved issue and informed the ERT that the corrections and necessary changes will be implemented in the 2023 annual submission.	I.17	Recommendation has been implemented in the NIR in submission 2023. Way of presenting information 4.72-4.77 was changed. Shares are summing up to 100% now		Chapter 4.7.2
2.F.1 Refrigeration and air conditioning – HFCs (I.21, 2020) Transparency	Provide transparent information in both the CRF tables and the NIR on the inclusion of HFC emissions from industrial refrigeration (2.F.1.c) under commercial refrigeration (2.F.1.a). Addressing. The Party reported in CRF table 9 that the HFC emissions from industrial refrigeration are reported under commercial refrigeration. However, it did not explain in the NIR why it cannot allocate HFC emissions from industrial refrigeration under the corresponding subcategory 2.F.1.c industrial refrigeration. Information explaining the allocation of HFC emissions for this subcategory is still missing from the NIR. During the review, the Party indicated that the main source of the information for F-gases is the national F-gas register implemented by the EU F-gas regulation. It also indicated that the disadvantage of the register is that the units used in commercial and industrial refrigeration are reported under one single category, which does not allow disaggregation. The ERT considers that the recommendation has not yet been fully addressed, but notes that including the explanation in the NIR on the aggregation of the national F-gas register and other relevant detailed information would help to resolve this issue.	I.16	Recommendation has been implemented in the NIR since submission 2023. Information that industrial refrigeration is reported in commercial refrigeration is provided in the NIR and CRF		Chapter 4.7.2
2.F.2 Foam blowing agents – HFC-134a (I.22, 2020) Transparency	Revise the formula for calculating operating stock and corresponding emissions for 1999–2004, review the entire time series for HFC-134a contained in foam blowing agents in the light of this revision and report on any resulting recalculations in the next submission.	I.20	Information since the NIR 2023 was revised		Chapter 4.7.2 Section 2.F.2 Foam blowing agents

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	Addressing. The Party revised and used the formula for calculating operating stock and corresponding emissions for 1999–2004 for HFC-134a contained in foam blowing agents. During the review, the Party informed the ERT that this improvement was implemented in the 2021 submission, including corresponding recalculations. Therefore, an explanation of the recalculations performed was not provided in the NIR of the 2022 annual submission. The Party also indicated that it corrected the HFC-134a product manufacturing factor for closed cell foams from 95 to 50 per cent. The ERT noted that this value was reported in CRF table 2(II)B-H (sheet 2); however, it was not updated in the NIR (chap. 4.7.2, p.169). Furthermore, the ERT noted that the Party did not provide any information on the indicated recalculation in the NIR of the 2021 submission (chap. 4.7.5, p.166). The ERT considers that the recommendation has not yet been fully addressed as the required and updated information was not provided in the NIRs of the 2021 or the 2022 annual submission.				
Agriculture					
3.B Manure management – CH4 (A.4, 2020) (A.7, 2018) (A.8, 2016) (A.8, 2015) (71, 2014) (82, 2013) Comparability	Separately report CH4 emissions from anaerobic digesters. Addressing. The Party reported in its NIR (chap. 5.3.2.1, p.199) that the separate reporting of CH4 emissions from anaerobic digesters under category 3.B manure management is still under development owing to insufficient methodological guidance given in the 2006 IPCC Guidelines and data needed to make these calculations. During the review, the Party explained that it provided preliminary CH4 emission calculations from anaerobic digesters in NIR table 5.3.7 (p.199). However, the ERT notes that no final calculations have been made and no separate data are reported in the CRF tables. The ERT considers that this issue has not yet been fully resolved, although it is being addressed by the Party. The ERT also considers that the issue does not represent any underestimation of emissions for this category, as no emissions are missing.	A.2	Implemented since the submission 2024		Chapter 5.3.2
LULUCF					
4. General (LULUCF) (L.1, 2020) (L.1, 2018) (L.1, 2016) (L.1, 2015) (78, 2014) (94, 2013) (98, 2012) Transparency	Provide detailed information on the rationale for and impact of the recalculations for the LULUCF sector. Addressing. The Party provided in its NIR (chap. 6.6.7, p.275) a brief explanation for the recalculations of the LULUCF categories subject to recalculations. Poland indicated that the rationale for the recalculations refers to the land-use change matrix revision (inclusion of data since 1968), inclusion of deadwood estimates, an update of EFs for biomass burning and an update of harvested wood products production data. While the rationale for the recalculations is mentioned in general, specific and detailed information on the rationale for and the impact of each LULUCF category recalculation under the respective chapter of the NIR was not provided. During the review, the Party clarified that the deadwood update is only for forest land remaining forest land, and that the EF for biomass burning is for wildfires on grassland. A more detailed explanation of the updates per subchapter will be provided in the next annual submission. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet provided detailed information on the rationale for each recalculated category in the LULUCF sector.	L.1	Issue addressed since 2023 submission. Poland provided updated information on the rationale for the recalculations in LULUCF sector performed in the NIR 2022		Chapter 6.6.7.
4. General (LULUCF) (L.4, 2020) (L.5, 2018) (L.27, 2016) (L.27, 2015) Transparency	Include in the NIR sufficient information on the rationale for and the impacts of changing from the gain–loss to the stock-change method to estimate CO2 emissions and removals from forest land remaining forest land for all years. Not resolved. The Party reported in its NIR (chap. 6.2.4, pp.233–236) the data and calculation	L.2	Issues addressed since 2023 submission. Information summarizing recent progress in addressing ERT recommendation has been amended in the NIR 2022		Section 6.2.9.

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	steps to estimate carbon stock changes in forest land remaining forest land using the stock-change method. One impact identified by the Party is that uncertainties are potentially lower than when using the gain-loss method, but it did not explain why this is the case for Poland. The NIR also does not contain the rationale for changing from the gain-loss to the stock-change method. During the review, the Party provided the rationale for this change clarifying that the switch to the stock-change method was made because of difficulties in obtaining data for biomass gains and losses per age and species class. The Party also provided an uncertainty assessment on the stock-change method, which showed an average (all species and age classes) uncertainty of 45 per cent for stock difference. However, the impact on the results of the change from the gain-loss to the stock-change method remains unclear. The ERT considers that the recommendation has not yet been addressed because the Party did not provide in the NIR the rationale for and the impacts of changing from the gain-loss to the stock-change method, including explaining how the stock-change method led to a lower uncertainty of the estimates.		Section 6.2.9.		
4.A.1 Forest land remaining forest land – CO ₂ (L.7, 2020) (L.31, 2018) Transparency	Verify the BEF2 values used for pines and broadleaves and clarify in the NIR (perhaps in a footnote to table 6.8) that the BEF2 values applied in the inventory are at the lower end of the range of default values in table 3A1.10 of the IPCC good practice guidance for LULUCF. Explain in the NIR the assumptions made in applying those values and the results of that choice. Not resolved. The Party did not clarify in the NIR why the BEF2 values (1.05 and 1.20) at the lower end of the range of default values in table 3A1.10 of the IPCC good practice guidance for LULUCF (p.3.178) have been used to represent the Polish growing stocks for pine and broadleaf species, nor did it provide information on verifying these BEF2 values. During the review, the Party clarified that it used the lower end values to apply the conservativeness principle, and that the footnote to table 3A.1.10 of the IPCC good practice guidance for LULUCF could apply for Polish forests representing relatively large areas of mature forests. The ERT considers that the recommendation has not yet been addressed because the Party has not explained in the NIR the assumptions made for applying these values, which are at the lower end of the range of default values provided in table 3A.1.10 of the IPCC good practice guidance for LULUCF and the results of that choice, nor has it included a note indicating that no removals were overestimated or emissions underestimated while applying a ratio of above- to below-ground biomass (known as R).	L.6	issues addressed since 2023 submission. Information summarizing assumptions made in applying BEF2 values has been amended in the NIR 2023 Section 6.2.4.5		Section 6.2.4.5
4.A.1 Forest land remaining forest land – CO ₂ (L.9, 2020) (L.33, 2018) Transparency	Provide information (e.g. a table) in the NIR showing the average growing stock volume (m³/ha) and the stock difference (m³/ha/year) and provide a detailed explanation of why the implied carbon stock change factors for forest land remaining forest land are not in line with the annual stock differences. Addressing. The Party reported in its NIR (figure 6.7, p.235) a graph showing the trend of the total growing stocks (gross merchantable timber) in Poland based on aggregated data from a bottom-up statistics approach with information on growing stocks by stand aggregated by species and growing stock. In the NIR, the Party clarified that the stock-change method application might not imply a proportion between the annual stock differences and the average growing stock since the different level of data disaggregation has been applied. The ERT considers that the recommendation has not been fully addressed because the Party has not included in the NIR a table reflecting the different granularity of information and data sources used to calculate the stock difference based on growing stock volumes or demonstrated why	L.8	Issue partially addressed in 2023 submission. Information summarizing stock-change method application has been provided in the NIR 2022 section 6.2.4.3. Tabular information on data sources used to calculate the stock difference based on growing stock volumes for forest land remaining forest land will be provided in the NIR 2024 section 6.2.4.3.		Section 6.2.4.3

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	these results are different from the IEFs for forest land remaining forest land.				
4.A.1 Forest land remaining forest land – CO ₂ (L.10, 2020) (L.7, 2018) (L.6, 2016) (L.6, 2015) (87, 2014) Transparency	Provide more detailed information on how the NFI data were factored into the calculation to estimate the growing stock volume since 2009. Addressing. The Party reported in its NIR (chap. 6.2.4.3, p.234) that NFI data were used to derive post-2009 estimates for growing stock volumes. In its NIR (tables 6.7 and 6.8, pp.234–235) Poland reported the merchantable timber volumes calibrated with the NFI data since 2009 used for estimating growing stock volumes. During the review, the Party indicated that data before 2009 are still primarily based on annual surveys reflecting statistics reported by the Office of Forest Management and Geodesy. The ERT considers that the recommendation has not yet been fully addressed because while the Party reported the merchantable volumes since 2009, it has not yet explained how these have been derived from the NFI or provided further related detailed information (forest stratification, frequency of measurements, sample design, classes per forest age/species, district, etc.).	L.9	Issue addressed in 2023 submission. Information summarizing application NFI data to derive post-2009 estimates for growing stock volume has been provided in the NIR 2022 section 6.2.4.3.		Section 6.2.4.3
4.A.1 Forest land remaining forest land – CO ₂ (L.12, 2020) (L.9, 2018) (L.8, 2016) (L.8, 2015) (88, 2014) Accuracy	Explore the possibility of using country-specific values for the BEF and the root-to-shoot ratio and indicate the results of such an attempt and its limitations in the NIR. Addressing. The Party reported in its NIR (chap. 6.2.4.5, pp.239–240) that it is exploring the possibility of using country-specific values for both the BEF and the root-to-shoot ratio. However, no information was provided on the results of the ongoing analysis and the associated limitations. During the review, the Party clarified that the NFI is currently focusing on growing stock inventories rather than species-specific biomass inventories. It indicated that for calculating country-specific BEFs, species-specific biomass inventories are needed. To date, knowledge of possible sources of developing biomass conversion factors on a large scale is still limited. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet provided an update on and the results of the ongoing exploration of using country-specific values for the BEF and the root-to-shoot ratio.	L.11	Issue addressed in 2023 submission. Information summarizing recent efforts in assessing the possibilities of using country-specific values for the BEF and the root-to-shoot ratios in the NIR 2022 section 6.2.4.3.		Section 6.2.4.3
4.A.1 Forest land remaining forest land – CO ₂ , CH ₄ and N ₂ O (L.13, 2020) (L.11, 2018) (L.28, 2016) (L.2, 2015) Accuracy	Use a tier 2 or higher IPCC approach to estimate emissions from both the litter and the deadwood carbon pools. Addressing. The Party reported in its NIR (chap. 6.2.4.8, p.241) that estimates for the deadwood carbon pool were made using a tier 2 method, while those for the litter carbon pool were still estimated using the default method; therefore, this pool was assumed to be in equilibrium. The Party assumed that changes in the litter pool are not a source of emissions; however, the NIR did not include a quantitative analysis of this statement. During the review, the Party explained that it reported “NO” for litter using a conservative approach that the carbon stocks are in equilibrium. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet estimated the litter pool using a tier 2 method or provided in the NIR quantitative information to justify that the litter pool is not a source of emissions.	L.12	Issue addressed in 2023 submission. The Tier 1 assumption for both dead wood (apart from FL_FL) and litter pools for all land-use categories is that their stocks are not changing over time if the land remains within the same land-use category.		Section 6.2.5.4.
4.A.2 Land converted to forest land – CO ₂ (L.14, 2020) (L.14, 2018) (L.12, 2016) (L.12, 2015) (93, 2014) (104, 2013)	Further analyze the NFI data and use data exclusively from age class I (1–20 years) for estimating the carbon stock changes in living biomass and deadwood for land converted to forest land. Not resolved. The Party reported in its NIR (chap. 6.2.5.3, p.245) that the NFI has not provided specific annual increment data for the young forests in age class I (1–20 years). During the review, the Party clarified that there are delays in the implementation of the new modelling framework (CBM-CFS3 model). It indicated that average increment data are available but yield	L.13	Issue partially addressed in 2023 submission. Information summarizing recent efforts in assessing the possibilities of using country-specific NFI data and use data exclusively from age class I (1–20 years) for estimating the carbon		Section 6.2.5.3

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
Accuracy	tables with gross roundwood volumes are not yet available for age class I, although they are expected to be available for both biomass and deadwood for the 2024 annual submission. The ERT considers that the recommendation has not yet been addressed because the Party did not use NFI data exclusively from age class I for estimating carbon stock changes in biomass and deadwood.		stock changes in living biomass and deadwood for land converted to forest land. Information summarizing recent efforts and limitation encountered in assessing the possibilities of using country-specific data will be provided by NIR 2024 section 6.2.5.3.		
4.A.2 Land converted to forest land – CO ₂ (L.15, 2020) (L.15, 2018) (L.13, 2016) (L.13, 2015) (94, 2014) Accuracy	Apply the gain–loss method (tier 2), which follows a more disaggregated approach and allows for more precise estimates of the carbon stock changes in biomass. Not resolved. The Party reported in its NIR (chap. 6.2.5.3, p.246) that a tier 1 method for the annual average biomass increment was selected for its calculations of carbon stock changes in biomass. During the review, the Party clarified that, pending the implementation of the new modelling framework, it continues to use the gain–loss method (tier 1). Not implementing the modelling framework is owing to the fact that the specific allometric equations were missing for the age class I forest and therefore the carbon increment could not be estimated. Inputs from the NFI are also still missing, such as yields on roundwood volumes. The ERT considers that the recommendation has not yet been addressed because the Party has not yet used a tier 2 method for estimating carbon stock changes in biomass.	L.14	Issue partially addressed since 2023 submission. Information summarizing recent efforts in assessing the possibilities of using country-specific NFI data and use data exclusively from age class I (1–20 years) for estimating the carbon stock changes in living biomass and deadwood for land converted to forest land. Information summarizing recent efforts and limitation encountered in assessing the possibilities of using country-specific data will be provided by NIR 2024 section 6.2.5.3. During the review 2022, Poland clarified that the switch to stock-change method was made because of difficulties to obtain data for biomass gains and losses per age and species class, which provides the rationale for this change. Subsequently, Poland also provided an uncertainty assessment on the sampling method.		Section 6.2.5.3
4.A.2 Land converted to forest land – CO ₂ (L.16, 2020) (L.16, 2018) (L.14, 2016) (L.14, 2015) (94, 2014) Transparency	Disaggregate the area converted by species and clarify in the NIR why the conversion occurs only for extensively managed forests and not intensively managed forests, as would be the case for plantations. Not resolved. A disaggregated area converted by species was not reported in the relevant chapter of the NIR (chap. 6.2.5.3, pp.245–246). Moreover, the Party did not provide information on why conversion occurs only for extensively managed forests. During the review, the Party clarified that a weighted average by areas disaggregated by species was used to calculate the average annual above-ground biomass growth of 4 t/ha/year. The Party indicated that it uses 3 t/ha/year for coniferous and 4 t/ha/year for broadleaf species. The Party also clarified that the management of forest is only considered extensive on the basis of a management approach	L.15	Issue partially addressed in 2023 submission. Information summarizing recent efforts in assessing the possibilities of using country-specific NFI data and use data exclusively from age class I (1–20 years) for estimating the carbon stock changes in living biomass and deadwood for land converted to forest land. Information summarizing recent efforts and		Section 6.2.5.3

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	promoting natural renewal supported by Polish forest law and that it reports all intensively managed plantations (e.g. Christmas trees) under cropland. The ERT considers that the recommendation has not yet been addressed because the Party has not explained in the NIR how the area converted has been disaggregated by species (coniferous versus broadleaf) and how intensively managed forests have been excluded from managed forests.		limitation encountered in assessing the possibilities of using country-specific data will be provided by NIR 2024 section 6.2.5.3. A disaggregated area per species will be provided in the NIR 2024 section 6.2.4.3. Furthermore, since during ERT 2022 Poland clarified that the forest management is considered only extensive based on Polish siliculture practices, similar information will be provided in the NIR 2024 section 6.2.5.3		
4.A.2 Land converted to forest land – CO ₂ (L.17, 2020) (L.17, 2018) (L.15, 2016) (L.15, 2015) (95, 2014) Transparency	Provide in the NIR more detailed information on the estimation methods used for the carbon stock changes in the dead organic matter and soil pools. Addressing. The Party reported in its NIR (chap. 6.2.5.4, pp.246–248) detailed information and assumptions on the approach taken for dead organic matter. The Party also reported in its NIR (chap. 6.2.5.5, p.249) the SOCREF default values selected and the soil type distribution per non-forest land area used for estimating the carbon stock changes in soil pools. Poland also reported the carbon stock change factors for forest land in the NIR (chap. 6.4.4.3, pp.259–260) but it did not indicate which factors it selected for the other land uses. During the review, Poland confirmed that stock change factors for previous land use based on the percentage of the area per previous land use have been used for the soil carbon estimates, as reported in the NIR for cropland (chap. 6.3.4.4, p.254) and grassland (chap. 6.4.4.3, p.260). The ERT considers that the recommendation has not yet been fully addressed because the Party did not provide detailed information on the estimation methods for carbon stock changes in soil pools, and, in particular, it has not yet indicated which carbon stock change factors have been used for cropland and grassland (see ID# L.35 in table 5).	L.16	Issue addressed in 2023 submission. The Tier 1 assumption applied for both dead wood and litter pools for all land-use change categories is that their stocks are not changing over time if the land remains within the same land-use category. Poland Information confirming that stock change factors for previous land use based on the percentage of the area per previous land use have been used for the soil carbon estimates, as reported in the NIR for cropland (chap. 6.3.4.4) and grassland (chap. 6.4.4.3) will be provided in the NIR 2024 Section 6.2.5.5.		Section 6.2.5.4; Section 6.2.5.5
4.A.2 Land converted to forest land – CO ₂ (L.18, 2020) (L.18, 2018) (L.30, 2016) (L.30, 2015) Accuracy	Use a higher-tier method (e.g. using NFI data exclusively from age class I (1–20 years)) to estimate a country-specific biomass increment value to increase the accuracy of the estimate for the land converted to forest land category, and provide the results and the limitations encountered in the next NIR. Not resolved. The Party reported in its NIR (chap. 6.6.8, p.282) that it is working on the implementation of a new modelling framework using the CBM-CFS3 model, which will allow a higher-tier method to be developed using NFI data exclusively within age class I. During the review, the Party clarified that the new modelling framework is not yet implemented, as it is lacking relevant reliable data, such as explicit growth curves exclusively for age class I to be utilized in the modelling framework. The ERT considers that the recommendation has not yet been addressed because the Party has not yet used a higher-tier method to estimate a country-specific biomass increment values for land converted to forest land.	L.17	Issue partially addressed since 2023 submission. Information summarizing recent efforts in assessing the possibilities of using country-specific NFI data and use data exclusively from age class I (1–20 years) for estimating the carbon stock changes in living biomass and deadwood for land converted to forest land. Information summarizing recent efforts and limitation encountered in assessing the possibilities of using country-specific data will be provided by NIR		Section 6.2.5.3

CRF category/issue	Review recommendation	Review report/ paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
4.A.2 Land converted to forest land – CO ₂ (L.19, 2020) (L.19, 2018) (L.31, 2016) (L.31, 2015) Accuracy	Account for emissions and removals from deadwood and litter following the 2006 IPCC Guidelines (vol. 4, chap. 2.3.2) with the highest possible tier approach. Not resolved. The Party indicated in its NIR (chaps. 6.2–6.6, pp.247–284) that it did not report emissions and removals from deadwood and litter for land converted to forest land. The ERT noted that “NA” and “NO” were reported in CRF table 4.A for these two pools under category 4.A.2 land converted to forest land. During the review, Poland mentioned that it could not disaggregate the NFI results for deadwood for age class I and therefore reported all estimates for deadwood in forest land remaining forest land using the stock-difference method (tier 2). The ERT considers that the recommendation has not yet been addressed because the Party has not estimated emissions and removals from deadwood and litter in accordance with the 2006 IPCC Guidelines.	L.18	2024 section 6.2.5.3. Issue addressed since 2023 submission. The Tier 1 assumption applied for both dead wood and litter pools for all land-use change categories is that their stocks are not changing over time if the land remains within the same land-use category. Poland Information confirming that stock change factors for previous land use based on the percentage of the area per previous land use have been used for the soil carbon estimates, as reported in the NIR for cropland (chap. 6.3.4.4) and grassland (chap. 6.4.4.3) will be provided in the NIR 2024 Section 6.2.5.5.		Section 6.2.5.4; Section 6.2.5.5
4.C.2 Land converted to grassland – CO ₂ (L.22, 2020) (L.36, 2018) Accuracy	Use the correct values for change in carbon stocks in biomass on land converted to other land-use category (–4.7 t C/ha) and biomass before conversion (4.7 t C/ha) for annual crops converted to grassland. Not resolved. The Party reported in its NIR (chap. 6.4.4.2, p.258) that the value of 5 t/ha/year provided in table 5.9 of the 2006 IPCC Guidelines (vol. 4, chap. 5, p.5.28) was used for biomass stock before conversion for annual crops converted to grassland, which suggests that Poland was still using this value for biomass after one year of conversion on land converted to grasslands. During the review, the Party confirmed the use of 5 t C/ha instead of 4.7 t C/ha for changes in carbon stocks in biomass for all land converted to other land-use category. Therefore, the ERT concluded that the recommendation has not yet been addressed.	L.24	Issue corrected since 2023 submission		section 6.4.4.2
4.D.1 Wetlands remaining wetlands – CO ₂ (L.24, 2020) (L.39, 2018) Accuracy	Verify the methodology applied for subcategory 4.D.1.1 to estimate net carbon stock change in soils (both mineral and organic soils) and report the values correctly in CRF table 4.D under the appropriate subcategory; report “NE” for net carbon stock change in soils under flooded land (subcategory 4.D.1.2); and update the NIR to reflect the correct methodologies applied for subcategories 4.D.1.1 and 4.D.1.2 for net carbon stock change in soils. Addressing. The ERT noted that the Party continued using “NA” for net carbon stock change in soils under flooded land remaining flooded land (subcategory 4.D.1.2) and that, to report values of biomass emissions under land converted for peat extraction under subcategory 4.D.2.2 land converted to flooded land, the Party used “NO” instead of “NE”. The Party sufficiently updated the NIR (chap. 6.5.4.3, pp.266–267) with an explanation of the methodology used to estimate soil organic carbon stock changes in soils for subcategories 4.D.1.1 and 4.D.1.2. During the review, the Party mentioned that during an internal EU consultation, the use of the notation key “NA” was recommended for carbon pools, instead of “NE” or “NO”, and therefore Poland continued to use “NA”. The ERT considers the recommendation has not yet been fully addressed because the correct notation key “NE” has not been used for reporting net carbon stock change	L.25	Issue will be corrected in 2024 submission. Notation key “NO” has not been used for reporting net carbon stock change in soils for subcategory 4.D.1.2.		CRF 2024; table 4D

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	in soils for subcategory 4.D.1.2.				
4.D.1 Wetlands remaining wetlands 4.D.2 Land converted to wetlands – CO ₂ , CH ₄ and N ₂ O (L.25, 2020) (L.40, 2018) Transparency	(b) Why land converted for peat extraction is reported under subcategory 4.D.2.2 land converted to flooded land; (c) How land converted for peat extraction and land under peat extraction are reported in the inventory; (b) Not resolved. The Party did not explain in the NIR why land converted for peat extraction and in particular biomass removals on other lands (mainly grasslands) converted to peatlands for extraction are accounted under subcategory 4.D.2.2 land converted to flooded land. The ERT noted that the Party did not report emissions from biomass on peatlands remaining peatlands under the correct subcategory 4.D.1.1 or otherwise did not explain why it is reported under subcategory 4.D.2.2; (c) Not resolved. Poland did not provide information in the NIR on land areas of grassland converted for peatland or how land converted for peat extraction and land under peat extraction are reported in the inventory;	L.26	Issue under consideration. Poland considered peatlands as terrestrial wetland ecosystems in line Methodology to allocate peat extraction and in particular biomass removals on other than WL lands is considered subjects to further improvements. So far information contained in the database (Spatial Information System on Wetlands/ GIS Mokradla) became accessible for the inventory experts since 2020. However, this information do not cover any specific (geographically explicit) information on already existing and new peat excavation sites. An assessment of the usefulness of GIS Mokradla is beeing conducted (notably as a part of InCoNaDa project - more: https://inconada.eu/index.php/about-the-project/).		
4.E.2 Land converted to settlements – CO ₂ (L.26, 2020) (L.42, 2018) Transparency	Explain in the NIR the decision to apply instant oxidation instead of transition time for estimating carbon stock change in soil organic matter. Addressing. The Party reported in its NIR (chap. 6.6.4.2, p.271) that it used the stock change method for estimating carbon stock change in soil organic matter in accordance with the 2006 IPCC Guidelines. The Party provided the SOCREP values used, and all stock change factors used for previous land uses. The Party did not explain the stock change factors used for settlements (the final land use). During the review, the Party clarified that for conversions to settlements, the final soil organic carbon stock has been conservatively set to zero and a default transition time of 20 years for estimating carbon stock change in soil organic carbon has been applied. The ERT considers that it is important to include in the NIR the above-mentioned conservative assumptions made to explain the decision to apply instant oxidation and therefore considers that the recommendation has not yet been fully addressed.	L.27	Issue corrected since 2023 submission.		section 6.6.4
4.E.2 Land converted to settlements – CO ₂ (L.37, 2020) Transparency	Explain in both the CRF tables and the NIR the use of the notation key “IE” for gains under carbon stock change in living biomass. Not resolved. The Party reported in its NIR (chap. 6.6.4.2, pp.272–273) that the notation key “IE” has been used for gains in carbon stock change in living biomass for cropland and grassland converted to settlements under category 4.E.2 land converted to settlements. During the review, the Party clarified that currently no gains are reported associated with this category and the notation key “NO” should be used instead. The ERT considers that the recommendation has not been addressed because the Party did not use the correct notation key “NO” instead of “IE” for gains in carbon stock change in living biomass and did not provide a related correct	L.29	Issue corrected since 2023 submission.		section 6.6.4

CRF category/issue	Review recommendation	Review report/ paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	explanation in the NIR.				
4.E.2.2 Cropland converted to settlements – CO ₂ (L.28, 2020) (L.27, 2018) (L.24, 2016) (L.24, 2015) (84, 2014) (98, 2013) Transparency	Clearly explain the allocation of the emissions and removals from all carbon pools in the subcategory cropland converted to settlements. Addressing. The Party included in its NIR (chap. 6.6.4.2, p.272) a discussion on biomass and soils, which explained the allocation of emissions and removals for the biomass and mineral soils pools in cropland converted to settlements. The ERT noted that “IE” was used only for gains in carbon stock change in living biomass in CRF table 4.E. However, the Party did not provide an explanation of how emissions and removals from organic soils under cropland converted to settlements have been allocated nor information on how they were estimated. During the review, Poland indicated that the information will be added to its future annual submissions. The ERT considers that the recommendation has not yet been fully addressed.	L.30	Issue corrected since 2023 submission.		section 6.6.5
4(II) Emissions/removals from drainage and rewetting and other management of organic/mineral soils – N ₂ O (L.38, 2020) Transparency	Provide evidence in the NIR that the cited laws prevent the draining of forest soils. Addressing. The Party provided in its NIR (chap. 11.6.1, pp.393–394) a reference to the Act on National Policy on Forests (1997) as evidence of the prevention of drainage of forest soils. In this Act (p.26) it is stated that State-owned forests (about half of total forests in the country) are classified as protective, which means that they protect the soils and prevent their draining. The ERT noted, however, that the Act does not state the same for non-State-owned forests. During the review, the Party clarified that in addition to the Act mentioned in the NIR, the Act on the Protection of Agricultural and Forest Land shall be considered while drawing up forest management plans or a simplified forest management plan for non-State forests, which together will prevent drainage from organic soils from happening on all managed forests. The ERT considers that the recommendation has not yet been fully addressed because the Party did not provide a reference in the NIR to the above-mentioned Act on the Protection of Agricultural and Forest Land and the reference to the Act as evidence of how it prevents private forest owners from draining forest soils is missing.	L.31	Issue will be corrected in 2024 submission. The reference to the Act on National Policy on Forests (1997) and Act on the Protection of Agricultural and Forest Land with the particular reference to drainage protection activities as evidences of the prevention of drainage of forest soils will added to the NIR 2024, section 6.2.5.5.		section 6.2.5.5
4(V) Biomass burning – CO ₂ (L.29, 2020) (L.28, 2018) (L.25, 2016) (L.25, 2015) (101, 2014) Transparency	Provide more information on the values used for mass of available fuel, fraction of biomass combusted and EFs to estimate non-CO₂ emissions from wildfires. Addressing. The Party reported in NIR tables 6.15 and 6.16 (p.243) the EFs selected and the fraction of biomass combusted taken from tables 2.5 and 2.6 from the 2006 IPCC Guidelines (vol. 4, chap. 2, p.2.47) used for the calculation of non-CO₂ emissions from wildfires on forest land. The Party reported the AD and the mass of available fuel in NIR table 6.17 (p.243) but not the sources of these data or their derivation. During the review, the Party clarified that the total mass of available fuel is taken from the NFI data and is the weighted mean of the growing stock of forests under State management and privately owned forests. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet provided the data source for the mass of available fuel or explained how the values in NIR table 6.17 are calculated.	L.32	Issue corrected since 2023 submission.		section 6.2.4.11
Waste					
5.A Solid waste disposal on land – CH ₄ (W.1, 2020) (W.5, 2018)	Improve the accuracy of estimated emissions from landfills by using the new waste database. Not resolved. The ERT noted that no clear indication of progress on the preparation of the new waste database was provided in the NIR. During the review, the Party clarified that owing to	W.1	New AD are included in submission.		Chapter 7.2

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
Accuracy	time constraints the new landfill AD were not included in the latest annual submission and that it is working on verification and QC and aiming to finish these activities for its next annual submission. The Party informed the ERT that facility data are under analysis; these data are expected to bring detailed information on amounts of landfilled waste and sludge, morphology of waste, management practices, recovered CH ₄ , size of landfill, geocoordinates, date of closure, etc. The ERT commends the Party for its willingness to include new AD in the next annual submission but considers that the recommendation has not yet been addressed. Nevertheless, the ERT also considers that no underestimation of CH ₄ emissions for this category can be identified as, in the 2022 annual submission, the Party used the best available data at the time of the calculation of emission estimates for this category.				
5.B.1 Composting – CH ₄ and N ₂ O (W.6, 2020) Accuracy	Report on the results of the investigation of available alternative data sets that would improve the reporting for category 5.B.1 in the NIR and recalculate emissions, if appropriate, while also better describing the emissions trend. Addressing. The ERT noted that observed inter-annual variation in the amount of waste treated for composting between 2016 and 2017 (–52.7 per cent) still persists. The Party reported in its NIR (chap. 7.3.6, p.304) information on the investigation into the possibility of applying facility data for the estimates. The Party indicated that improvement of emission estimates for composting and anaerobic digestion was included in the specific planned improvements for this category. Regarding emission trends, the Party also reported in the NIR (chap. 7.3.1, p.302) that a modification in the methodology adopted by Statistics Poland in 2017 to calculate the mass of composted waste caused a significant decrease in CH₄ emissions since 2017. During the review, the Party informed the ERT that efforts are being made to finalize the analysis of facility data and that these data are planned to be incorporated in the next annual submission. The revised data should solve the inter-annual variation issues observed. The ERT considers that the results of the investigation have been captured as a specific planned improvement and commends Poland for its willingness to finalize the analysis of facility data and the planned improvement to include the alternative data set for the calculations in the next annual submission on the understanding that this would improve the reporting for category 5.B.1 and reduce identified inter-annual variations. However, the ERT considers that the recommendation is not yet fully addressed. Nevertheless, the ERT also considers that no underestimation of CH₄ emissions for this category has occurred, including for 2017, as the Party used the best available data at the time of the calculation of emission estimates for this category for its 2022 annual submission; it is even possible that CH₄ emissions for 2016 (and 2015) were overestimated.	W.3	New AD are included in submission.		Chapter 7.3
5.B.2 Anaerobic digestion at biogas facilities – CH ₄ and N ₂ O (W.7, 2020) Completeness	Report emissions separately for anaerobic digestion of organic waste (5.B.2) in the future submissions. If this is not possible, explain the allocation of emissions between categories 5.B.2 and 5.B.1 (composting) in the NIR and revise the use of notation keys. For the period 2005–2012, include emissions under category 5.B.2 – even if deemed insignificant – in order to provide a consistent time series. Addressing. The ERT noted that the Party continued to report the notation key “NE” for 2004–2012 and “IE” for 2013–2020 in CRF table 5.B for CH₄ emissions for subcategory 5.B.2.a municipal solid waste under category 5.B.2 anaerobic digestion at biogas facilities. The Party specifically indicated in its NIR (chap. 7.3.1, p.302) that anaerobic digestion plants have been operating in Poland since 2005 and that emissions for category 5.B.2 anaerobic digestion at biogas facilities were included under category 5.B.1 composting. The Party explained that for	W.4	New AD are included in submission.		Chapter 7.3

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	2005–2012 no reliable AD on waste digested anaerobically were available to estimate CH₄ emissions for category 5.B.2 and reported emissions as “NE” in CRF table 5.B. It indicated that these emissions are below the threshold of significance in accordance with estimates provided in the previous review; however, it did not provide such a justification in the NIR in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The Party also explained that since 2013 only aggregated AD on waste composted and treated anaerobically have been available, and therefore the notation key “IE” was reported in CRF table 5.B from 2013 to 2020. On the other hand, during the review, the Party confirmed that it does not report N₂O emissions for category 5.B.2 since those emissions are considered negligible according to the 2006 IPCC Guidelines (vol. 5, chap. 4.1.3.1, table 4.1, p.4.6). The Party informed the ERT that efforts are being made to finalize the analysis of facility data and their incorporation in the next annual submission, including reporting separate emissions for category 5.B.2. The revised data should provide annual information on amounts of waste treated anaerobically, size of the facility, time of operation and technology, among others. The ERT considers that the recommendation has not yet been fully addressed.				
5.D Wastewater treatment and discharge – CH ₄ (W.3, 2020) (W.6, 2018) Transparency	Improve the transparency of the reporting on sludge removed in domestic and industrial wastewater by including in the NIR the amount of domestic sludge removed under category 5.D.1, disaggregated by final use, and an explanation that the amount of sludge removed under industrial wastewater (category 5.D.2) is zero, in accordance with the IPCC default tier 1 value, given the lack of any data on sludge split by industry. Verify the values reported in NIR table 7.10 with the amount of sludge removed and landfilled (20.67 kt in 2016) in the table provided during the review (and used for the calculation of emissions), and justify and explain the reasons for any significant differences in values. Not resolved. The ERT noted that disaggregated data by final use of domestic sludge removed under category 5.D.1 domestic wastewater were not included in the NIR. The Party did not explain that the amount of sludge removed under category 5.D.2 industrial wastewater is assumed to be zero or provide information on the verification of the values reported in the NIR with the amount of sludge removed and landfilled (20.67 kt in 2016) used for the calculation of emissions. During the review, the Party explained that the data on amount of domestic sludge removed under category 5.D.1 disaggregated by final use are published by Statistics Poland, and that the amount of sludge removed under category 5.D.2 industrial wastewater is conservatively defined as zero, in accordance with the 2006 IPCC Guidelines (vol. 5, chap. 6.2.1, p.6.9). Poland confirmed that, according to Statistics Poland, in 2016, the amount of domestic sludge removed and landfilled was 20.67 kt dry matter and the amount of industrial sludge removed and landfilled was 76.90 kt dry matter. Poland agreed to improve the transparency of the information on this issue in its next annual submission and include disaggregated information on sludge removed under category 5.D.1. The ERT considers that the recommendation has not been addressed.	W.5	Disaggregated information on sludge removed under category 5.D.1 is included in 2024 submission. In 2025 subssion MS changed removed sludge AD source and applied 2019 IPCC GL Refinement. Therefore, it is not possible to include the recommendation in NID 2025.		Chapter 7.5.2.1
5.D.2 Industrial wastewater – CH ₄ (W.4, 2020) (W.7, 2018) Transparency	Include a description in the NIR of how wastewater management has evolved over time with regard to the management of industrial liquid effluents. Addressing. The ERT noted that the information on the evolution of industrial wastewater management based on a country-specific study mentioned in the NIR was provided in NIR table 7.31 (p.315). The ERT recognizes that this is a relevant improvement on the disaggregation of	W.7	Decription of evolution of industrial wastewater management is included submission.		Chapter 7.5.2.1

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	data. Nevertheless, the ERT could not identify a substantial effort to increase the transparency in the NIR by including a description of how wastewater management has evolved over time with regard to the management of industrial liquid effluents, in particular for recent years. During the review, the Party explained that a proper description of industrial wastewater management will be provided in the next annual submission. The ERT considers that the recommendation has not yet been fully addressed.				
Table 5					
Energy					
1.B.1.a Coal mining and handling – CO ₂ and CH ₄	The Party reported in CRF table 1.B.1 CH₄ recovery/flaring for subcategory 1.B.1.a.i underground mines as “NE”. During the review, Poland confirmed that both recovery and flaring of CH₄ occur but are not estimated for subcategory 1.B.1.a.i, and that all recovery and flaring of CH₄ is reported as venting of CH₄. The ERT considers that the lack of an estimate for recovery and flaring, which should be discounted from CH₄ emissions for subcategory 1.B.1.a.i underground mines, leads to an overestimation of CH₄ emissions reported for subcategory 1.B.1.a.i (see ID# G.2 in table 3). The ERT recommends that the Party estimate the amount of CH₄ flared from underground mines and report the values as CO₂ emissions in CRF table 1.B.1 (under subcategory 1.B.1.c). The ERT also recommends that the Party report recovery of CH₄ for energy purposes in both CRF table 1.B.1 and the corresponding category in CRF table 1.A(a) with documentation in the NIR on the method used for calculations and allocation of the emissions. Until such time as the amount of CH₄ recovered and flared can be estimated, the ERT recommends that Poland report as “IE” the amount of CH₄ recovered and flared for subcategory 1.B.1.a.i underground mines, with documentation in the NIR and information in CRF table 1.B.1, and describing how emissions from this activity have been calculated, reported and allocated.	E.8	Party has reached out to the Higher Mining Office – the supervising body for mining facilities in Poland – requesting information regarding methane burning on flares. Party has received information stating that methane burning on flares accompanying the extraction of hard coal and brown coal does not occur in Poland. Consequently, Party will change NE to NO in CRF tables in submission 2024.		Chapter 3.3.1.2
1.B.2.b Natural gas – CO ₂ and CH ₄	The ERT noted the use of marketable gas as the AD for both subcategories 1.B.2.b.4 transmission and storage and 1.B.2.b.5 distribution, which shows an incorrect application of the tier 1 method described in the 2006 IPCC Guidelines (vol. 2, chap. 4, table 4.2.7, p.4.67) for the estimation of emissions for subcategory 1.B.2.b.5 distribution. During the review, the Party acknowledged that the AD used for the estimation of emissions for subcategory 1.B.2.b.5 distribution reported as “gas consumed” in CRF table 1.B.2 are incorrect. The ERT estimated the impact of revising emission estimates using utility sales of gas as correct AD in accordance with the 2006 IPCC Guidelines and concluded that use of these correct AD would lead to a reduction in emissions for this category of approximately 443 kt CO₂ eq for 2020, with the new amount of emissions estimated at 179 kt CO₂ eq, accounting for 0.0477 per cent of total GHG emissions without LULUCF. The ERT recommends that Poland use the correct AD for subcategory 1.B.2.b.5 distribution, which are those for utility sales of gas, in accordance with the tier 1 method described in the 2006 IPCC Guidelines (vol. 2, chap. 4, table 4.2.7, p.4.67) and revise the emission estimates for the relevant years of the time series.	E.9		Party does not have data on use of marketable gas. AD for 1.B.2.b come from EUROSTAT and for historical years from IEA database. For estimating emissions for this subcategory Party has to take available data as is “gas consumed”.	
IPPU					
2.F.1 Refrigeration and air conditioning – HFCs and PFCs	Poland reported in its NIR (chap. 4.7.2, p.163) information explaining the trend and lifetime values used for mobile air conditioning estimates. The ERT noted that explanations of the trend and lifetime values used for stationary air conditioning estimates are missing from the NIR, as well as an overview of the lifetime values used for other subcategories under category 2.F.1	I.21	This information is provided in the NIR in submission 2024		Chapter 4.7.2

CRF category/issue	Review recommendation	Review report/ paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	refrigeration and air conditioning. The ERT considers that information on lifetime values for the use of F-gases is an important part of the information to be included in the NIR, as it is the basis for the calculation of emissions from the production, usage and disposal of F-gases. During the review, the Party provided the ERT with a table showing an overview of the lifetime values used in the emission calculations for category 2.F.1 refrigeration and air conditioning. The ERT recommends that the Party include a table in the NIR with an overview of the lifetimes used for HFC and PFC emission calculations for category 2.F.1 refrigeration and air conditioning, and information explaining the trend of these lifetime values.				
LULUCF					
4.A.1 Forest land remaining forest land – CO ₂	The Party reported in its NIR (chap. 6.2.4.8, p.241) that emissions and removals from the deadwood pool are based on deadwood volume stock values collected from the NFI and that it used the stock-change method for its estimates. The ERT found that from 2012 onward a sharp increase in deadwood carbon stock gains occurred (483.0 per cent between 2012 and 2020), which has not been explained in the NIR. The ERT also noted that this increase did not occur in the stock changes reported for the forest biomass pool. During the review, the Party clarified that the increase identified is due to bark beetle degradation affecting mostly the Białowieża forests (north-eastern Poland) and some mountainous regions of the country. The ERT considers that this information explains the increase in the deadwood carbon stock gains from 2012 onward. The ERT recommends that the Party include in the NIR the explanation for the sudden increase in deadwood carbon stock gains after 2012.	L.33	This information (namely information characterising the sudden increase in deadwood carbon stock gains after 2012) will be provided in the NIR in submission 2024 in line to the information provided to the ERT 2022.		section 6.2.4.8
4.A.1 Land converted to forest land – CO ₂	The Party reported in its NIR (chap. 6.2.5.3, pp.245–246) that it used the gain–loss method to calculate CO ₂ removals in the biomass pool for land converted to forest land. It explained how biomass gains were estimated but did not provide any information on how losses were accounted for. During the review, the Party explained that losses were assumed to be zero given that first maintenance cuts are allowed only in age category 20–50 years, as stipulated in the Polish domestic forest silviculture rules to prevent harvest loss in the forests. The ERT agreed with this explanation. The ERT recommends that the Party include in the NIR the justification for assuming that no harvest losses in the biomass pool occur for land converted to forest land.	L.34	This information (namely the justification for assuming that no harvest losses in the biomass pool occur for land converted to forest land) will be provided in the NIR in submission 2024 in line to the information provided to the ERT 2022.		section 6.2.4.8
4.A.2.1 Cropland converted to forest land 4.A.2.2 Grassland converted to forest land– CO ₂	The Party reported in its NIR (chap. 6.3.4.4, pp.253–254) the default carbon stock change factors and the distribution of area per soil type used for calculating CO ₂ emissions and removals from mineral soils for these subcategories. The ERT noted that the Party did not provide in the NIR the assumptions made for the choice of the carbon stock change factors. During the review, Poland clarified that the stock change factors reported in the respective non-forest NIR chapters (e.g. chap. 6.4.4.3, p.260, for grassland) were also used for conversions to forest land. The Party also clarified that it made a mistake in the distribution of area per soil type and that this had an impact on the total emissions from mineral soils in grassland converted to forest land and cropland converted to forest land. Poland also reported two transcription errors: (a) for CO ₂ emissions from biomass in 2020, it mistakenly reported the 2019 CO ₂ emissions value in CRF table 4.A; and (b) for 2020, it mistakenly reported for CO ₂ emissions from grassland converted to forest land (subcategory 4.A.2.2), the same values as those reported under cropland converted to forest land (subcategory 4.A.2.1). In order to correct this, the Party made a formal resubmission of the CRF tables during the review week. The correction reported by the Party for category 4.A in 2020 eliminated the removal overestimation of 11.38 kt C (41.78 kt CO ₂) for land	L.35	This information (namely the information on soil type distribution under grassland reported in the NIR (table 6.13) has been corrected subsequently since the submission 2023.		section 6.4.4.3

CRF category/issue	Review recommendation	Review report/paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
	converted to forest land concerning stock changes in mineral soils and organic soils, the removal overestimation of 61.35 kt C (224.95 kt CO₂) for living biomass in grassland converted to forest land and the removal overestimation of 30.12 kt C (110.43 kt CO₂) for cropland converted to forest land. The ERT agreed with the revised estimates (see ID# KL.7 below). The ERT recommends that the Party correct in the NIR (i.e. table 6.13) the information on soil type distribution under grassland. The ERT also recommends that the Party provide in the NIR an explanation of how stock change factors have been selected and used for relevant conversion categories to forest land.				
4.B.1 Cropland remaining cropland 4.B.2.1 Forest land converted to cropland – CO ₂	Poland reported in its NIR (chap. 6.6.4.1, p.270) an EF of 5 t C/ha/year (to be understood as a negative value for the IEFs) used for the calculation of CO₂ emissions from drained organic soils in cropland remaining cropland, forest land converted to cropland, settlements remaining settlements, and forest land converted to settlements. The ERT noted that in CRF tables 4.B and 4.E, the Party reported an IEF of –1 t C/ha instead, showing an underestimation of CO₂ emissions. During the review week, the Party formally resubmitted the CRF tables for the entire time series using the correct EFs (5 t C/ha/year) for the estimates and reporting resulting emissions in CRF tables 4.B and 4.E. The revised estimates increased CO₂ emissions by 640.14 kt C (2,347.33 kt CO₂) for cropland (remaining and converted to cropland) and 56.82 kt C (208.35 kt CO₂) for settlements (remaining and converted to settlements) in 2020 (the revised values for the complete time series are at a similar level). The ERT agreed with the revised estimates (see ID #KL.8 below). The ERT recommends that Poland provide in the NIR information on the relevant assumptions for the selection of the EFs used for the calculation of CO₂ emissions from drained organic soils in cropland remaining cropland, forest land converted to cropland, settlements remaining settlements and forest land converted to settlements.	L.36	The ERT 2022 recommendation has been fully considered since 2023 submission. Default EF for drained organic soils had been applied.		section 6.3.4.4; section 6.4.4.4
4.D Wetlands – CO ₂	The ERT noted large inter-annual area changes in the category other land for the complete time series (maximum inter-annual change of –36.1 per cent for 2002–2003). The Party reported in its NIR (chap. 6.13, p.225) that fluctuations of the total land area in Poland occur owing to fluctuations in the coastal land areas that are water bodies and rivers at country borders. Poland reports water bodies and coastal land areas that are not regulated under other land with the aim of reporting the total area of the country in a consistent manner. The ERT noted that this is not in accordance with the definition of wetlands and other land categories in the 2006 IPCC Guidelines (vol. 4, chap. 3, p.3.6), which states that water bodies and wetlands, including those that are unregulated, should be reported under unmanaged wetlands. During the review, the Party clarified that all land in the country is considered as managed, based on the provisions stipulated in the Act on Spatial Planning and Development (2003) and, therefore, areas of water bodies and coastal land areas that are not regulated have been reported under other land. The ERT recommends that the Party report all water bodies and wetlands, including those water bodies and coastal land areas that are unregulated, under the category wetlands instead of other land, in accordance with the definition of wetlands and other land categories in the 2006 IPCC Guidelines (vol. 4, chap. 3, p.3.6).	L.37	The ERT 2022 recommendation has been fully considered. 2024 inventory is considering all water bodies and coastal land areas that are unregulated, under the category wetlands instead of other land, in accordance with the definition of wetlands and other land categories in the 2006 IPCC Guidelines (vol. 4, chap. 3, p.3.6). Furthermore, Poland has introduced slight change in the country's area associated to the adjustment of the borders of territorial units to the baseline of the territorial sea. This adjustment is resulting from the regulation of the Council of Ministers of January 13, 2017 on the detailed course of the baseline, the external border of the territorial sea and the external border of the contiguous zone of		section 6.1

CRF category/issue	Review recommendation	Review report/ paragraph	MS response/status of implementation	Reason for non-implementation	Chapter/section in the NIR
			the Republic of Poland (Journal of Laws, item 183). As a result of the implementation of the above-mentioned regulation provisions appropriate changes to the register of land and buildings has been introduced. Changes in this respect were made in 2022 and mainly consisted in including the Bay of Puck and part of the Bay of Gdańsk into internal marine waters, dividing these waters and assigning them in the EGIB (Official land cadaster data base) to the territorial division units adjacent to them.		
4(II) Emissions/removals from drainage and rewetting and other management of organic/mineral soils – N ₂ O	Poland reported in its NIR (chap. 6.5.4, pp.264–267) the use of default EF values with equation 7.6 for N-rich and N-poor soils and other default parameters of the 2006 IPCC Guidelines (vol. 4, chap. 7, pp.7.9–7.16) for estimating N ₂ O emissions from drained soils. However, the ERT noted that the Party reported N ₂ O emissions from drainage and rewetting as “NA” in CRF table 4(II). During the review, the Party clarified that it is looking into the impact of the N-enriched organic soil types from the Spatial Information System on Polish Wetlands/GIS Mokradla (http://www.gis-mokradla.info/html/index.php?page=mokradla) and that preliminary results will be reflected in the CRF tables of the 2023 annual submission. The ERT recommends that the Party report N ₂ O emissions from drainage and rewetting of organic soils in CRF table 4(II) in accordance with the UNFCCC Annex I inventory reporting guidelines, under which reporting of direct N ₂ O emissions from drainage of soils is mandatory.	L.38	Issue under consideration. In the 2024 submission Poland will clarify its assumption that all forest soils under forest management are not drained, thus not leading to N ₂ O emissions from drainage. Evidences proving prevention of the draining of forest soils (such as legal constraints) will be provided in NIR 2024, section 6.4		section 6.4
Waste					
5.D.2 Industrial wastewater – CH ₄	The ERT noted that CH ₄ emission estimates for category 5.D.2 industrial wastewater were calculated using the tier 1 method from the 2006 IPCC Guidelines (vol. 5, chap. 6.2.3.1, p.6.20) despite the fact that this is a key category. During the review, the Party indicated that the decision to apply the tier 1 method to estimate CH ₄ emissions was made because country-specific data were not available. The ERT notes that the use of a tier 1 method to estimate CH ₄ emissions for this category does not lead to an underestimation of emissions. The ERT recommends that the Party collect national COD data and outflow data for each relevant industrial activity in the country and report corresponding CH ₄ emission estimates for this key category in accordance with the guidance in the 2006 IPCC Guidelines (vol. 5, chap. 6.2.3.1, p.6.19).	W.8	Party noted that 5D2 in fact is not key category, as CH ₄ emissions are lower than emissions from 5B1, and are less than 0.09% of total emissions (CO ₂ eq). Analysis on EF and AD applied in inventory of CH ₄ emissions from 5D2 are planned in further future. In 2025 submission MS applied 2019 IPCC GL Refinement, and noted Tier 2 methodology in NID 2025 because of application CS source of AD and EFs.	emissions from this source are insignificant as amounted to 0.09% of total GHG emission (in 2024 submission)	section 7.5.2.2

ABBREVIATIONS

AL	Agricultural Land
AR	Afforestation/Reforestation
AR 5	IPCC Fifth Assessment report on climate change
AWMS	Animal waste management system
BEF	Biomass expansion factor (LULUCF)
BOD	Biochemical Oxygen Demand
CBDK	Central Database of Equine
CEP	Climate and Energy Package
COD	Chemical Oxygen Demand
CRF	Common reporting format
D	Deforestation
DOC	Degradable organic component
DW	Dead wood
ERT	Expert Review Team
FM	Forest management
GHG	Greenhouse Gases
GUS	Statistics Poland
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
HWP	Harvested wood products
IE	Included elsewhere
KOBIZE	National Centre for Emissions Management
LT	Litter
LULUCF	Land use, land-use change and forestry
MCF	Methane correction factor (Waste)
MCF	Methane Conversion Factor (Agriculture)
MSW	Municipal solid waste
NA	Not applicable
NE	Not estimated
NO	Not occurring
NMVOC	Non-methane volatile organic compounds
PFCs	Perfluorocarbons
SOC	Soil organic carbon
SWDS	Solid waste disposal site
TC	Technical correction

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Annex 1. Key categories in 2024

The source/sink categories in all sectors, are identified to be key categories, on the basis of their contribution to the total level and/or trend assessment. The methodology of reporting key categories is based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Approach 1. Additionally, qualitative method is used to indentify key categories.

Poland's key category analysis guides the inventory preparation and is used to set priorities for the development of more advanced methodologies. In 2024, 30 sources were identified as Poland's key categories excluding LULUCF and 39 including LULUCF, while in 1988 - 22 and 26 respectively with the application of quantitative and qualitative approach.

The biggest contributors of the GHG emissions (without sector LULUCF) identified as key categories in level assessment analysis in 2024 are:

1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO ₂
1.A.3.b Road Transportation	CO ₂
1.A.4 Other Sectors - Solid Fuels	CO ₂

Emission from abovementioned sources made up to 55.89% of the total GHG emissions in Poland expressed in units of CO₂ equivalents.

The biggest contributors of the GHG emissions in trend assessment (without sector LULUCF) in 2024 are categories:

1.A.3.b Road Transportation	CO ₂
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO ₂
1.A.4 Other Sectors - Solid Fuels	CO ₂

Share of these sources made up to 55.89% of the total GHG emissions in Poland (CO₂ equivalent).

As a result of analysis with use of qualitative criteria no additional categories were identified as key categories.

The following tables present results of Key Category Analysis under UNFCCC inventory for year 1988 and current year of inventory.

Summary of key category analysis with sector LULUCF in 2024

No.	IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)			Comments
1	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	L	T		
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	L			
3	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	L	T		
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	L	T		
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	L			
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	L	T		
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	L	T		
8	1.A.3.b Road Transportation	CO2	L	T		
9	1.A.3.c Railways	CO2		T		
10	1.A.4 Other Sectors - Biomass	CH4	L	T		
11	1.A.4 Other Sectors - Gaseous Fuels	CO2	L	T		
12	1.A.4 Other Sectors - Liquid Fuels	CO2	L	T		
13	1.A.4 Other Sectors - Solid Fuels	CO2	L	T		
14	1.A.4 Other Sectors - Solid Fuels	CH4		T		
15	1.B.1 Fugitive emissions from Solid Fuels	CH4	L	T		
16	1.B.1 Fugitive emissions from Solid Fuels	CO2	L			
17	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	L	T		
18	2.A.1 Cement Production	CO2	L	T		
19	2.A.2 Lime Production	CO2		T		
20	2.A.4 Other Process Uses of Carbonates	CO2	L	T		
21	2.B.1 Ammonia Production	CO2	L			
22	2.B.2 Nitric Acid Production	N2O		T		
23	2.C.1 Iron and Steel Production	CO2		T		
24	2.F.1 Refrigeration and Air conditioning	F-gases	L	T		
25	3.A Enteric Fermentation	CH4	L			
26	3.B Manure Management	N2O	L			
27	3.B Manure Management	CH4	L			
28	3.D.1 Direct N2O Emissions From Managed Soils	N2O	L	T		
29	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	L			
30	4.A.1 Forest Land Remaining Forest Land	CO2	L	T		
31	4.A.2 Land Converted to Forest Land	CO2	L	T		
32	4.B.1 Cropland Remaining Cropland	CO2	L			
33	4.B.1 Cropland Remaining Cropland	CO2		T		
34	4.D.2 Land Converted to Wetlands	CO2		T		
35	4.E.2 Land Converted to Settlements	CO2	L	T		
36	4.E.2 Land Converted to Settlements	N2O	L	T		
37	4.G Harvested Wood Products	CO2	L	T		
38	5.A Solid Waste Disposal	CH4		T		
39	5.D Wastewater Treatment and Discharge	CH4	L			

Summary of key category analysis with sector LULUCF in 1988

No.	IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)			Comments
1	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	L			
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	L			
3	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	L			
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	L			
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	L			
6	1.A.3.b Road Transportation	CO2	L			
7	1.A.3.c Railways	CO2	L			
8	1.A.4 Other Sectors - Gaseous Fuels	CO2	L			
9	1.A.4 Other Sectors - Liquid Fuels	CO2	L			
10	1.A.4 Other Sectors - Solid Fuels	CO2	L			
11	1.A.4 Other Sectors - Solid Fuels	CH4	L			
12	1.B.1 Fugitive emissions from Solid Fuels	CH4	L			
13	1.B.1 Fugitive emissions from Solid Fuels	CO2	L			
14	2.A.1 Cement Production	CO2	L			
15	2.A.2 Lime Production	CO2	L			
16	2.B.1 Ammonia Production	CO2	L			
17	2.B.2 Nitric Acid Production	N2O	L			
18	2.C.1 Iron and Steel Production	CO2	L			
19	3.A Enteric Fermentation	CH4	L			
20	3.B Manure Management	N2O	L			
21	3.D.1 Direct N2O Emissions From Managed Soils	N2O	L			
22	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	L			
23	4.A.1 Forest Land Remaining Forest Land	CO2	L			
24	4.B.1 Cropland Remaining Cropland	CO2	L			
25	5.A Solid Waste Disposal	CH4	L			
26	5.D Wastewater Treatment and Discharge	CH4	L			

Summary of key category analysis without sector LULUCF in 2024

No.	IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)			Comments
1	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	L	T		
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	L			
3	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	L	T		
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	L	T		
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	L			
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	L	T		
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	L	T		
8	1.A.3.b Road Transportation	CO2	L	T		
9	1.A.3.c Railways	CO2		T		
10	1.A.4 Other Sectors - Biomass	CH4	L	T		
11	1.A.4 Other Sectors - Gaseous Fuels	CO2	L	T		
12	1.A.4 Other Sectors - Liquid Fuels	CO2	L	T		
13	1.A.4 Other Sectors - Solid Fuels	CO2	L	T		
14	1.A.4 Other Sectors - Solid Fuels	CH4		T		
15	1.B.1 Fugitive emissions from Solid Fuels	CH4	L	T		
16	1.B.1 Fugitive emissions from Solid Fuels	CO2	L			
17	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	L	T		
18	2.A.1 Cement Production	CO2	L	T		
19	2.A.4 Other Process Uses of Carbonates	CO2	L	T		
20	2.B.1 Ammonia Production	CO2	L			
21	2.B.2 Nitric Acid Production	N2O		T		
22	2.C.1 Iron and Steel Production	CO2		T		
23	2.F.1 Refrigeration and Air conditioning	F-gases	L	T		
24	3.A Enteric Fermentation	CH4	L	T		
25	3.B Manure Management	N2O	L			
26	3.B Manure Management	CH4	L			
27	3.D.1 Direct N2O Emissions From Managed Soils	N2O	L	T		
28	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	L			
29	5.A Solid Waste Disposal	CH4		T		
30	5.D Wastewater Treatment and Discharge	CH4	L			

Summary of key category analysis without sector LULUCF in 1988

No.	IPCC Source Categories	GHG	Identification criteria (Level, Trend, Qualitative)			Comments
1	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	L			
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	L			
3	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	L			
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	L			
5	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	L			
6	1.A.3.b Road Transportation	CO2	L			
7	1.A.4 Other Sectors - Gaseous Fuels	CO2	L			
8	1.A.4 Other Sectors - Liquid Fuels	CO2	L			
9	1.A.4 Other Sectors - Solid Fuels	CO2	L			
10	1.A.4 Other Sectors - Solid Fuels	CH4	L			
11	1.B.1 Fugitive emissions from Solid Fuels	CH4	L			
12	1.B.1 Fugitive emissions from Solid Fuels	CO2	L			
13	2.A.1 Cement Production	CO2	L			
14	2.B.1 Ammonia Production	CO2	L			
15	2.B.2 Nitric Acid Production	N2O	L			
16	2.C.1 Iron and Steel Production	CO2	L			
17	3.A Enteric Fermentation	CH4	L			
18	3.B Manure Management	N2O	L			
19	3.D.1 Direct N2O Emissions From Managed Soils	N2O	L			
20	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	L			
21	5.A Solid Waste Disposal	CH4	L			
22	5.D Wastewater Treatment and Discharge	CH4	L			

Level assessment without sector LULUCF in 2024

KEY CATEGORIES OF EMISSIONS AND REMOVALS		GHG	Level Assessment	Cumulative Total
1	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	0.309	0.309
2	1.A.3.b Road Transportation	CO2	0.202	0.511
3	1.A.4 Other Sectors - Solid Fuels	CO2	0.048	0.559
4	3.A Enteric Fermentation	CH4	0.044	0.603
5	1.B.1 Fugitive emissions from Solid Fuels	CH4	0.040	0.642
6	1.A.4 Other Sectors - Gaseous Fuels	CO2	0.039	0.681
7	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	0.037	0.719
8	3.D.1 Direct N2O Emissions From Managed Soils	N2O	0.033	0.752
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	0.029	0.781
10	1.A.4 Other Sectors - Liquid Fuels	CO2	0.028	0.809
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0.027	0.836
12	2.A.1 Cement Production	CO2	0.019	0.855
13	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	0.013	0.868
14	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	0.012	0.880
15	2.F.1 Refrigeration and Air conditioning	F-gases	0.010	0.890
16	2.B.1 Ammonia Production	CO2	0.009	0.900
17	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	0.008	0.907
18	3.B Manure Management	N2O	0.008	0.915
19	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	0.007	0.922
20	2.A.4 Other Process Uses of Carbonates	CO2	0.006	0.927
21	5.D Wastewater Treatment and Discharge	CH4	0.006	0.933
22	1.B.1 Fugitive emissions from Solid Fuels	CO2	0.005	0.938
23	1.A.4 Other Sectors - Biomass	CH4	0.005	0.943
24	3.B Manure Management	CH4	0.005	0.948
25	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	0.005	0.953

Level assessment without sector LULUCF in 1988

KEY CATEGORIES OF EMISSIONS AND REMOVALS		GHG	Level Assessment	Cumulative Total
1	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	0.424	0.424
2	1.A.4 Other Sectors - Solid Fuels	CO2	0.157	0.581
3	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	0.069	0.649
4	1.B.1 Fugitive emissions from Solid Fuels	CH4	0.046	0.695
5	3.A Enteric Fermentation	CH4	0.039	0.734
6	1.A.3.b Road Transportation	CO2	0.036	0.770
7	5.A Solid Waste Disposal	CH4	0.026	0.796
8	3.D.1 Direct N2O Emissions From Managed Soils	N2O	0.026	0.823
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0.013	0.836
10	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	0.013	0.849
11	2.A.1 Cement Production	CO2	0.012	0.861
12	2.C.1 Iron and Steel Production	CO2	0.012	0.873
13	1.A.4 Other Sectors - Gaseous Fuels	CO2	0.011	0.884
14	1.A.4 Other Sectors - Solid Fuels	CH4	0.009	0.894
15	1.A.4 Other Sectors - Liquid Fuels	CO2	0.009	0.903
16	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	0.009	0.911
17	1.B.1 Fugitive emissions from Solid Fuels	CO2	0.007	0.918
18	5.D Wastewater Treatment and Discharge	CH4	0.007	0.925
19	2.B.1 Ammonia Production	CO2	0.007	0.932
20	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	0.007	0.938
21	2.B.2 Nitric Acid Production	N2O	0.006	0.945
22	3.B Manure Management	N2O	0.006	0.951

Level assessment with sector LULUCF in 2024

KEY CATEGORIES OF EMISSIONS AND REMOVALS		GHG	Level Assessment	Cumulative Total
1	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	0.262	0.262
2	1.A.3.b Road Transportation	CO2	0.171	0.432
3	4.A.1 Forest Land Remaining Forest Land	CO2	0.079	0.511
4	1.A.4 Other Sectors - Solid Fuels	CO2	0.041	0.552
5	3.A Enteric Fermentation	CH4	0.037	0.589
6	1.B.1 Fugitive emissions from Solid Fuels	CH4	0.033	0.623
7	1.A.4 Other Sectors - Gaseous Fuels	CO2	0.033	0.656
8	4.E.2 Land Converted to Settlements	CO2	0.032	0.688
9	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	0.032	0.719
10	3.D.1 Direct N2O Emissions From Managed Soils	N2O	0.028	0.747
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	0.025	0.772
12	1.A.4 Other Sectors - Liquid Fuels	CO2	0.024	0.796
13	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0.023	0.819
14	2.A.1 Cement Production	CO2	0.016	0.835
15	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	0.011	0.845
16	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	0.010	0.856
17	4.B.1 Cropland Remaining Cropland	CO2	0.010	0.866
18	4.G Harvested Wood Products	CO2	0.009	0.875
19	2.F.1 Refrigeration and Air conditioning	F-gases	0.009	0.884
20	4.A.2 Land Converted to Forest Land	CO2	0.009	0.893
21	2.B.1 Ammonia Production	CO2	0.008	0.900
22	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	0.006	0.907
23	3.B Manure Management	N2O	0.006	0.913
24	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	0.006	0.919
25	4.E.2 Land Converted to Settlements	N2O	0.006	0.924
26	2.A.4 Other Process Uses of Carbonates	CO2	0.005	0.929
27	5.D Wastewater Treatment and Discharge	CH4	0.005	0.934
28	1.B.1 Fugitive emissions from Solid Fuels	CO2	0.004	0.939
29	1.A.4 Other Sectors - Biomass	CH4	0.004	0.943
30	3.B Manure Management	CH4	0.004	0.947
31	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	0.004	0.951

Level assessment with sector LULUCF in 1988

KEY CATEGORIES OF EMISSIONS AND REMOVALS		GHG	Level Assessment	Cumulative Total
1	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	0.385	0.385
2	1.A.4 Other Sectors - Solid Fuels	CO2	0.143	0.528
3	4.A.1 Forest Land Remaining Forest Land	CO2	0.069	0.597
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	0.063	0.660
5	1.B.1 Fugitive emissions from Solid Fuels	CH4	0.042	0.702
6	3.A Enteric Fermentation	CH4	0.035	0.737
7	1.A.3.b Road Transportation	CO2	0.033	0.770
8	5.A Solid Waste Disposal	CH4	0.024	0.793
9	3.D.1 Direct N2O Emissions From Managed Soils	N2O	0.024	0.817
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0.012	0.829
11	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	0.012	0.841
12	2.A.1 Cement Production	CO2	0.011	0.853
13	2.C.1 Iron and Steel Production	CO2	0.011	0.863
14	1.A.4 Other Sectors - Gaseous Fuels	CO2	0.010	0.873
15	1.A.4 Other Sectors - Solid Fuels	CH4	0.009	0.882
16	1.A.4 Other Sectors - Liquid Fuels	CO2	0.008	0.890
17	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	0.008	0.898
18	4.B.1 Cropland Remaining Cropland	CO2	0.007	0.905
19	1.B.1 Fugitive emissions from Solid Fuels	CO2	0.006	0.911
20	5.D Wastewater Treatment and Discharge	CH4	0.006	0.918
21	2.B.1 Ammonia Production	CO2	0.006	0.924
22	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	0.006	0.930
23	2.B.2 Nitric Acid Production	N2O	0.006	0.936
24	3.B Manure Management	N2O	0.006	0.942
25	2.A.2 Lime Production	CO2	0.005	0.947
26	1.A.3.c Railways	CO2	0.004	0.951

Trend assessment without sector LULUCF in 2024

KEY CATEGORIES OF EMISSIONS AND REMOVALS		GHG	Trend Assessment	Cumulative Total
1	1.A.3.b Road Transportation	CO2	0.281	0.251
2	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	0.194	0.426
3	1.A.4 Other Sectors - Solid Fuels	CO2	0.185	0.591
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	0.067	0.651
5	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	0.057	0.702
6	1.A.4 Other Sectors - Gaseous Fuels	CO2	0.047	0.744
7	5.A Solid Waste Disposal	CH4	0.040	0.780
8	1.A.4 Other Sectors - Liquid Fuels	CO2	0.032	0.809
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0.023	0.829
10	2.F.1 Refrigeration and Air conditioning	F-gases	0.018	0.845
11	2.C.1 Iron and Steel Production	CO2	0.014	0.858
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	0.014	0.871
13	2.A.1 Cement Production	CO2	0.012	0.881
14	3.D.1 Direct N2O Emissions From Managed Soils	N2O	0.012	0.892
15	1.B.1 Fugitive emissions from Solid Fuels	CH4	0.011	0.901
16	1.A.4 Other Sectors - Solid Fuels	CH4	0.009	0.910
17	2.B.2 Nitric Acid Production	N2O	0.009	0.918
18	3.A Enteric Fermentation	CH4	0.009	0.925
19	1.A.4 Other Sectors - Biomass	CH4	0.008	0.933
20	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	0.008	0.939
21	2.A.4 Other Process Uses of Carbonates	CO2	0.008	0.946
22	1.A.3.c Railways	CO2	0.007	0.952

Trend assessment with sector LULUCF in 2024

KEY CATEGORIES OF EMISSIONS AND REMOVALS		GHG	Trend Assessment	Cumulative Total
1	1.A.3.b Road Transportation	CO2	0.218	0.208
2	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	0.196	0.394
3	1.A.4 Other Sectors - Solid Fuels	CO2	0.162	0.548
4	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	0.059	0.605
5	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	0.045	0.648
6	4.E.2 Land Converted to Settlements	CO2	0.045	0.690
7	1.A.4 Other Sectors - Gaseous Fuels	CO2	0.036	0.725
8	5.A Solid Waste Disposal	CH4	0.034	0.757
9	1.A.4 Other Sectors - Liquid Fuels	CO2	0.024	0.781
10	4.A.1 Forest Land Remaining Forest Land	CO2	0.017	0.797
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0.017	0.813
12	2.F.1 Refrigeration and Air conditioning	F-gases	0.014	0.826
13	1.B.1 Fugitive emissions from Solid Fuels	CH4	0.013	0.839
14	2.C.1 Iron and Steel Production	CO2	0.013	0.851
15	4.G Harvested Wood Products	CO2	0.012	0.862
16	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	0.010	0.872
17	1.A.4 Other Sectors - Solid Fuels	CH4	0.008	0.880
18	2.A.1 Cement Production	CO2	0.008	0.887
19	2.B.2 Nitric Acid Production	N2O	0.008	0.895
20	4.E.2 Land Converted to Settlements	N2O	0.007	0.902
21	4.A.2 Land Converted to Forest Land	CO2	0.007	0.908
22	3.D.1 Direct N2O Emissions From Managed Soils	N2O	0.006	0.915
23	1.A.4 Other Sectors - Biomass	CH4	0.006	0.920
24	1.B.2.d Fugitive Emissions from Fuels - Other	CO2	0.006	0.926
25	1.A.3.c Railways	CO2	0.006	0.932
26	2.A.4 Other Process Uses of Carbonates	CO2	0.006	0.937
27	4.D.2 Land Converted to Wetlands	CO2	0.005	0.942
28	2.A.2 Lime Production	CO2	0.004	0.947
29	4.B.1 Cropland Remaining Cropland	CO2	0.004	0.951

Annex 2. Uncertainty assessment of the 2024 inventory

Uncertainty analysis for the year 2024 was performed with use of Approach 1 provided in 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Chosen methodology is based on the assumptions that every value is independent (there is no correlation between values) and probability of underestimation and overestimation is the same.

Conclusions from the previous centralized reviews and in-country review in 2013 were taken into account.

Latest major changes applied to uncertainties follow the changes in estimation methodology and new revised classification in CRT reporting tables. Uncertainty calculation model was extended to provide separate result for assessments including and excluding LULUCF sector. Another improvement triggered by ERT recommendation was calculation of overall uncertainty of inventory including information about uncertainties involved in estimation of Global Warming Potentials.

Additionally, since submission 2015 was provided uncertainty analysis of emission trend with use of 1988 emission inventory as a base year.

Since submission 2023 indirect emission from solvents use is excluded from IPPU sector and reported separately as indirect emission. Uncertainty analysis for base year and latest reported year takes into account indirect emission when estimating total uncertainty of the inventory.

Uncertainty analysis for industrial gases for HFC, PFC and SF6 was significantly improved in submission 2018, in response to recommendations of the previous UNFCCC reviews. Previously uncertainty assumptions were applied directly to emission values of each pollutant due to lack of available information. Present calculation model was revised and extended to include uncertainties applied to activity data and emission factors. Uncertainty assessment is now performed taking into account information given on for different subcategories and single f-gases. Uncertainty is also assessed separately for manufacture, operating and decommissioning of f-gases containing equipment. Some of the assumptions for uncertainty of activity data were revised in submission 2018 and 2019.

Since submission 2023 overall results expressed in CO2 equivalent are estimated using GWP potential given in IPCC 5th Assessment Report. To ensure consistency with the approach taken in the NIR uncertainty assessment model for f-gases covers complete set of categories resulting in emission of gases (2.C Metal production, 2.F Product uses as substitutes for ODS and 2.G. Other product manufacture and use). No NF3 emission sources were identified in Poland thus, it was excluded from the analysis.

General approach

First stage of the estimates was to assign uncertainty to each activity data and emission factor. Next step was to estimate error propagation and its influence on national total emissions. To

estimate error propagation from activity and emission factor to emission values, formula (1) was used.

$$U_{\text{emission}} = \text{square root } (U_{\text{act}}^2 + U_{\text{EF}}^2) \quad (1)$$

where: U_{emission} – uncertainty of emission value

U_{act} – uncertainty of activity value

U_{ef} – uncertainty of emission factor value

To estimate error propagation from sectoral emissions to national total, formula (2) was used

$$U_{\text{emission}} = \text{square root } (\sum (\text{Emission} * U_{\text{emission}})^2) / \sum \text{Emission} \quad (2)$$

where: U_{emission} – uncertainty of emission value in sector

Emission – emission from sector

As the base bottom level of analysis the following sectors were chosen:

- sector 1. *Energy*: categories on levels 1.A.1, 1.A.2, 1.A.3, 1.A.4, 1.A.5 with disaggregation by fuel type (liquid, solid, gaseous, biomass etc.)
- sector 2. *IPPU*: subcategories 2.A.1, 2.A.2... 2.C.3
- sector 3. *Agriculture*: subcategories 3.A.1, 3.A.2... 3.F.5 with further disaggregation
- sector 4. *LULUCF*: main subcategories 4.A, 4.B... 4.E
- sector 5. *Waste*: 5.A.1, 5.A.2; 5.B with further disaggregation

Most of the estimates were based on default assumption described in methodology, but after investigation of socio-economic parameters literature data was applied to selected activities in sector 1. *Energy* and for activities and emission factors in sector 2. *Industrial processes and product use*.

Results of analysis of error propagation of uncertainty of national totals for 2024 were shown below:

	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆	All GHG recalculated to CO ₂ eq.
Total uncertainty Including IPCC 4. LULUCF	5.2%	22.2%	40.2%	11.7%	20.6%	5.7%	5.7%
Emission recalculated to CO₂ eq [kt] Including IPCC 4. LULUCF and indirect emission	251 317.61	37 726.76	23 511.75	3 717.21	8.64	128.72	316 410.70
Total uncertainty Excluding IPCC 4. LULUCF	1.9%	22.2%	44.7%	11.7%	20.6%	5.7%	4.0%
Emission recalculated to CO₂ eq [kt] Excluding IPCC 4. LULUCF and including indirect emission	278 945.43	37 715.50	20 518.20	3 717.21	8.64	128.72	341 033.71

Activity data

Most uncertain values of activity were assigned in category 3.F *Agriculture/Field Burning of Agricultural Residues* and in 5.B *Waste/Domestic and Commercial Wastewater* (30%). Lowest uncertainty values were assigned to 1.A.1 *Energy/ Fuel Combustion*, especially in subsector 1.A.1 *Energy Industries* (2%,). In general Polish energy sector is responsible for 90% of GHG emission and is covered with detailed national statistics, which allows to keep overall uncertainty of inventory at low level.

CO₂ emission factors

Most uncertain values for CO₂ emission factors were assigned in sector 4.G *LULUCF/Other* (30%), 2.A.4 *Mineral industry/Other* (15%) and 2.C *Metal Industry* (10%), the most precise values were reported in 1.A *Fuel Combustion* (1-2%).

Low level of uncertainty of national total of CO₂ (1.9%) comes from the fact, that major part of emission comes from sector 1.A *Fuel Combustion* where input data for activities and factors is the most precise (relatively 1-5% and 1-3%, excluding biomass).

CH₄ emission factors

Most uncertain values for CH₄ emission factors were assigned in sector 5.A *Solid Waste Disposal* (100%), 5.B *Biological treatment of solid waste* (100%), 1.B *Fugitive Emission from fuels* (50%), 3.A *Enteric Fermentation* and 3.B *Manure Management* (50%). The most precise values were identified in 1.A *Energy/Fuel Combustion* (10-24%), 2. *Industrial Processes and Product Use* (20%) and 3.F *Field Burning of Agricultural Residues* (20%). In 2009 new sources were included to analysis in 2.C *Metal Production (sinter, electric furnaces, pig iron and basic oxygen furnaces)* as a result of incorporating to national emission inventories data from reporting for EU Emission Trading Scheme.

Uncertainty of CH₄ emission is app. 21.5% which is result of share of agriculture and waste sectors in national totals – emission factors in those sectors have high relatively uncertainty.

N₂O emission factors

Most uncertain values for N₂O emission factors were assigned in sector 3.D *Agricultural Soils* (150%), 3.F *Agriculture/Field Burning of Agricultural Residues* (150%) and in 3.B *Manure management* (100%), most precise values were applied in sector 1.A *Energy/Fuel combustion* for liquid fuels (20%). Data available from polish part of EU Emission Trading Scheme reporting were taken into account during this analysis with relatively low uncertainty.

Highest value of uncertainty of national total was identified for N₂O (44.6%) and is a result of high uncertainty of the emission factors in most contributing sector of *Agriculture*.

Industrial Gases

As mentioned in introduction to this annex, uncertainty assessment model for f-gases was redesigned and extended to cover subcategories, f-gases types, and circumstances of occurring of the emission (production, operation and decommissioning of equipment). Results of the

analysis are presented by category and by gas in tables below. More details on assumptions applied are given in the detailed table on next pages. Some of the assumptions regarding uncertainty of the activity data were revised to better reflect national circumstances – in result uncertainty of the f-gases slightly increased. According to new model results lowest uncertainty was identified for manufacturing activities and the highest one for decommissioning, what is in line with observation of the national market.

Uncertainty of f-gases by categories	From manufacturing	From stocks	From disposal	Total	Contributing f-gases
TOTAL	4.20%	11.40%	26.66%	11.27%	HFC, PFC, SF₆
C. Metal production	-	-	-	-	SF ₆
F. Product uses as substitutes for ODS	2.93%	11.71%	26.66%	11.67%	HFC, PFC
G. Other product manufacture and use	5.39%	7.07%	-	5.69%	SF ₆

Uncertainty of f-gases by gases	From manufacturing	From stocks	From disposal	Total	Contributing categories
TOTAL	4.20%	11.40%	26.66%	11.27%	2.C, 2.F, 2.G
HFCs	2.96%	11.78%	26.66%	11.73%	2.F
PFCs	2.83%	20.62%	18.03%	20.62%	2.C, 2.F
SF₆	5.39%	7.07%	11.18%	5.69%	2.C, 2.G

Uncertainty introduced into the trend in total national emissions

In response to previous review recommendations uncertainty analysis is now providing information on uncertainty introduced into the trend in total national emissions. First step of the analysis was assessing of level uncertainty introduced to national total in base year (1988). Methodology used to assess trend uncertainties is the same as mentioned for analysis for latest reported year. Results of level uncertainty analysis for base year with and without IPCC 4. LULUCF are presented below.

Base year	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆	All GHG recalculated to CO ₂ eq.
Total uncertainty Including IPCC 4. LULUCF	4.1%	23.9%	39.1%		5.4%		5.3%
Emission recalculated to CO₂ eq [kt] Including IPCC 4. LULUCF and indirect emission	423 022.49	77 955.32	31 499.82		0.00		532 477.62
Total uncertainty Excluding IPCC 4. LULUCF	2.0%	23.9%	40.7%		5.4%		4.2%
Emission recalculated to CO₂ eq [kt] Excluding IPCC 4. LULUCF and including indirect emission	471 590.23	77 900.23	30 204.53		0.00		579 694.98

On the basis of results of analysis made for the base year and latest reported year analysis for trend was done and results are presented below:

	CO ₂	CH ₄	N ₂ O
Trend uncertainty with IPCC 4. <i>LULUCF</i>	1.24%	1.20%	2.30%
Trend uncertainty without IPCC 4. <i>LULUCF</i>	1.06%	1.20%	2.24%

Uncertainty related to IPCC Sector 4. *LULUCF*

Methodology used for this assessment were based on the “IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories”, but also takes into account additional information given in the chapter 2.4.3 of the “IPCC 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol” and in the chapter 5.2 of the “IPCC Good Practice Guidance for LULUCF”

One of the main assumption of the applied approach was to be consistent with with sector IPCC 3. *Agriculture*.

Assumptions for the main LULUCF category 4.A *Forest Land* were based on the study made among EU countries (Laitat et al., 2000) where reported uncertainty vary between 1-15%. Regarding CO₂ emission factor GPG for LULUCF gives uncertainty varying between 10-50% (Chapter 3.2.1.1.1.4, p.3.50; Chapter 3.2.2.1.1.4, page 3.56). After analysis Poland decided to apply 5% uncertainty for activity data and 30% for CO₂ emission factor. Regarding non-CO₂ emissions GPG for LULUCF suggests to apply 70% uncertainty for emission factors (Chapter 3.2.1.4.2.4, page 3.50).

In category 4.B *Cropland* Poland applied default uncertainty for CO₂ emission factor given in GPG for LULUCF, which is 75% (Chapter 3.3.1.1.1.4, page 3.73).

For category 4.C *Grassland* uncertainty for CO₂ emission factor (75%) was applied on the basis of the default data given in table 3.4.2 of the IPCC GPG for LULUCF (Chapter 3.4.1.1.1.2, page 3.109)

Regarding category 4.D *Wetland* – 75% uncertainty of CO₂ emission factor was based on information on default uncertainty for that category given in IPCC GPG for LULUCF (Chapter 3.5.2.1.1.4., page 3.139)

4.E *Settlements* – second contributing category in the LULUCF sector, where following the instruction given in chapter 3.6.2 of IPCC GPG for LULUCF – the same approach as taken in category 4.A *Forest Land* was introduced. Thus applied assumption are 5% for activity data and 30% for emission factors.

Regarding Harvested Wood Product reported in category 4.G *Other* – assumptions for the CO₂ emission factor uncertainty (50%) were made on the basis of information given in table 3.A.1.4 in the chapter 3.A.1.3 (page 3.268) of the IPCC GPG for LULUCF.

Use of uncertainty analysis results to improve inventory process

Results of uncertainty analysis are evaluated with regard to finding potential for further improvements in the inventory process. To identify areas for potential improvement uncertainty analysis is investigated together with key category analysis – this approach allows to prioritize the needs their importance. As a result of this process Poland identified category

2.F.1 *Refrigeration and air conditioning equipment*, which has potential for future improvement and according to key category analysis has relatively high share in total emission. Depending on the availability of budget selected category will be subject to further investigation.

Planned improvements for next years

- improving accuracy of estimates for industrial gases

GHG inventory 2024 – Uncertainty analysis, part 1, sector IPCC 1. Energy

2024	Activity [TJ]	Activity uncertainty [%]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [kt]	CH4 [kt]	N2O [kt]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [kt]	CH4 Emission absolute uncertainty [kt]	N2O Emission absolute uncertainty [kt]
TOTAL (without LULUCF, including indirect emission)						278 945.43	1 346.98	77.43	1.9%	22.2%	44.7%	5 313.14	299.54	34.60
TOTAL (with LULUCF, including indirect emission)						251 317.61	1 347.38	88.72	5.2%	22.2%	40.2%	13 063.32	299.54	35.67
1. Energy						261 282.93	641.90	8.58	2.0%	34.8%	11.1%	5272.87	223.26	0.96
A. Fuel Combustion						257 832.83	122.15	8.58	2.0%	14.4%	11.1%	5263.43	17.65	0.96
1. Energy Industries						123 432.94	1.09	1.89	2.4%	9.5%	28.6%	2998.19	0.10	0.54
Liquid Fuels	62 038	2.0%	1.0%	10.0%	20.0%	4 316.01	0.14	0.03	2.2%	10.2%	20.1%	96.51	0.01	0.01
Solid Fuels	1 065 653	2.0%	2.0%	13.5%	35.0%	105 441.99	0.25	1.51	2.8%	13.6%	35.1%	2982.35	0.03	0.53
Gaseous Fuels	226 622	2.0%	1.0%	17.0%	40.0%	12 705.42	0.23	0.02	2.2%	17.1%	40.0%	284.10	0.04	0.01
Other fossil fuels	9 852	5.0%	5.0%	25.0%	75.0%	969.52	0.30	0.04	7.1%	25.5%	75.2%	68.56	0.08	0.03
Peat	NO					NO	NO	NO						
Biomass	86 603	10.0%	5.0%	24.0%	37.0%	8 953.50	0.18	0.30	11.2%	26.0%	38.3%	1001.03	0.05	0.11
2. Manufacturing Industries and Construction						25 689.92	3.97	0.54	2.4%	13.1%	26.8%	606.31	0.52	0.14
Liquid Fuels	34 186	3.0%	1.0%	10.0%	20.0%	2 313.31	0.06	0.01	3.2%	10.4%	20.2%	73.15	0.01	0.00
Solid Fuels	94 675	3.0%	2.0%	13.5%	35.0%	10 035.16	0.82	0.12	3.6%	13.8%	35.1%	361.82	0.11	0.04
Gaseous Fuels	163 275	4.0%	1.0%	17.0%	40.0%	9 153.92	0.16	0.02	4.1%	17.5%	40.2%	377.43	0.03	0.01
Other fossil fuels	30 858	5.0%	5.0%	25.0%	75.0%	4 187.53	0.93	0.12	7.1%	25.5%	75.2%	296.10	0.24	0.09
Peat	NO					NO	NO	NO						
Biomass	67 920	10.0%	5.0%	20.0%	37.0%	7 532.53	2.00	0.27	11.2%	22.4%	38.3%	842.16	0.45	0.10
3. Transport						69 262.74	2.92	2.51	5.8%	9.6%	19.0%	4017.83	0.28	0.48
Liquid Fuels	944 968.56	3.0%	5.0%	10.0%	20.0%	68 904.29	2.66	2.33	5.8%	10.4%	20.2%	4017.78	0.28	0.47
Solid Fuels	NO					NO	NO	NO						
Gaseous Fuels	3 836.79	4.0%	5.0%	17.0%	40.0%	217.70	0.09	0.01	6.4%	17.5%	40.2%	13.94	0.02	0.00
Other fossil fuels	1 845.07	10.0%	5.0%	25.0%	75.0%	140.74	0.00	0.01	11.2%	26.9%	75.7%	15.74	0.00	0.00
Biomass	55 745.65	10.0%	5.0%	24.0%	37.0%	4 098.71	0.16	0.16	11.2%	26.0%	38.3%	458.25	0.04	0.06
4. Other Sectors						39 447.24	114.17	3.64	3.8%	15.5%	16.8%	1484.99	17.64	0.61
Liquid Fuels	131 896.98	4.0%	5.0%	10.0%	20.0%	9 547.82	0.69	2.52	6.4%	10.8%	20.4%	611.36	0.07	0.51
Solid Fuels	174 223.83	4.0%	5.0%	13.5%	35.0%	16 429.05	49.55	0.26	6.4%	14.1%	35.2%	1051.97	6.98	0.09
Gaseous Fuels	237 164.66	4.0%	5.0%	17.0%	40.0%	13 294.73	1.19	0.02	6.4%	17.5%	40.2%	851.28	0.21	0.01
Other fossil fuels	1 455.84	4.0%	5.0%	25.0%	75.0%	175.64	0.44	0.01	6.4%	25.3%	75.1%	11.25	0.11	0.00
Peat	NO					NO	NO	NO						
Biomass	211 428.16	10.0%	5.0%	24.0%	37.0%	23 458.00	62.31	0.83	11.2%	26.0%	38.3%	2622.68	16.20	0.32
5. Other						0.00	0.00	0.00	0.0%	0.0%	0.0%	0.00	0.00	0.00
Liquid Fuels	NO	5.0%	3.0%	10.0%	20.0%				5.8%	11.2%	20.6%	0.00	0.00	0.00
Solid Fuels	NO	5.0%	5.0%	13.5%	35.0%				7.1%	14.4%	35.4%	0.00	0.00	0.00
Gaseous Fuels	NO	5.0%	5.0%	17.0%	40.0%				7.1%	17.7%	40.3%	0.00	0.00	0.00
Biomass	NO	20.0%	5.0%	24.0%	37.0%				20.6%	31.2%	42.1%	0.00	0.00	0.00
B. Fugitive Emissions from Fuels						3450.10	519.74	0.00	9.1%	42.8%	71.20%	315.30	222.56	0.00
1. Solid Fuels						1794.92	481.96		15.0%	46.2%		269.07	222.51	0.00
1. B. 1. a. Coal Mining and Handling												0.00	0.00	0.00
i. Underground Mines [Activity in Mt, EF in kg/t]	43.95	2.0%		50.0%			443.22			50.0%		0.00	221.79	0.00
ii. Surface Mines [Activity in Mt, EF in kg/t]	40.97	2.0%		50.0%			35.69			50.0%		0.00	17.86	0.00
1. B. 1. b. Solid Fuel Transformation [Activity in Mt, EF in kg/t]	0.00					1793.83	0.00		15.0%	25.0%		269.07	0.00	
1. B. 1. c. Other [CO2 Emission from Coking Gas Subsystem]	495.87	2.0%	10.0%	50.0%		1.09	3.06		10.2%	50.0%		0.11	1.53	
2. Oil and Natural Gas						1655.18	37.78	0.00	9.9%	13.0%	71.20%	164.36	4.92	0.00
1. B. 2. a. Oil														
1. Exploration [Activity in Gg, EFs in kg/PJ]	802.95	2.0%	6.6%	50.0%		8.488	0.18		6.9%	50.0%		0.59	0.09	
2. Production [Activity in PJ, EFs in kg/PJ]	802.95	2.0%	6.6%	50.0%		0.155	2.15		6.9%	50.0%		0.01	1.08	
3. Transport [Activity in kt]	26 325.70	2.0%	6.6%	50.0%		0.015	0.17		6.9%	50.0%		0.00	0.08	
4. Refining/storage [kt]	26 000.00	2.0%	6.6%	50.0%		0.000	1.238095		6.9%	50.0%			0.62	
1. B. 2. b. Natural Gas												0.00	0.00	
1. Exploration [Activity in PJ, EF in kg/PJ]	0.00	2.0%	6.6%			NO	NO							
2. Production [Activity in PJ, EF in kg/PJ]	3 922.18	2.0%	6.6%	50.0%		0.320	8.97		6.9%	50.0%		0.02	4.49	
3. Processing [Activity in PJ, EF in kg/PJ]	3 922.18	2.0%	6.6%	50.0%		1.255	4.04		6.9%	50.0%		0.09	2.02	
4. Transmission and storage [Activity in PJ, EF in kg/PJ]	12 180.18	2.0%	6.6%	50.0%		0.012	6.15		6.9%	50.0%		0.00	3.08	
5. Distribution [Activity in PJ, EF in kg/PJ]	12 180.18	2.0%	6.6%	50.0%		0.621	13.40		6.9%	50.0%		0.04	6.70	
6. Other leakage [Activity in PJ, EF in kg/PJ]	0.00	2.0%	6.6%	50.0%					6.9%	50.0%		0.00	0.00	
1. B. 2. c. Venting - Oil	802.95	5.0%	6.6%	50.0%		0.159	1.44		8.3%	50.2%		0.01	0.72	
1. B. 2. c. Venting and flaring - oil [kt]	802.95	5.0%	6.6%	50.0%	100.0%	38.236	0.02	0.00	8.3%	50.2%	100.1%	3.17	0.01	0.00
1. B. 2. c. Venting and flaring - natural gas [10 ⁶ m3]	3 922.18	5.0%	6.6%	50.0%	100.0%	48.555	0.03	0.00	8.3%	50.2%	100.1%	4.02	0.02	0.00
1. B. 2. d. Other (Process emission from refineries and flaring)	NA		NA			1 557.37			10.0%			155.74		

GHG inventory 2024 – Uncertainty analysis, part 2, sector IPCC 2. *Industrial processes and product use*

2. Industrial processes and product use						16 113.86	1.79	2.06	3.8%	29.2%	43.1%	616.45	0.52	0.89
A. Mineral Industry						10 178.72			5.7%			584.13	0.00	0.00
1. Cement Production [Activity in kt, EF in t/t]	12 530.95	5.0%	5.0%			6 519.80			7.1%			461.02	0.00	0.00
2. Lime Production [Activity in kt, EF in t/t]	1 423.30	5.0%	10.0%			1 049.93			11.2%			117.39	0.00	0.00
3. Glass production [activity in kt, EFs in t/t]	3 637.84	8.0%	10.0%			582.05			12.8%			74.54		
4.a Ceramics [Activity in kt, EF in t/t]	2 059.74	5.0%	10.0%			91.02			11.2%			10.18		
4.b Other uses of soda ash [Activity in kt, EF in t/t]	387.36	10.0%	15.0%			160.72			18.0%			28.97	0.00	0.00
4.d Other [Activity in kt, EF in t/t]	4 034.53	10.0%	15.0%			1 775.19			18.0%			320.03	0.00	0.00
B. Chemical Industry						4 023.20	1.44	1.60	4.3%	36.0%	54.3%	173.31	0.52	0.87
1. Ammonia Production [Activity in kt, EF in t/t]	2 102.10	2.0%	5.0%			3 145.63			5.4%			169.40	0.00	0.00
2. Nitric Acid Production [Activity in kt, EF in t/t]	2 358.86	2.0%	5.0%		60.0%			1.44			60.0%	0.00	0.00	0.86
3. Adipic Acid Production [Activity in kt, EF in t/t]	NO	2.0%						NO						
4. Caprolactam production [Activity in kt, EF in t/t]	103.46	2.0%	10.0%		60.0%			0.16			60.0%		0.00	0.10
5. Calcium carbide production [Activity in kt, EF in t/t]	NO					NO								
6. Titanium oxide production [Activity in kt, EF in t/t]	26.35	2.0%	10.0%			0.00								
7. Soda ash production [Activity in kt, EF in t/t]	974.75	2.0%	10.0%			0.00								
8.a Methanol [Activity in kt, EF in t/t]	NO	2.0%	5.0%	50.0%						50.0%				
8.b Ethylene [Activity in kt, EF in t/t]	343.33	2.0%	5.0%	50.0%		653.35	1.03		5.4%	50.0%		35.18		
8.c. Ethylene Dichloride and Vinyl Chloride Monomer [Activity in kt, EF in t/t]	212.05	2.0%	5.0%	30.0%		62.41	0.00		5.4%	30.1%		3.36		
8.d. Ethylene oxide [Activity in kt, EF in t/t]	34.32	2.0%	5.0%	25.0%		29.62	0.06		5.4%	25.1%		1.60		
8.e Acrylonitrile [Activity in kt, EF in t/t]	NO													
8.f Carbon black production [Activity in kt, EF in t/t]	50.46	5.0%	5.0%	20.0%		132.19	0.00		7.1%	20.6%		9.35	0.00	0.00
8.g Other / Styrene [Activity in kt, EF in t/t]	86.03	2.0%		20.0%			0.34			20.1%		0.00	0.07	0.00
C. Metal Industry						1 597.36	0.35		5.4%	16.9%		86.02	0.06	0.00
1. Iron and Steel Production												0.00	0.00	0.00
1.b Pig iron [Activity in kt, EF in t/t]	3 445.70	5.0%	10.0%			49.59			11.2%			5.54	0.00	0.00
1.d Sinter [Activity in kt, EF in t/t]	3 936.47	5.0%	10.0%	20.0%		272.05	0.28		11.2%	20.6%	NA	NA		0.00
1.f Open-heart Steel [Activity in kt, EF in t/t]	NO													
1.f. Basic Oxygen Furnace Steel [Activity in kt, EF in t/t]	3 852.76	5.0%	10.0%			609.81			11.2%			68.18	0.00	0.00
1.f. Electric Furnace Steel [Activity in kt, EF in t/t]	3 314.01	5.0%	10.0%			179.53			11.2%			20.07	0.00	0.00
2. Ferroalloys Production [Activity in kt, EF in t/t]	72.72	5.0%	10.0%	20.0%		290.88	0.07		11.2%	20.6%		32.52	0.01	0.00
3. Aluminium Production [Activity in kt, EF in t/t]	NO											0.00	0.00	0.00
4. Magnesium production [Activity in kt, EF in t/t]	NO	5.0%	10.0%										0.00	0.00
6. Lead production [Activity in kt, EF w t/t]	69.08	5.0%	10.0%			35.92			11.2%			4.02		
7. Zinc production [Activity in kt, EF w t/t]	92.78	5.0%	10.0%			159.59			11.2%			17.84		
D. Non-energy Products from Fuels and Solvent Use						314.573			11.7%			36.96	0.00	0.00
1. Lubricant use	214.37					132.05			20.0%					
2. Paraffin Wax Use	139.65					86.03			20.0%					
3.a Solvents use (reported as indirect)	IE								20.0%					
3.b Urea used as catalyst	355.58					96.50			20.0%					
G. Other Product Manufacture and Use							0.46				40.3%	0.00	0.00	0.18
3. N2O from product uses [Activity in N2O used, EF in t/t]	0.46	20.0%			35.0%		0.46				40.3%			

GHG inventory 2024 – Uncertainty analysis, part 3, sector IPCC 3. Agriculture

3. Agriculture						1 081.09	592.78	61.99	17.9%	31.8%	55.1%		188.31	34.17
A. Enteric Fermentation							533.94			35.0%			186.83	0.00
1. Cattle													0.00	0.00
Dairy cattle [Activity in 1000 heads, EF in kg/head]	2 335.6	5.0%	50.0%				310.16			50.2%			155.85	0.00
Non-dairy cattle [Activity in 1000 heads, EF in kg/head]	4 000.3	5.0%	50.0%				204.54			50.2%			102.78	0.00
2. Sheep [Activity in 1000 heads, EF in kg/head]	298.6	5.0%	50.0%				2.39			50.2%			1.20	0.00
3. Swine [Activity in 1000 heads, EF in kg/head]	9 132.0	5.0%	50.0%				13.70			50.2%			6.88	0.00
4.a Goats [Activity in 1000 heads, EF in kg/head]	63.5	5.0%	50.0%				0.32			50.2%			0.16	0.00
4.b Horses [Activity in 1000 heads, EF in kg/head]	157.6	5.0%	50.0%				2.84			50.2%			1.43	0.00
B. Manure Management							57.79	9.69		40.8%	34.4%		23.58	3.33
1. Cattle													0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2 336	5.0%	50.0%	100.0%			20.03	2.13		50.2%	100.1%		10.07	2.13
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	4 000	5.0%	50.0%	100.0%			6.52	1.35		50.2%	100.1%		3.28	1.36
2. Sheep [Activity in 1000 heads, EF in kg/head]	299	5.0%	50.0%	100.0%			0.06	0.01		50.2%	100.1%		0.03	0.01
3. Swine [Activity in 1000 heads, EF in kg/head]	9 132	5.0%	50.0%	100.0%			20.86	0.77		50.2%	100.1%		10.48	0.77
4.a Fur bearing animals [Activity in 1000 heads, EF in kg/head]	4 380	5.0%	50.0%	100.0%			2.98	0.09		50.2%	100.1%		1.50	0.09
4.b Rabbits [Activity in 1000 heads, EF in kg/head]	644	5.0%	50.0%	100.0%			0.05	0.02		50.2%	100.1%		0.03	0.02
4.c Goats [Activity in 1000 heads, EF in kg/head]	63	5.0%	50.0%	100.0%			0.01	0.00		50.2%	100.1%		0.00	0.00
4.d Horses [Activity in 1000 heads, EF in kg/head]	158	5.0%	50.0%	100.0%			0.25	0.05		50.2%	100.1%		0.12	0.05
4.e Poultry [Activity in 1000 heads, EF in kg/head]	268 863	5.0%	50.0%	100.0%			7.04	0.25		50.2%	100.1%		3.54	0.25
5.a Indirect emission [emission in kt]	NA							5.02			40.0%			2.01
D. Agricultural Soils								52.26			65.1%			34.00
a. Direct Soil Emissions														0.00
1. Inorganic N fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	949 100	5.0%	150.0%				14.91			150.1%			22.38	
2. Organic N fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	432 924	5.0%	150.0%				6.80			150.1%			10.21	
3. Urine and dung deposited by grazing animals [Activity in kg N, EF in kg N2O-N/kg N]	60 420	5.0%	150.0%				1.85			150.1%			2.77	
4. Crop residues [Activity in kg N, EF in kg N2O-N/kg N]	456 408	5.0%	150.0%				7.17			150.1%			10.76	
5. Mineralization/immobilization associated with loss/gain of soil or	9 680	5.0%	150.0%				0.15			150.1%			0.23	
6. Cultivation of organic soils (i.e. histosols) [Activity in kg N, EF in kg N2O-N/kg N]	920 877	5.0%	150.0%				11.58			150.1%			17.37	
b. Indirect N2O Emissions from managed soils														
1. Atmospheric deposition [Activity in kg N, EF in kg N2O-N/kg N]	193 579	20.0%	150.0%				3.04			151.3%			4.60	
2. Nitrogen leaching and run-off [Activity in kg N/yr, EF in kg N2O-N/kg N]	572 559	20.0%	150.0%				6.75			151.3%			10.21	
F. Field Burning of Agricultural Residues							1.06	0.04		17.2%	96.5%		0.18	0.04
1. Cereals													0.00	0.00
Wheat [Activity in t of crop production, EF in kg/t dm]	42.408	30.0%	20.0%	150.0%			0.14	0.00		36.1%	153.0%		0.05	0.00
Barley [Activity in t of crop production, EF in kg/t dm]	9.338	30.0%	20.0%	150.0%			0.03	0.00		36.1%	153.0%		0.01	0.00
Maize [Activity in t of crop production, EF in kg/t dm]	11.436	30.0%	20.0%	150.0%			0.04	0.00		36.1%	153.0%		0.01	0.00
Oats [Activity in t of crop production, EF in kg/t dm]	5.611	30.0%	20.0%	150.0%			0.02	0.00		36.1%	153.0%		0.01	0.00
Rye [Activity in t of crop production, EF in kg/t dm]	13.212	30.0%	20.0%	150.0%			0.04	0.00		36.1%	153.0%		0.02	0.00
Triticale [Activity in t of crop production, EF in kg/t dm]	21.507	30.0%	20.0%	150.0%			0.07	0.00		36.1%	153.0%		0.03	0.00
Cereals mixed [Activity in t of crop production, EF in kg/t dm]	2.322	30.0%	20.0%	150.0%			0.01	0.00		36.1%	153.0%		0.00	0.00
Millet and buckwheat [Activity in t of crop production, EF in kg/t dm]	0.488	30.0%	20.0%	150.0%			0.00	0.00		36.1%	153.0%		0.00	0.00
Other crops [Activity in t of crop production, EF in kg/t dm]	0.025	30.0%	20.0%	150.0%			0.00	0.00		36.1%	153.0%		0.00	0.00
2 Pulses	1	30.0%	20.0%	150.0%			0.00	0.00		36.1%	153.0%		0.00	0.00
3 Tuber and Root													0.00	0.00
Potatoes [Activity in t of crop production, EF in kg/t dm]	13	30.0%	20.0%	150.0%			0.04	0.00		36.1%	153.0%		0.01	0.00
5 Other													0.00	0.00
All straw and hay [Activity in t of crop production, EF in kg/t dm]	1	30.0%	20.0%	150.0%			0.00	0.00		36.1%	153.0%		0.00	0.00
Rape and other oil-bearing [Activity in t of crop production, EF in kg/t dm]	102	30.0%	20.0%	150.0%			0.31	0.01		36.1%	153.0%		0.11	0.01
Fruits [Activity in t of crop production, EF in kg/t dm]	120.83	30.0%	20.0%	150.0%			0.36	0.02		36.1%	153.0%		0.13	0.03
Vegetables [Activity in t of crop production, EF in kg/t dm]	2.18	30.0%	20.0%	150.0%			0.01	0.00		36.1%	153.0%		0.00	0.00
G. Liming							714.79		24.5%					
Limestone CaCO3 [Activity in t, EF in t CO2-C/t]	1 257 455.07	30.0%	5.0%				553.28		30.4%					
Dolomite CaMg(CO3)2 [Activity in t, EF in t CO2-C/t]	338 834.75	30.0%	5.0%				161.51		30.4%					
H. Urea application	332 357.14	30.0%	5.0%				243.73		30.4%					
I. Other carbon-containing fertilizers	278 571.43	30.0%	5.0%				122.57		30.4%					

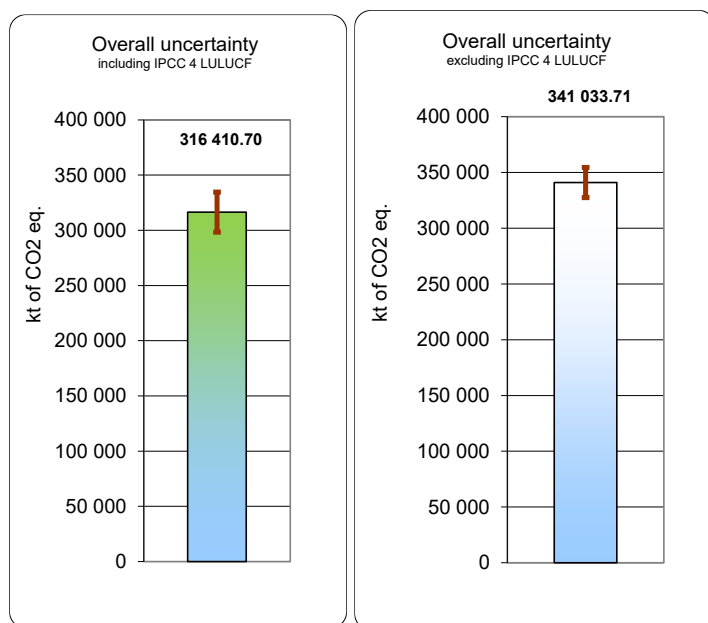
GHG inventory 2024 – Uncertainty analysis, part 4, sector IPCC 4. *Land use, land-use change and forestry*, IPCC sector 5. *Waste* and indirect emission

4. Land-Use, land-use change and forestry						-27 627.82	0.40	11.30	43.2%	63.6%	76.9%	-11934.02	0.26	8.681
A. Forest Land [Activity in kha, EF in kt/kha]	9 471.61	5.0%	30.0%	70.0%	70.0%	-35 447.94	0.36	0.57	30.4%	70.2%	70.2%	-10781.07	0.25	0.399
B. Cropland [Activity in kha, EF in kt/kha]	13 710.33	5.0%	75.0%		100.0%	-3 290.71		0.11	75.2%		100.1%	-2473.51	0.00	0.112
C. Grassland [Activity in kha, EF in kt/kha]	4 208.42	5.0%	75.0%	70.0%	100.0%	783.46	0.04	0.00	75.2%	70.2%	100.1%	0.00	0.03	0.002
D. Wetlands [Activity in kha, EF in kt/kha]	1 472.32	5.0%	75.0%		100.0%	1 332.96		0.02	75.2%		100.1%	1001.94	0.00	0.022
E. Settlements [Activity in kha, EF in kt/kha]	2 446.04	5.0%	30.0%		100.0%	12 778.59		8.3710	30.4%		100.1%	3886.46	0.00	8.381
F. Other Land [Activity in kha, EF in kt/kha]	84.59	10.0%	75.0%						75.7%				0.00	0.000
G. Other [Activity in kt C, EF in kt/kha]	NA	5.0%	50.0%			-3 784.17			50.2%			-1901.52		
4 (IV) Indirect N ₂ O emission from managed soils [Activity in kgN/yr, EF in kgN ₂ O-N/kgN]	188 461.08	5.0%			100.0%			2.2211			100.1%			2.224
5. Waste						0.00	110.51	4.80		60.1%	110.4%	0.00	66.47	5.29
A. Solid Waste Disposal							31.49			90.3%		0.00	28.44	0.00
1. Managed waste disposal sites [Activity in kt, EF in t/t MSW]	10 762.49	23.0%		100.0%			27.56			102.6%		0.00	28.28	0.00
2. Unmanaged waste disposal sites [Activity in kt, EF in t/t MSW]	NO	23.0%		100.0%			1.28			102.6%		0.00	1.31	0.00
3. Uncategorized waste disposal sites [Activity in kt, EF in t/t MSW]	NO	23.0%		100.0%			2.65			102.6%		0.00	2.72	0.00
B. Biological treatment of solid waste							10.93	0.64		101.2%	153.0%	0.00	11.07	0.97
1. Composting [Activity in kt DC(1), EF in kg/kg DC]	1 059.43	30.0%		100.0%	150.0%		10.59	0.64		104.4%	153.0%	0.00	11.06	0.97
2. Anaerobic digestion in biogas installations [Activity in kt DC(1), EF in kg/kg DC]	169.48	30.0%		100.0%			0.34			104.4%		0.00	0.35	0.00
C. Waste Incineration						0.00		0.00						
1. Waste incineration [Activity in kt, EF in kg/t waste]	IE	15.0%	30.0%	100.0%	150.0%						150.7%	0.00		0.00
2. Open burning of waste [Activity in kt, EF in kg/t waste]	NA													
D. Wastewater treatment and discharge							68.08	4.16		86.7%	125.1%	0.00	59.05	5.20
1. Domestic wastewater [Activity in kt DC(1), EF in kg/kg DC]	821.01	10.0%		100.0%	150.0%		57.86	3.37		100.5%	150.3%	0.00	58.15	5.07
2. Industrial wastewater [Activity in kt DC(1), EF in kg/kg DC]	334.67	10.0%		100.0%	150.0%		10.23	0.79		100.5%	150.3%	0.00	10.28	1.19
Indirect CO₂	NA		0			467.55			20.0%			93.51		

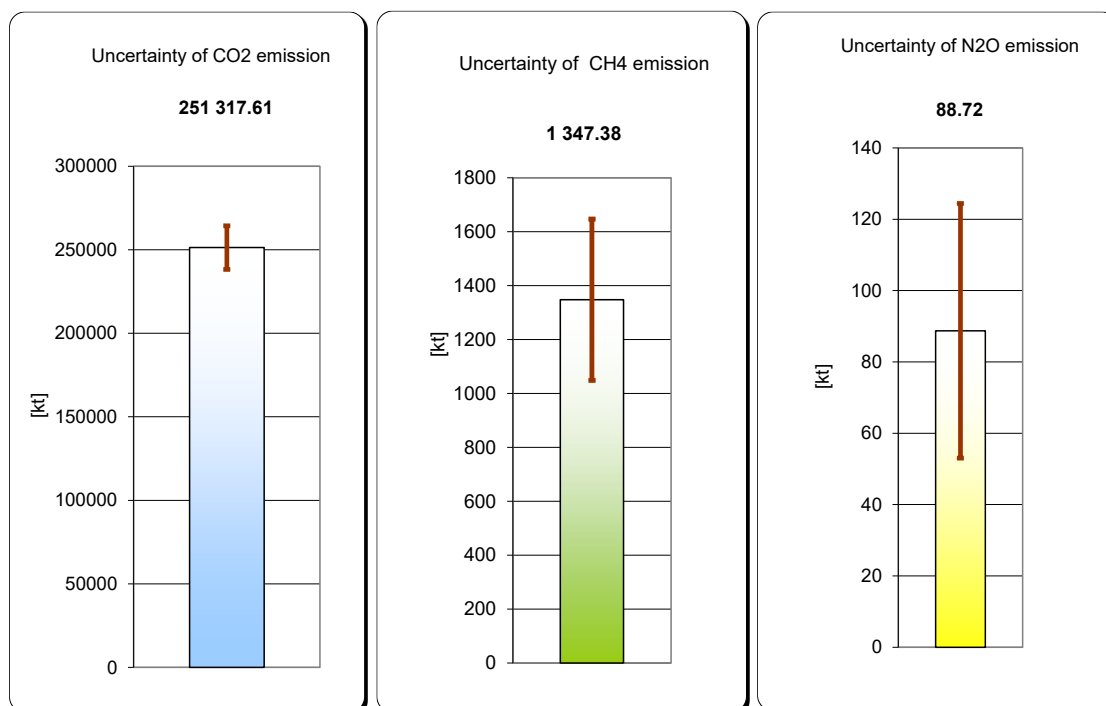
F- gases inventory 2024 – Uncertainty analysis for HFC, PFC and SF₆.

		Activity data			Uncertainty of activity data			Emission factors			Uncertainty of emission factors			Emission in t			Emission in t of CO2 equivalent				Uncertainty of emission			
		Filled into new manufactured products	In operating systems (average annual stocks)	Remaining in products at decommissioning	Uncertainty of amount filled into new manufactured products	Uncertainty of amount in operating systems	Uncertainty of amount remaining in products at decommissioning	Product manufacturing factor	Product life factor	Disposal loss factor	Uncertainty of product manufacturing factor	Uncertainty of life factor	Uncertainty of disposal loss factor	From manufacturing	From stocks	From disposal	From manufacturing	From stocks	From disposal	Total	From manufacturing	From stocks	From disposal	Total
Total	CO2 equivalent [kt] →																35 434.68	3 810 838.82	8 304.77	3 854 578.27	4.20%	11.40%	26.66%	11.27%
C. Metal production																								
3. Aluminium production																	0.00			0.00	0.00%			0.00%
CF4 [t]	CF4	NO			2%			0.00			5%			0.00			0.00			0.00	0.00%			0.00%
C2F6 [t]	C2F6	NO			2%			0.00			5%			0.00			0.00			0.00	5.39%			5.39%
4. Magnesium production																	0.00			0.00	0.00%			0.00%
SF6 [t]	SF6	NO			5%			0.00			5%			0.00			0.00			0.00	7.07%			7.07%
F. Product uses as substitutes for ODS																	8 138.35	3 709 413.31	8 304.77	3 725 856.43	2.93%	11.71%	26.66%	11.67%
1. Refrigeration and airconditioning [kt of CO2 eq.]																								
Commercial refrigeration [kt of CO2 eq.]																								
HFC-32 [t]	HFC-32	25.26	168.37		2%	30%	15%	0.50	7.83	NO	2%	15%	25%	0.13	13.18	0.00	85.51	8 923.19	0.00	9 008.70	2.83%	33.54%	29.15%	33.22%
HFC-125 [t]	HFC-125	18.52	1562.03	132.27	2%	30%	15%	0.50	8.78	0.00	2%	15%	25%	0.09	137.13	0.13	293.59	434 701.61	419.31	435 414.51	2.83%	33.54%	29.15%	33.49%
HFC-134a [t]	HFC-134a	25.90	1512.68	132.27	2%	30%	15%	0.50	8.87	0.00	2%	15%	25%	0.13	134.19	0.13	168.33	174 453.25	171.96	174 793.54	2.83%	33.54%	29.15%	33.48%
HFC-143a [t]	HFC-143a	NO	1884.70	177.89	2%	30%	15%	NO	8.87	0.00	2%	15%	25%	0.00	167.19	0.18	0.00	802 528.82	853.87	803 382.69	2.83%	33.54%	29.15%	33.51%
Domestic refrigeration [kt of CO2 eq.]																								
HFC-134a [t]	HFC-134a	NO	NO	NO	2%	15%	30%	0.00	0.00	0.00	2%	15%	25%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83%	21.21%	39.05%	
Industrial refrigeration [kt of CO2 eq.]																								
HFC-32 [t]	HFC-32	10.13	40.86	NO	2%	30%	15%	0.50	7.36	NO	2%	15%	25%	0.05	3.01	0.00	34.30	2 036.96	0.00	2 071.26	2.83%	33.54%	29.15%	32.99%
HFC-125 [t]	HFC-125	4.33	506.98	17.61	2%	30%	15%	0.50	7.95	0.00	2%	15%	25%	0.02	40.30	0.04	68.66	127 745.93	111.65	127 926.23	2.83%	33.54%	29.15%	33.49%
HFC-134a [t]	HFC-134a	23.64	1984.25	52.97	2%	30%	15%	0.50	6.96	0.00	2%	15%	25%	0.12	138.12	0.11	153.68	179 556.00	137.72	179 847.40	2.83%	33.54%	29.15%	33.49%
HFC-143a [t]	HFC-143a	NO	525.79	21.36	2%	30%	15%	NO	8.00	0.00	2%	15%	25%	0.00	42.06	0.04	0.00	201 903.36	205.06	202 108.42	2.83%	33.54%	29.15%	33.51%
Transport refrigeration [kt of CO2 eq.]																								
HFC-32 [t]	HFC-32	29.81	149.77	2.55	5%	20%	30%	0.60	12.00	0.00	5%	15%	30%	0.18	17.97	0.01	121.09	12 167.36	3.45	12 291.89	7.07%	25.00%	42.43%	24.75%
HFC-125 [t]	HFC-125	107.31	1095.55	56.23	5%	20%	30%	0.60	12.00	0.00	5%	15%	30%	0.64	131.47	0.11	2 041.11	416 747.41	356.48	419 145.00	7.07%	25.00%	42.43%	24.86%
HFC-134a [t]	HFC-134a	286.17	314.30	7.66	5%	20%	30%	0.60	12.00	0.00	5%	15%	30%	1.72	37.72	0.02	2 232.13	49 030.41	19.91	51 282.45	7.07%	25.00%	42.43%	23.90%
HFC-143a [t]	HFC-143a	NO	822.58	66.44	5%	20%	30%	NO	12.00	0.00	5%	15%	30%	NO	98.71	0.13		473 806.08	637.82	474 443.90	7.07%	25.00%	42.43%	24.97%
Mobile air-conditioning [kt of CO2 eq.]																								
HFC-134a [t]	HFC-134a	127.97	3563.64	371.46	2%	20%	30%	0.50	8.40	0.01	5%	15%	30%	0.64	299.50	3.71	831.81	389 352.35	4 828.98	395 013.14	5.39%	25.00%	42.43%	24.65%
Stationary air-conditioning [kt of CO2 eq.]																								
HFC-32 [t]	HFC-32	4.10	3442.26	114.15	2%	50%	15%	0.50	4.87	0.00	2%	15%	15%	0.02	167.61	0.12	13.89	113 469.12	84.28	113 567.28	2.83%	52.20%	21.21%	52.16%
HFC-125 [t]	HFC-125	0.48	859.44	106.63	2%	50%	15%	0.50	4.67	0.00	2%	15%	15%	0.00	40.12	0.12	7.68	127 174.76	372.37	127 554.80	2.83%	52.20%	21.21%	52.05%
HFC-134a [t]	HFC-134a	0.85	732.03	71.00	2%	50%	15%	0.50	4.64	0.00	2%	15%	15%	0.00	33.98	0.08	5.51	44 172.83	101.93	44 280.27	2.83%	52.20%	21.21%	52.07%
HFC-143a [t]	HFC-143a	NO	NO	NO	2%	50%	15%	NO	NO	NO	2%	15%	15%	0.00	0.00	0.00				0.00	2.83%	52.20%	21.21%	
2. Foam blowing agents [kt of CO2 eq.]																								
Closed cells																								
HFC-134a [t]	HFC-134a	1.97	575.21	NO	5%	10%	15%	50.00	2.50	NO	2%	10%	30%	0.99	14.38	0.00	1 280.63	18 694.42	0.00	19 975.05	5.39%	14.14%	33.54%	13.24%
HFC-152a [t]	HFC-152a	NO	1481.96	NO	5%	10%	15%	NO	2.50	NO	2%	10%	30%	0.00	37.05	0.00	0.00	5 112.75	0.00	5 112.75	5.39%	14.14%	33.54%	14.14%
HFC-227ea [t]	HFC-227ea	1.39	238.99	NO	5%	10%	15%	10.00	4.50	NO	2%	10%	30%	0.14	10.75	0.00	465.86	36 027.00	0.00	36 492.86	5.39%	14.14%	33.54%	13.96%
Open cells																								
HFC-134a [t]	HFC-134a	NO	NO		4%	10%		56.23	0.60		5%	10%		0.00	0.00		0.00	0.00		0.00	6.40%	14.14%		
3. Fire protection [kt of CO2 eq.]																								
HFC-227ea [t]	HFC-227ea	1.56	264.25	NO	2%	20%	10%	1.00	5.00	NO	2%	5%	15%	0.02	13.21	0.00	52.14	44 262.21	0.00	44 314.35	2.83%	20.62%	18.03%	20.59%
HFC-236fa [t]	HFC-236fa	NO	87.06	NO	2%	20%	10%	NO	5.00	NO	2%	5%	15%	0.00	4.35	0.00	0.00	35 086.49	0.00	35 086.49	2.83%	20.62%	18.03%	20.62%
C4F10 [t]	C4F10	NO	18.79	NO	2%	20%	10%	NO	5.00	NO	2%	5%	15%	0.00	0.94	0.00	0.00	8 643.85	0.00	8 643.85	2.83%	20.62%	18.03%	20.62%
4. Aerosols [kt of CO2 eq.]																								
Metered dose inhalers																								
HFC-134a [t]	HFC-134a	0.32	2.41		2%	30%		67.69	100.00		2%	5%		0.22	2.41		282.45	3 126.50		3 408.95	2.83%	30.41%		
HFC-152a [t]	HFC-152a	NO	NO		2%	30%		NO	NO		2%	5%		0.00	0.00		0.00	0.00		0.00	2.83%	30.41%		
Other (please specify - one row per substance)																								
Technical aerosols																								
HFC-152a [t]	HFC-152a	NO	NO		5%	30%		NO	NO		2%	5%		0.00	0.00		0.00	0.00		0.00	5.39%	30.41%		
5. Solvents [kt of CO2 eq.]																								
HFC-43-10mee [t]	HFC-43-10mee	NO	0.42	NO	2%	5%	10%	NO	100.00	NO	5%	10%	30%	0.00	0.42	0.00	0.00	690.66	0.00	690.66	5.39%	11.18%	31.62%	11.18%
HFC-365mfc [t]	HFC-365mfc	NO	NO	NO	0.02	5%	10%	NO	NO	NO	5%	10%	30%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.39%	11.18%	31.62%	
G. Other product manufacture and use																	27 296.33	101 425.51		128 721.84	5.39%	7.07%		5.69%
1. Electrical equipment [kt of CO2 eq.]																								
SF6 [t]	SF6	19.36	215.80	NO	0.05	5%	10%	6.00	2.00	NO	2%	5%	5%	1.16	4.32	0.00	27 296.33	101 425.51	0.00	128 721.84	5.39%	7.07%	11.18%	5.69%

Overall emission results for 2024 including and excluding IPCC 4. *LULUCF* with uncertainties bars



Emission results for 2024 including IPCC 4. *LULUCF* with uncertainties bars



Annex 3. National Energy Balance for 2024 in EUROSTAT format

TJ 2024	Total	Solid fossil fuels	Anthracite	Coking coal	Other bituminous coal	Sub-bituminous coal	Lignite	Potent fuel	Coke oven coke	Gas coke	Coal tar	Brown coal briquettes
+ Primary production	2 209 159.9	1 393 432.1	0.0	330 204.5	726 861.8	0.0	336 365.8	Z	Z	Z	Z	Z
+ Recovered & recycled products	8 518.9	5 998.9	0.0	0.0	5 998.9	0.0	0.0	Z	Z	Z	Z	Z
+ Imports	2 505 210.6	208 273.1	500.6	57 171.6	143 474.4	0.0	1 391.2	361.2	5 092.8	0.0	246.3	36.0
- Exports	626 347.1	300 726.3	0.0	78 002.6	46 582.9	0.0	17.1	137.9	163 715.8	0.0	12 212.6	57.5
+ Change in stock	17 504.7	33 112.2	133.5	-3 216.7	32 102.6	0.0	-164.0	-2.1	3 860.1	0.0	317.2	81.7
= Gross available energy	4 114 047.0	1 340 090.1	634.1	306 156.7	861 854.8	0.0	337 575.9	221.2	-154 762.9	0.0	-11 649.0	59.2
- International maritime bunkers	7 498.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
= Gross inland consumption	4 106 548.4	1 340 090.1	634.1	306 156.7	861 854.8	0.0	337 575.9	221.2	-154 762.9	0.0	-11 649.0	59.2
- International aviation	55 747.1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
= Total energy supply	4 050 801.2	1 340 090.1	634.1	306 156.7	861 854.8	0.0	337 575.9	221.2	-154 762.9	0.0	-11 649.0	59.2
Transformation input	3 147 287.8	1 348 209.9	0.0	296 734.0	661 169.0	0.0	335 472.9	0.0	54 833.9	0.0	0.0	0.0
+ Electricity & heat generation	1 483 363.4	997 852.3	0.0	1 196.3	661 169.0	0.0	335 472.9	0.0	14.0	0.0	0.0	0.0
+ Main activity producer electricity only	166 101.1	30 150.1	0.0	0.0	30 150.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Main activity producer CHP	1 029 146.5	870 627.1	0.0	0.0	535 326.2	0.0	335 300.9	0.0	0.0	0.0	0.0	0.0
+ Main activity producer heat only	94 635.7	68 528.9	0.0	0.0	68 351.1	0.0	163.8	0.0	14.0	0.0	0.0	0.0
+ Autoproducer electricity only	54 869.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Autoproducer CHP	120 813.4	24 668.9	0.0	292.4	24 376.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Autoproducer heat only	5 972.6	3 877.3	0.0	903.9	2 968.2	0.0	8.2	0.0	0.0	0.0	0.0	0.0
+ Electrically driven heat pumps	2.3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for pumped storage	5 088.8	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for charging batteries	5 574.9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Derived heat for electricity production	1 159.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	297 651.8	297 651.8	0.0	296 537.7	0.0	0.0	0.0	0.0	2 114.1	0.0	0.0	0.0
+ Blast furnaces	48 578.9	48 578.9	0.0	0.0	0.0	0.0	0.0	0.0	48 578.9	0.0	0.0	0.0
+ Refineries & petrochemical industry	1 260 719.8	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Liquid biofuels blended	52 811.2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified	4 162.6	4 126.9	0.0	0.0	0.0	0.0	0.0	0.0	4 126.9	0.0	0.0	0.0
Transformation output	2 506 293.4	224 945.0	Z	Z	Z	Z	Z	0.0	212 994.2	0.0	11 950.8	0.0
+ Electricity & heat generation	880 189.7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer electricity only	132 844.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer CHP	525 595.2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer heat only	83 972.4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer electricity only	54 869.1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer CHP	73 369.6	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer heat only	4 538.4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electrically driven heat pumps	7.3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Pumped hydro	3 633.7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Other sources	1 360.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	282 560.1	224 945.0	Z	Z	Z	Z	Z	Z	212 994.2	Z	11 950.8	Z
+ Blast furnaces	21 755.3	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Refineries & petrochemical industry	1 248 577.1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Liquid biofuels blended	52 811.2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Gas-to-liquids plants	20 400.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Energy sector	2 47 900.5	2 916.8	0.0	1 771.0	1 104.3	0.0	41.0	0.0	0.5	0.0	0.0	0.0
+ Own use in electricity & heat generation	43 719.9	7.4	0.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Coal mines	20 366.9	462.5	0.0	0.0	421.0	0.0	41.0	0.0	0.5	0.0	0.0	0.0
+ Oil & natural gas extraction plants	22 699.3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	40 978.4	1 771.0	0.0	1 771.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Gas works	167.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Petroleum refineries (oil refineries)	85 611.4	676.0	0.0	0.0	676.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Liquefaction & regasification plants (LNG)	3 014.5	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (energy)	31 342.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Distribution losses	58 593.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Available for final consumption	3 103 312.9	213 908.3	634.1	7 651.7	199 581.5	0.0	2 062.0	221.2	3 396.9	0.0	301.7	59.2
Final non-energy consumption	212 177.4	2 039.4	0.0	0.0	337.7	0.0	0.0	0.0	1 400.0	0.0	301.8	0.0
+ Non-energy use industry/transformation/energy	196 602.7	2 039.4	0.0	0.0	337.7	0.0	0.0	0.0	1 400.0	0.0	301.8	0.0
+ Non-energy use in transport sector	5 019.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Non-energy use in other sectors	10 555.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final energy consumption	2 891 162.6	250 284.7	119.0	18.8	237 742.2	0.0	3 435.2	221.3	8 698.4	0.0	0.0	49.8
+ Industry sector	608 546.1	75 060.9	119.0	2.9	66 662.2	0.0	1 795.2	8.1	7 423.7	0.0	0.0	49.6
+ Iron & steel	54 697.0	2 947.4	0.0	0.0	2 573.5	0.0	0.0	3.4	370.6	0.0	0.0	0.0
+ Chemical & petrochemical	103 584.0	30 581.0	0.0	0.0	28 173.3	0.0	0.0	0.0	2 407.7	0.0	0.0	0.0
+ Non-ferrous metals	17 677.0	713.4	0.0	0.0	50.9	0.0	0.0	0.0	662.5	0.0	0.0	0.0
+ Non-metallic minerals	113 609.0	12 255.1	82.0	0.3	8 902.9	0.0	682.3	0.0	2 587.4	0.0	0.0	0.0
+ Transport equipment	19 070.5	241.7	0.0	0.0	241.5	0.0	0.0	0.1	0.1	0.0	0.0	0.0
+ Machinery	30 431.6	610.6	0.0	2.0	553.1	0.0	0.0	3.5	52.0	0.0	0.0	0.0
+ Mining & quarrying	19 080.8	813.3	33.9	0.1	429.3	0.0	106.6	0.0	241.3	0.0	0.0	0.0
+ Food, beverages & tobacco	96 155.2	20 270.5	3.0	0.4	19 226.7	0.0	0.1	0.1	1 040.3	0.0	0.0	0.0
+ Paper, pulp & printing	64 642.3	4 369.8	0.0	0.0	4 369.1	0.0	0.0	0.7	0.0	0.0	0.0	0.0
+ Wood & wood products	43 508.5	807.9	0.0	0.0	807.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Construction	7 605.8	1 322.9	0.0	0.1	216.1	0.0	996.2	0.3	60.6	0.0	0.0	49.6
+ Textile & leather	4 056.7	194.8	0.0	0.0	194.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Not elsewhere specified (industry)	34 427.8	932.4	0.0	0.0	923.2	0.0	8.0	0.0	1.2	0.0	0.0	0.0
+ Transport sector	1 020 301.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Rail	15 601.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Road	1 000 313.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Domestic aviation	2 124.1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Domestic navigation	46.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Pipeline transport	2 215.4	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (transport)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Other sectors	1 262 315.5	174 223.8	0.0	15.9	171 080.0	0.0	1 640.0	213.2	1 274.7	0.0	0.0	0.1
+ Commercial & public services	310 372.6	9 378.6	0.0	15.5	9 100.0	0.0	123.0	0.0	140.0	0.0	0.0	0.1
+ Households	822 145.0	151 426.0	0.0	0.0	148 980.0	0.0	1 312.0	0.0	1 134.0	0.0	0.0	0.0
+ Agriculture & forestry	129 661.6	13 418.1	0.0	0.4	12 998.9	0.0	206.0	213.2	0.7	0.0	0.0	0.0
+ Fishing	82.4	1.1	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Not elsewhere specified (other)	54.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Statistical differences	-27.1	-38 415.8	515.1	7 632.9	-38 496.4	0.0	-1 373.2	-0.1	-6 701.5	0.0	0.0	9.4

TJ 2024	Manufactured gases	Gas works gas	Coke oven gas	Blast furnace gas	Other recovered gases	Peat and peat products	Peat	Peat products	Oil shale and oil sands	Oil and petroleum products	Crude oil
+ Primary production	Z	Z	Z	Z	Z	0.0	0.0	Z	0.0	34 364.6	34 244.0
+ Recovered & recycled products	Z	Z	Z	Z	Z	0.0	0.0	Z	0.0	2 520.0	Z
+ Imports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 647 898.0	1 084 742.7
- Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	251 826.4	7 788.5
+ Change in stock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-37 848.6	-10 047.7
= Gross available energy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 395 107.6	1 101 150.6
- International maritime bunkers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7 498.7	Z
= Gross inland consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 387 608.9	1 101 150.6
- International aviation	Z	Z	Z	Z	Z	Z	Z	Z	Z	55 747.1	0.0
= Total energy supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 331 861.8	1 101 150.6
Transformation input	28 692.5	0.0	16 704.0	10 888.5	1 100.0	0.0	0.0	0.0	0.0	1 280 516.3	1 105 130.0
+ Electricity & heat generation	28 692.5	0.0	16 704.0	10 888.5	1 100.0	0.0	0.0	0.0	0.0	19 796.5	0.0
+ Main activity producer electricity only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.0	0.0
+ Main activity producer CHP	19 298.5	0.0	7 560.0	10 838.5	900.0	0.0	0.0	0.0	0.0	5 629.1	0.0
+ Main activity producer heat only	1 400.0	0.0	1 350.0	50.0	0.0	0.0	0.0	0.0	0.0	1 774.3	0.0
+ Autoproducer electricity only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Autoproducer CHP	7 940.0	0.0	7 740.0	0.0	200.0	0.0	0.0	0.0	0.0	12 199.7	0.0
+ Autoproducer heat only	54.0	0.0	54.0	0.0	0.0	0.0	0.0	0.0	0.0	64.5	0.0
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electric boilers	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for pumped storage	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for charging batteries	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Derived heat for electricity production	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Blast furnaces	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Refineries & petrochemical industry	Z	Z	Z	Z	Z	Z	Z	Z	Z	1 260 719.8	1 105 130.0
+ Liquid biofuels blended	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformation output	79 370.4	0.0	57 615.1	18 554.1	3 201.2	0.0	Z	0.0	Z	1 268 977.1	0.0
+ Electricity & heat generation	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electric boilers	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Pumped hydro	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Other sources	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	57 615.1	Z	57 615.1	Z	Z	Z	Z	Z	Z	Z	Z
+ Blast furnaces	21 755.3	Z	Z	18 554.1	3 201.2	Z	Z	Z	Z	Z	Z
+ Refineries & petrochemical industry	Z	Z	Z	Z	Z	Z	Z	Z	Z	1 248 577.1	0.0
+ Liquid biofuels blended	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (energy)	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0	Z	14 025.0	Z
Energy sector	36 191.1	0.0	36 191.1	0.0	0.0	0.0	0.0	0.0	0.0	42 241.4	0.0
+ Own use in electricity & heat generation	0.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	168.1	0.0
+ Coal mines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	870.2	0.0
+ Oil & natural gas extraction plants	Z	Z	Z	Z	Z	Z	Z	Z	Z	126.7	0.0
+ Coke ovens	36 190.4	0.0	36 190.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Gas works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Petroleum refineries (oil refineries)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41 076.3	Z
+ Liquefaction & regasification plants (LNG)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (energy)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Distribution losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Available for final consumption	14 486.8	0.0	4 720.0	7 665.6	2 101.2	0.0	0.0	0.0	0.0	1 278 081.2	-3 979.4
Final non-energy consumption	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150 085.2	0.0
+ Non-energy use industry/transformation/energy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133 503.0	0.0
+ Non-energy use in transport sector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5 019.1	0.0
+ Non-energy use in other sectors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11 563.0	0.0
Final energy consumption	14 486.8	0.0	4 720.0	7 665.6	2 101.2	0.0	0.0	0.0	0.0	1 108 491.2	0.0
+ Industry sector	14 486.8	0.0	4 720.0	7 665.6	2 101.2	0.0	0.0	0.0	0.0	34 186.4	0.0
+ Iron & steel	11 511.4	0.0	2 961.4	7 665.6	884.4	0.0	0.0	0.0	0.0	195.3	0.0
+ Chemical & petrochemical	447.6	0.0	447.6	0.0	0.0	0.0	0.0	0.0	0.0	14 721.7	0.0
+ Non-ferrous metals	1 291.5	0.0	74.7	0.0	1 216.8	0.0	0.0	0.0	0.0	329.7	0.0
+ Non-metallic minerals	1 234.4	0.0	1 234.4	0.0	0.0	0.0	0.0	0.0	0.0	3 831.8	0.0
+ Transport equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	904.9	0.0
+ Machinery	1.9	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	831.0	0.0
+ Mining & quarrying	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4 072.5	0.0
+ Food, beverages & tobacco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3 555.3	0.0
+ Paper, pulp & printing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 340.6	0.0
+ Wood & wood products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	520.5	0.0
+ Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2 915.9	0.0
+ Textile & leather	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	274.1	0.0
+ Not elsewhere specified (industry)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	693.1	0.0
+ Transport sector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	944 617.5	0.0
+ Rail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3 400.8	0.0
+ Road	Z	Z	Z	Z	Z	Z	Z	Z	Z	939 055.5	0.0
+ Domestic aviation	Z	Z	Z	Z	Z	Z	Z	Z	Z	2 124.1	0.0
+ Domestic navigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.4	0.0
+ Pipeline transport	Z	Z	Z	Z	Z	Z	Z	Z	Z	1.7	0.0
+ Not elsewhere specified (transport)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Other sectors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129 687.3	0.0
+ Commercial & public services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16 889.1	0.0
+ Households	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22 154.0	0.0
+ Agriculture & forestry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90 551.0	0.0
+ Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.2	0.0
+ Not elsewhere specified (other)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.0	0.0
Statistical differences	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19 504.8	-3 979.4

TJ 2024	Natural gas liquids	Refinery feedstocks	Additives and oxygenates (excluding biofuel portion)	Other hydrocarbons	Refinery gas	Ethane	Liquefied petroleum gases	Motor gasoline (excluding biofuel portion)	Aviation gasoline	Gasoline-type jet fuel	Kerosene-type jet fuel (excluding biofuel portion)
+ Primary production	0.0	Z	120.6	0.0	Z	Z	Z	Z	Z	Z	Z
+ Recovered & recycled products	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Imports	0.0	75 533.2	1 607.6	0.0	Z	0.0	112 934.8	48 928.5	44.0	0.0	1 217.5
- Exports	0.0	0.0	0.0	0.0	Z	0.0	19 538.7	11 985.5	880.0	0.0	860.0
+ Change in stock	0.0	1 301.2	0.0	0.0	0.0	0.0	-332.7	-4 707.3	88.0	0.0	-591.6
= Gross available energy	0.0	76 834.4	1 728.2	0.0	0.0	0.0	93 053.4	32 235.8	-748.0	0.0	-234.1
- International maritime bunkers	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
= Gross inland consumption	0.0	76 834.4	1 728.2	0.0	0.0	0.0	93 053.4	32 235.8	-748.0	0.0	-234.1
- International aviation	0.0	Z	Z	Z	Z	0.0	0.0	0.0	1.5	0.0	55 745.6
= Total energy supply	0.0	76 834.4	1 728.2	0.0	0.0	0.0	93 053.4	32 235.8	-749.5	0.0	-55 979.8
Transformation input	0.0	98 519.4	1 509.4	20 400.0	5 890.4	0.0	2 500.4	0.0	0.0	0.0	0.0
+ Electricity & heat generation	0.0	0.0	0.0	0.0	1 594.0	0.0	49.5	0.0	0.0	0.0	0.0
+ Main activity producer electricity only	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Main activity producer CHP	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Main activity producer heat only	0.0	Z	Z	Z	0.0	0.0	37.5	0.0	0.0	0.0	0.0
+ Autoproducer electricity only	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Autoproducer CHP	0.0	Z	Z	Z	1 594.0	0.0	7.6	0.0	0.0	0.0	0.0
+ Autoproducer heat only	0.0	Z	Z	Z	0.0	0.0	4.4	0.0	0.0	0.0	0.0
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for pumped storage	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for charging batteries	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Derived heat for electricity production	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Blast furnaces	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Refineries & petrochemical industry	0.0	98 519.4	1 509.4	20 400.0	4 296.4	0.0	2 450.8	0.0	0.0	0.0	0.0
+ Liquid biofuels blended	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformation output	0.0	20 532.3	0.0	20 400.0	39 042.1	0.0	25 887.3	194 629.9	880.0	0.0	55 900.0
+ Electricity & heat generation	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Pumped hydro	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Other sources	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Blast furnaces	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Refineries & petrochemical industry	0.0	20 532.3	0.0	0.0	39 042.1	0.0	25 887.3	194 629.9	880.0	0.0	55 900.0
+ Liquid biofuels blended	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Gas-to-liquid plants	Z	Z	0.0	20 400.0	Z	Z	Z	Z	Z	Z	Z
Energy sector	0.0	0.0	0.0	0.0	20 186.0	0.0	134.4	1.6	0.0	0.0	0.0
+ Own use in electricity & heat generation	0.0	Z	Z	Z	0.0	0.0	0.6	0.9	0.0	0.0	0.0
+ Coal mines	0.0	Z	Z	Z	0.0	0.0	0.5	0.8	0.0	0.0	0.0
+ Oil & natural gas extraction plants	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Coke ovens	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Gas works	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Petroleum refineries (oil refineries)	Z	Z	Z	Z	20 186.0	0.0	133.4	0.0	0.0	0.0	0.0
+ Liquefaction & regasification plants (LNG)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (energy)	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Distribution losses	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Available for final consumption	0.0	-1 152.8	218.7	0.0	12 965.7	0.0	116 306.0	226 864.0	130.5	0.0	-79.8
Final non-energy consumption	0.0	Z	Z	Z	Z	0.0	3 541.7	0.0	0.0	0.0	0.0
+ Non-energy use industry/transformation/energy	0.0	Z	Z	Z	0.0	0.0	3 541.7	0.0	0.0	0.0	0.0
+ Non-energy use in transport sector	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Non-energy use in other sectors	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final energy consumption	0.0	Z	Z	Z	12 965.7	0.0	111 162.9	226 864.0	249.1	0.0	1 891.9
+ Industry sector	0.0	Z	Z	Z	12 965.7	0.0	5 822.9	99.3	0.0	0.0	16.9
+ Iron & steel	0.0	Z	Z	Z	0.0	0.0	65.2	0.6	0.0	0.0	0.0
+ Chemical & petrochemical	0.0	Z	Z	Z	12 965.7	0.0	381.3	0.2	0.0	0.0	0.0
+ Non-ferrous metals	0.0	Z	Z	Z	0.0	0.0	29.8	0.0	0.0	0.0	0.0
+ Non-metallic minerals	0.0	Z	Z	Z	0.0	0.0	1 089.5	4.3	0.0	0.0	0.0
+ Transport equipment	0.0	Z	Z	Z	0.0	0.0	212.9	12.6	0.0	0.0	9.8
+ Machinery	0.0	Z	Z	Z	0.0	0.0	416.7	7.7	0.0	0.0	5.7
+ Mining & quarrying	0.0	Z	Z	Z	0.0	0.0	216.0	1.2	0.0	0.0	0.0
+ Food, beverages & tobacco	0.0	Z	Z	Z	0.0	0.0	2 357.2	7.6	0.0	0.0	1.2
+ Paper, pulp & printing	0.0	Z	Z	Z	0.0	0.0	161.6	1.3	0.0	0.0	0.0
+ Wood & wood products	0.0	Z	Z	Z	0.0	0.0	123.2	12.9	0.0	0.0	0.0
+ Construction	0.0	Z	Z	Z	0.0	0.0	109.8	48.9	0.0	0.0	0.0
+ Textile & leather	0.0	Z	Z	Z	0.0	0.0	201.3	0.5	0.0	0.0	0.0
+ Not elsewhere specified (industry)	0.0	Z	Z	Z	0.0	0.0	458.5	1.5	0.0	0.0	0.2
+ Transport sector	0.0	Z	Z	Z	0.0	0.0	84 180.0	226 860.3	249.1	0.0	1 875.0
+ Rail	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Road	0.0	Z	Z	Z	0.0	0.0	84 180.0	226 860.3	0.0	0.0	0.0
+ Domestic aviation	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	249.1	0.0	1 875.0
+ Domestic navigation	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Pipeline transport	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Not elsewhere specified (transport)	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Other sectors	0.0	Z	Z	Z	0.0	0.0	21 160.0	84.4	0.0	0.0	0.0
+ Commercial & public services	0.0	Z	Z	Z	0.0	0.0	1 380.0	0.0	0.0	0.0	0.0
+ Households	0.0	Z	Z	Z	0.0	0.0	17 940.0	0.0	0.0	0.0	0.0
+ Agriculture & forestry	0.0	Z	Z	Z	0.0	0.0	1 838.7	84.4	0.0	0.0	0.0
+ Fishing	0.0	Z	Z	Z	0.0	0.0	1.3	0.0	0.0	0.0	0.0
+ Not elsewhere specified (other)	0.0	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Statistical differences	0.0	-1 152.8	218.7	0.0	0.0	0.0	1 601.4	0.0	-118.6	0.0	-1 971.7

TJ 2024	Other kerosene	Naphtha	Gas oil and diesel oil (excluding biofuel portion)	Fuel oil	White spirit and special boiling point industrial spirits	Lubricants	Bitumen	Petroleum coke	Paraffin waxes	Other oil products	Natural gas
+ Primary production	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	128 948.0
+ Recovered & recycled products	0.0	0.0	0.0	0.0	0.0	2 520.0	0.0	0.0	0.0	0.0	Z
+ Imports	86.0	0.0	285 782.7	1 727.1	2 854.0	14 115.1	9 741.3	1 126.2	4 094.4	3 372.8	562 289.2
- Exports	0.0	26 400.0	78 927.8	65 878.3	1 026.0	13 799.6	9 143.6	9 212.0	313.1	6 073.2	3 422.5
+ Change in stock	-2.0	1 320.0	-28 055.7	808.0	1 177.2	-597.4	-286.1	70.6	74.8	1 932.0	22 576.5
= Gross available energy	84.0	-25 080.0	178 799.3	-63 343.2	3 005.2	2 238.1	311.6	-8 015.2	3 856.1	-768.4	710 391.2
- International maritime bunkers	0.0	0.0	5 990.7	1 508.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
= Gross inland consumption	84.0	-25 080.0	172 808.6	-64 851.2	3 005.2	2 238.1	311.6	-8 015.2	3 856.1	-768.4	710 391.2
- International aviation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z
= Total energy supply	84.0	-25 080.0	172 808.6	-64 851.2	3 005.2	2 238.1	311.6	-8 015.2	3 856.1	-768.4	710 391.2
Transformation input	0.0	18 861.4	3 527.1	14 918.5	0.0	3 360.0	0.0	0.0	14.6	5 885.1	167 218.5
+ Electricity & heat generation	0.0	0.0	3 234.5	14 918.5	0.0	0.0	0.0	0.0	0.0	0.0	167 182.7
+ Main activity producer electricity only	0.0	0.0	129.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16 290.0
+ Main activity producer CHP	0.0	0.0	1 392.2	4 236.9	0.0	0.0	0.0	0.0	0.0	0.0	85 005.2
+ Main activity producer heat only	0.0	0.0	1 620.4	116.3	0.0	0.0	0.0	0.0	0.0	0.0	14 813.5
+ Autoproducer electricity only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Autoproducer CHP	0.0	0.0	48.9	10 549.1	0.0	0.0	0.0	0.0	0.0	0.0	50 103.2
+ Autoproducer heat only	0.0	0.0	43.9	16.2	0.0	0.0	0.0	0.0	0.0	0.0	970.8
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electric boilers	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for pumped storage	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for charging batteries	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Derived heat for electricity production	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Blast furnaces	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Refineries & petrochemical industry	0.0	18 861.4	292.7	0.0	0.0	3 360.0	0.0	0.0	14.6	5 885.1	Z
+ Liquid biofuels blended	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.8
Transformation output	0.0	102 729.3	583 785.7	107 575.9	1 251.0	18 132.7	50 338.0	12 800.0	2 023.8	33 069.2	0.0
+ Electricity & heat generation	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electric boilers	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Pumped hydro	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Other sources	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Refineries & petrochemical industry	0.0	102 729.3	583 785.7	107 575.9	1 251.0	18 132.7	50 338.0	12 800.0	2 023.8	33 069.2	Z
+ Liquid biofuels blended	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Energy sector	0.3	0.0	1 159.4	20 724.7	0.0	0.0	0.0	0.0	0.0	34.9	59 439.6
+ Own use in electricity & heat generation	0.0	0.0	166.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	380.3
+ Coal mines	0.2	0.0	866.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	191.9
+ Oil & natural gas extraction plants	0.0	0.0	126.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21 944.2
+ Coke ovens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0
+ Gas works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Petroleum refineries (oil refineries)	0.0	0.0	0.0	20 724.7	0.0	0.0	0.0	0.0	0.0	32.2	33 256.8
+ Liquefaction & regasification plants (LNG)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	2 769.1
+ Not elsewhere specified (energy)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	886.3
Distribution losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	367.6
Available for final consumption	83.8	58 787.9	751 907.7	7 081.5	4 256.2	17 010.8	50 649.7	4 784.8	5 865.3	26 380.7	483 365.5
Final non-energy consumption	0.4	56 919.8	0.0	0.0	4 256.1	9 003.4	50 649.7	0.0	5 865.3	19 848.8	60 052.7
+ Non-energy use industry/transformation/energ	0.4	56 919.8	0.0	0.0	214.6	971.9	50 649.7	0.0	1 356.3	19 848.8	60 052.7
+ Non-energy use in transport sector	0.0	0.0	0.0	0.0	0.0	5 019.1	0.0	0.0	0.0	0.0	0.0
+ Non-energy use in other sectors	0.0	0.0	0.0	0.0	4 041.6	3 012.4	0.0	0.0	4 509.0	0.0	0.0
Final energy consumption	86.1	0.0	750 926.4	1 999.5	0.0	0.0	0.0	2 314.8	0.0	30.9	404 279.9
+ Industry sector	3.0	0.0	10 953.6	1 979.4	0.0	0.0	0.0	2 314.8	0.0	30.9	163 275.3
+ Iron & steel	0.0	0.0	69.7	0.0	0.0	0.0	0.0	59.6	0.0	0.2	19 929.5
+ Chemical & petrochemical	0.5	0.0	1 297.3	75.5	0.0	0.0	0.0	0.0	0.0	1.2	18 773.0
+ Non-ferrous metals	0.0	0.0	37.6	261.8	0.0	0.0	0.0	0.4	0.0	0.0	7 171.2
+ Non-metallic minerals	0.1	0.0	503.7	119.4	0.0	0.0	0.0	2 114.9	0.0	0.0	42 601.8
+ Transport equipment	1.0	0.0	665.3	2.9	0.0	0.0	0.0	0.0	0.0	0.3	4 627.3
+ Machinery	0.9	0.0	391.6	7.5	0.0	0.0	0.0	0.0	0.0	1.0	9 138.5
+ Mining & quarrying	0.0	0.0	3 702.9	0.0	0.0	0.0	0.0	139.9	0.0	12.4	1 331.8
+ Food, beverages & tobacco	0.0	0.0	929.9	259.3	0.0	0.0	0.0	0.0	0.0	0.2	38 748.8
+ Paper, pulp & printing	0.3	0.0	360.4	816.4	0.0	0.0	0.0	0.0	0.0	0.7	9 898.5
+ Wood & wood products	0.0	0.0	303.4	81.0	0.0	0.0	0.0	0.0	0.0	0.0	1 544.8
+ Construction	0.0	0.0	2 431.8	311.0	0.0	0.0	0.0	0.0	0.0	14.4	1 407.8
+ Textile & leather	0.0	0.0	48.0	23.9	0.0	0.0	0.0	0.0	0.0	0.5	1 500.7
+ Not elsewhere specified (industry)	0.0	0.0	211.9	20.8	0.0	0.0	0.0	0.0	0.0	0.1	6 601.6
+ Transport sector	0.0	0.0	631 633.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3 836.8
+ Rail	0.0	0.0	3 400.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z
+ Road	0.0	0.0	628 195.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2 340.9
+ Domestic aviation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z
+ Domestic navigation	0.0	0.0	35.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z
+ Pipeline transport	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 495.9
+ Not elsewhere specified (transport)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+ Other sectors	83.1	0.0	108 339.8	20.0	0.0	0.0	0.0	0.0	0.0	0.0	237 167.8
+ Commercial & public services	29.1	0.0	15 480.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58 048.4
+ Households	0.0	0.0	4 214.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	177 271.7
+ Agriculture & forestry	0.0	0.0	88 607.9	20.0	0.0	0.0	0.0	0.0	0.0	0.0	1 844.6
+ Fishing	0.0	0.0	37.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2
+ Not elsewhere specified (other)	54.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Statistical differences	-2.7	1 868.2	981.3	5 082.0	0.0	8 007.4	0.0	2 470.0	0.0	6 501.0	19 032.9

TJ 2024	Renewable and biofuels	Hydro	Tide, wave, ocean	Wind	Solar photovoltaic	Solar thermal	Geothermal	Primary solid biofuels	Charcoal	Biogases	Renewable municipal waste
+ Primary production	609 800.6	7 612.3	0.0	89 802.8	63 585.9	4 051.8	1 556.0	343 636.8	Z	17 105.1	5 065.6
+ Recovered & recycled products	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Imports	31 987.5	Z	Z	Z	Z	0.0	0.0	9 182.4	0.0	0.0	0.0
- Exports	22 684.4	Z	Z	Z	Z	0.0	0.0	8 981.0	0.0	0.0	0.0
+ Change in stock	-335.4	Z	Z	Z	Z	Z	Z	0.0	0.0	0.0	0.0
= Gross available energy	618 768.4	7 612.3	0.0	89 802.8	63 585.9	4 051.8	1 556.0	343 838.2	0.0	17 105.1	5 065.6
- International maritime bunkers	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
= Gross inland consumption	618 768.4	7 612.3	0.0	89 802.8	63 585.9	4 051.8	1 556.0	343 838.2	0.0	17 105.1	5 065.6
- International aviation	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
= Total energy supply	618 768.4	7 612.3	0.0	89 802.8	63 585.9	4 051.8	1 556.0	343 838.2	0.0	17 105.1	5 065.6
Transformation input	300 395.8	7 612.3	0.0	89 802.8	63 585.9	0.0	0.0	70 391.4	0.0	12 154.1	4 029.4
+ Electricity & heat generation	247 584.7	7 612.3	0.0	89 802.8	63 585.9	0.0	0.0	70 391.4	0.0	12 154.1	4 029.4
+ Main activity producer electricity only	119 532.0	7 601.6	0.0	89 802.8	8 727.7	0.0	0.0	13 400.0	Z	0.0	0.0
+ Main activity producer CHP	46 786.5	Z	Z	Z	Z	0.0	0.0	37 443.3	Z	7 868.8	1 474.4
+ Main activity producer heat only	8 090.6	Z	Z	Z	Z	0.0	0.0	8 080.6	Z	10.0	0.0
+ Autoproducer electricity only	54 869.1	10.8	0.0	0.0	54 858.3	0.0	0.0	0.0	Z	0.0	0.0
+ Autoproducer CHP	17 750.5	Z	Z	Z	Z	0.0	0.0	11 015.2	Z	4 229.9	2 505.4
+ Autoproducer heat only	556.1	Z	Z	Z	Z	0.0	0.0	452.4	Z	45.4	49.6
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for pumped storage	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for charging batteries	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Derived heat for electricity production	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Blast furnaces	0.0	Z	Z	Z	Z	Z	Z	Z	0.0	0.0	Z
+ Refineries & petrochemical industry	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Liquid biofuels blended	52 811.2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
Transformation output	52 811.2	Z	Z	Z	Z	Z	Z	Z	0.0	0.0	Z
+ Electricity & heat generation	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Pumped hydro	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Other sources	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Blast furnaces	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Refineries & petrochemical industry	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Liquid biofuels blended	52 811.2	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Gas-to-liquids plants	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Energy sector	27.8	Z	Z	Z	Z	0.0	0.0	27.8	0.0	0.0	0.0
+ Own use in electricity & heat generation	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Coal mines	27.8	Z	Z	Z	Z	0.0	0.0	27.8	0.0	0.0	0.0
+ Oil & natural gas extraction plants	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Gas works	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Petroleum refineries (oil refineries)	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Liquefaction & regasification plants (LNG)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (energy)	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
Distribution losses	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
Available for final consumption	371 156.0	0.0	0.0	0.0	0.0	4 051.8	1 556.0	273 419.0	0.0	4 951.0	1 036.1
Final non-energy consumption	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Non-energy use industry/transformation/energy	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Non-energy use in transport sector	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Non-energy use in other sectors	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Final energy consumption	371 100.6	Z	Z	Z	Z	4 051.8	1 556.0	273 365.7	0.0	4 949.3	1 036.1
+ Industry sector	67 920.5	Z	Z	Z	Z	0.0	0.0	66 037.1	0.0	1 144.6	738.7
+ Iron & steel	5.7	Z	Z	Z	Z	0.0	0.0	5.7	0.0	0.0	0.0
+ Chemical & petrochemical	260.5	Z	Z	Z	Z	0.0	0.0	204.5	0.0	56.0	0.0
+ Non-ferrous metals	0.7	Z	Z	Z	Z	0.0	0.0	0.7	0.0	0.0	0.0
+ Non-metallic minerals	4 014.9	Z	Z	Z	Z	0.0	0.0	4 014.9	0.0	0.0	0.0
+ Transport equipment	77.1	Z	Z	Z	Z	0.0	0.0	77.1	0.0	0.0	0.0
+ Machinery	81.7	Z	Z	Z	Z	0.0	0.0	81.7	0.0	0.0	0.0
+ Mining & quarrying	3.4	Z	Z	Z	Z	0.0	0.0	3.4	0.0	0.0	0.0
+ Food, beverages & tobacco	1 684.2	Z	Z	Z	Z	0.0	0.0	955.2	0.0	728.4	2.7
+ Paper, pulp & printing	27 812.2	Z	Z	Z	Z	0.0	0.0	26 774.8	0.0	301.4	736.0
+ Wood & wood products	29 519.9	Z	Z	Z	Z	0.0	0.0	29 489.1	0.0	30.8	0.0
+ Construction	67.7	Z	Z	Z	Z	0.0	0.0	37.7	0.0	30.0	0.0
+ Textile & leather	15.3	Z	Z	Z	Z	0.0	0.0	15.3	0.0	0.0	0.0
+ Not elsewhere specified (industry)	4 377.0	Z	Z	Z	Z	0.0	0.0	4 377.0	0.0	0.0	0.0
+ Transport sector	57 590.6	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Rail	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Road	57 590.6	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Domestic aviation	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Domestic navigation	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Pipeline transport	0.0	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (transport)	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
+ Other sectors	245 589.5	Z	Z	Z	Z	4 051.8	1 556.0	207 328.6	0.0	3 804.7	297.4
+ Commercial & public services	11 750.9	Z	Z	Z	Z	217.7	389.0	6 166.8	0.0	3 261.1	297.4
+ Households	216 908.2	Z	Z	Z	Z	3 834.1	1 167.0	184 775.0	0.0	0.0	0.0
+ Agriculture & forestry	16 927.8	Z	Z	Z	Z	0.0	0.0	16 384.2	0.0	543.6	0.0
+ Fishing	2.6	Z	Z	Z	Z	0.0	0.0	2.6	0.0	0.0	0.0
+ Not elsewhere specified (other)	0.0	Z	Z	Z	Z	0.0	0.0	0.0	0.0	0.0	0.0
Statistical differences	55.4	0.0	0.0	0.0	0.0	0.0	0.0	53.3	0.0	1.7	0.0

TJ 2024	Pure biogasoline	Blended biogasoline	Pure biodiesels	Blended biodiesels	Pure bio jet kerosene	Blended bio jet kerosene	Other liquid biofuels	Ambient heat (heat pumps)	Non-renewable waste
+ Primary production	11 099.3	Z	37 725.0	Z	0.0	Z	4.9	28 555.1	42 174.6
+ Recovered & recycled products	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Imports	2 163.2	1 961.0	15 862.5	2 818.4	0.0	0.0	0.0	Z	0.0
- Exports	986.1	0.0	12 717.2	0.0	0.0	0.0	0.0	Z	0.0
+ Change in stock	-159.7	0.0	-175.8	0.0	0.0	0.0	0.0	Z	0.0
= Gross available energy	12 116.7	1 961.0	40 694.5	2 818.4	0.0	0.0	4.9	28 555.1	42 174.6
- International maritime bunkers	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
= Gross inland consumption	12 116.7	1 961.0	40 694.5	2 818.4	0.0	0.0	4.9	28 555.1	42 174.6
- International aviation	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
= Total energy supply	12 116.7	1 961.0	40 694.5	2 818.4	0.0	0.0	4.9	28 555.1	42 174.6
Transformation input	12 116.7	0.0	40 694.5	0.0	0.0	0.0	3.8	4.9	9 851.7
+ Electricity & heat generation	0.0	0.0	0.0	0.0	0.0	0.0	3.8	4.9	9 851.7
+ Main activity producer electricity only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Main activity producer CHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	1 800.0
+ Main activity producer heat only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.5
+ Autoproducer electricity only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Autoproducer CHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	7 560.1
+ Autoproducer heat only	0.0	0.0	0.0	0.0	0.0	0.0	3.8	4.9	463.1
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for pumped storage	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electricity for charging batteries	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Derived heat for electricity production	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Blast furnaces	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	Z
+ Refineries & petrochemical industry	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Liquid biofuels blended	12 116.7	Z	40 694.5	Z	0.0	Z	0.0	Z	Z
+ Not elsewhere specified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformation output	Z	12 116.7	Z	40 694.5	Z	0.0	Z	Z	Z
+ Electricity & heat generation	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Main activity producer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer electricity only	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer CHP	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Autoproducer heat only	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Electrically driven heat pumps	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Pumped hydro	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Other sources	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Coke ovens	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Blast furnaces	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Refineries & petrochemical industry	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Liquid biofuels blended	Z	12 116.7	Z	40 694.5	Z	0.0	Z	Z	Z
+ Gas-to-liquids plants	Z	Z	Z	Z	Z	Z	Z	Z	Z
Energy sector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Own use in electricity & heat generation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Coal mines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Oil & natural gas extraction plants	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Coke ovens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Gas works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Petroleum refineries (oil refineries)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Liquefaction & regasification plants (LNG)	Z	Z	Z	Z	Z	Z	Z	Z	Z
+ Not elsewhere specified (energy)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
Distribution losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
Available for final consumption	0.0	14 077.7	0.0	43 512.9	0.0	0.0	1.1	28 550.2	32 322.8
Final non-energy consumption	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Non-energy use industry/transformation/energy	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Non-energy use in transport sector	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Non-energy use in other sectors	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
Final energy consumption	0.0	14 077.7	0.0	43 512.9	0.0	0.0	0.7	28 550.2	32 314.1
+ Industry sector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30 858.3
+ Iron & steel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Chemical & petrochemical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	51.1
+ Non-ferrous metals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Non-metallic minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	29 877.9
+ Transport equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Machinery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.4
+ Mining & quarrying	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	69.4
+ Food, beverages & tobacco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Paper, pulp & printing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	798.3
+ Wood & wood products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	30.3
+ Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.1
+ Textile & leather	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.2
+ Not elsewhere specified (industry)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	30.5
+ Transport sector	0.0	14 077.7	0.0	43 512.9	0.0	0.0	0.0	Z	0.0
+ Rail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Road	0.0	14 077.7	0.0	43 512.9	0.0	0.0	0.0	Z	0.0
+ Domestic aviation	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Domestic navigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Pipeline transport	Z	0.0	Z	0.0	Z	0.0	Z	Z	Z
+ Not elsewhere specified (transport)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Other sectors	0.0	0.0	0.0	0.0	0.0	0.0	0.7	28 550.2	1 455.8
+ Commercial & public services	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1 418.2	1 455.8
+ Households	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27 132.1	0.0
+ Agriculture & forestry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Z	0.0
+ Not elsewhere specified (other)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Statistical differences	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	8.7

TJ 2024	Industrial waste (non-renewable)	Non-renewable municipal waste	Nuclear heat	Heat	Electricity	Fossil energy	Bioenergy
+ Primary production	28 622.2	13 552.4	0.0	440.0	Z	1 598 919.3	414 636.6
+ Recovered & recycled products	Z	Z	Z	Z	Z	8 518.9	0.0
+ Imports	0.0	0.0	Z	0.0	54 762.8	2 456 153.1	34 513.6
- Exports	0.0	0.0	Z	0.0	47 687.6	588 798.1	24 884.1
+ Change in stock	0.0	0.0	Z	Z	Z	17 840.2	-335.4
= Gross available energy	28 622.2	13 552.4	0.0	440.0	7 075.3	3 492 633.2	423 930.7
- International maritime bunkers	Z	Z	Z	Z	Z	7 498.7	0.0
= Gross inland consumption	28 622.2	13 552.4	0.0	440.0	7 075.3	3 485 134.6	423 930.7
- International aviation	Z	Z	Z	Z	Z	55 747.1	0.0
= Total energy supply	28 622.2	13 552.4	0.0	440.0	7 075.3	3 429 387.4	423 930.7
Transformation input	1 288.9	8 562.9	0.0	1 599.0	10 666.1	2 843 407.7	140 034.2
+ Electricity & heat generation	1 288.9	8 562.9	0.0	1 599.0	10 666.1	1 232 294.5	87 223.0
+ Main activity producer electricity only	0.0	0.0	0.0	0.0	Z	46 569.1	13 400.0
+ Main activity producer CHP	200.0	1 600.0	0.0	0.0	Z	982 360.0	46 786.5
+ Main activity producer heat only	28.5	0.0	0.0	0.0	Z	86 545.2	8 090.6
+ Autoproducer electricity only	0.0	0.0	0.0	0.0	Z	0.0	0.0
+ Autoproducer CHP	797.2	6 762.9	0.0	440.0	Z	103 019.0	17 792.4
+ Autoproducer heat only	263.1	200.0	0.0	0.0	Z	5 416.5	551.2
+ Electrically driven heat pumps	Z	Z	Z	Z	2.3	1.6	0.1
+ Electricity for pumped storage	Z	Z	Z	Z	5 088.8	3 502.6	234.7
+ Electricity for charging batteries	Z	Z	Z	Z	5 574.9	3 837.2	257.2
+ Derived heat for electricity production	Z	Z	Z	1 159.0	Z	1 043.3	110.4
+ Coke ovens	Z	Z	Z	Z	Z	297 651.8	0.0
+ Blast furnaces	Z	Z	Z	Z	Z	48 578.9	0.0
+ Refineries & petrochemical industry	Z	Z	Z	Z	Z	1 260 719.8	0.0
+ Liquid biofuels blended	Z	Z	Z	Z	Z	0.0	52 811.2
+ Not elsewhere specified	0.0	0.0	Z	Z	Z	4 162.6	0.0
Transformation output	Z	Z	Z	259 608.4	620 581.3	2 234 132.6	106 158.8
+ Electricity & heat generation	Z	Z	Z	259 608.4	620 581.3	660 840.0	53 347.7
+ Main activity producer electricity only	Z	Z	Z	Z	132 844.0	91 435.3	6 127.8
+ Main activity producer CHP	Z	Z	Z	152 410.4	373 184.8	394 059.6	31 727.7
+ Main activity producer heat only	Z	Z	Z	83 972.4	Z	75 591.9	7 996.4
+ Autoproducer electricity only	Z	Z	Z	Z	54 869.1	37 765.9	2 531.0
+ Autoproducer CHP	Z	Z	Z	17 499.8	55 869.8	54 208.0	4 243.6
+ Autoproducer heat only	Z	Z	Z	4 538.4	Z	4 085.5	432.2
+ Electrically driven heat pumps	Z	Z	Z	7.3	Z	6.6	0.7
+ Pumped hydro	Z	Z	Z	Z	3 633.7	2 501.0	167.6
+ Other sources	Z	Z	Z	1 180.0	180.0	1 186.1	120.7
+ Coke ovens	Z	Z	Z	Z	Z	282 560.1	0.0
+ Blast furnaces	Z	Z	Z	Z	Z	21 755.3	0.0
+ Refineries & petrochemical industry	Z	Z	Z	Z	Z	1 248 577.1	0.0
+ Liquid biofuels blended	Z	Z	Z	Z	Z	0.0	52 811.2
+ Gas-to-liquids plants	Z	Z	Z	Z	Z	20 400.0	0.0
Energy sector	0.0	0.0	Z	23 295.7	83 788.2	219 430.3	6 111.1
+ Own use in electricity & heat generation	0.0	0.0	Z	5 850.0	37 313.4	31 505.2	2 278.3
+ Coal mines	0.0	0.0	Z	2 661.7	16 152.7	15 038.5	1 026.3
+ Oil & natural gas extraction plants	Z	Z	Z	0.0	628.4	22 503.4	29.0
+ Coke ovens	0.0	0.0	Z	774.5	2 231.5	40 205.6	176.7
+ Gas works	0.0	0.0	Z	16.5	151.1	118.9	8.5
+ Petroleum refineries (oil refineries)	0.0	0.0	Z	196.2	10 406.1	82 348.1	498.7
+ Liquefaction & regasification plants (LNG)	Z	Z	Z	0.0	245.4	2 938.0	11.3
+ Not elsewhere specified (energy)	0.0	0.0	Z	13 796.6	16 659.6	24 772.7	2 082.3
Distribution losses	0.0	0.0	Z	27 147.0	31 078.8	46 196.6	4 018.7
Available for final consumption	27 333.3	4 989.5	0.0	208 006.7	502 123.5	2 554 485.4	379 925.6
Final non-energy consumption	Z	Z	Z	Z	Z	212 177.4	0.0
+ Non-energy use industry/transformation/energy	Z	Z	Z	Z	Z	196 602.7	0.0
+ Non-energy use in transport sector	Z	Z	Z	Z	Z	5 019.1	0.0
+ Non-energy use in other sectors	Z	Z	Z	Z	Z	10 555.5	0.0
Final energy consumption	27 289.6	5 024.5	Z	208 006.7	502 123.6	2 342 786.6	379 912.1
+ Industry sector	26 468.3	4 390.0	Z	29 689.7	192 068.3	477 793.2	79 607.4
+ Iron & steel	0.0	0.0	Z	2 029.7	18 078.0	48 853.7	1 032.8
+ Chemical & petrochemical	51.1	0.0	Z	11 804.7	26 944.2	93 746.6	2 627.5
+ Non-ferrous metals	0.0	0.0	Z	626.2	7 544.3	15 262.2	408.3
+ Non-metallic minerals	25 487.9	4 390.0	Z	949.6	18 843.6	103 625.6	4 974.5
+ Transport equipment	0.0	0.0	Z	1 255.6	11 963.8	15 138.8	748.6
+ Machinery	0.4	0.0	Z	1 701.2	18 066.2	24 548.7	1 077.1
+ Mining & quarrying	69.4	0.0	Z	2 130.6	10 659.8	15 542.0	698.0
+ Food, beverages & tobacco	0.0	0.0	Z	2 266.6	29 629.7	85 008.9	3 266.8
+ Paper, pulp & printing	798.3	0.0	Z	2 546.0	17 877.0	31 003.6	28 879.3
+ Wood & wood products	30.3	0.0	Z	2 685.8	8 399.4	11 102.4	30 163.1
+ Construction	0.1	0.0	Z	166.3	1 725.0	6 983.8	163.1
+ Textile & leather	0.2	0.0	Z	282.1	1 789.4	3 455.4	124.8
+ Not elsewhere specified (industry)	30.5	0.0	Z	1 245.3	20 547.9	23 521.5	5 443.4
+ Transport sector	0.0	0.0	Z	Z	14 180.9	958 290.1	58 244.7
+ Rail	0.0	0.0	Z	Z	12 137.1	11 818.3	559.9
+ Road	0.0	0.0	Z	Z	1 326.0	942 309.1	57 651.8
+ Domestic aviation	Z	Z	Z	Z	Z	2 124.1	0.0
+ Domestic navigation	0.0	0.0	Z	Z	Z	46.9	0.0
+ Pipeline transport	Z	Z	Z	Z	717.9	1 991.7	33.1
+ Not elsewhere specified (transport)	0.0	0.0	Z	Z	0.0	0.0	0.0
+ Other sectors	821.4	634.5	Z	178 317.0	295 874.3	906 703.3	242 059.9
+ Commercial & public services	821.4	634.5	Z	40 397.0	172 452.8	240 835.0	21 527.7
+ Households	0.0	0.0	Z	137 300.0	117 085.2	555 037.7	203 250.5
+ Agriculture & forestry	0.0	0.0	Z	620.0	6 300.0	110 708.1	17 277.4
+ Fishing	0.0	0.0	Z	0.0	36.3	68.5	4.2
+ Not elsewhere specified (other)	0.0	0.0	Z	0.0	0.0	54.0	0.0
Statistical differences	43.7	-35.0	0.0	0.0	0.0	Z	Z

Annex 4. Quality Assurance and Quality Control

Quality Assurance/Quality Control and Verification programme for the Polish annual greenhouse gas inventory has been elaborated and updated if needed. It has been elaborated in line with the 2006 *IPCC Guidelines for National GHG Inventories*. The QA/QC programme aiming at improving and assuring the high quality of GHG inventories contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures. Detailed domestic QA/QC plan is a part of QA/QC programme.

Quality Control (QC) activities are carried out by the personnel directly responsible for the inventory and are aimed at keeping its high standards and quality.

Within the national inventory the main activities underlying Quality Control process are conducted using *Tier 1* method and relate to all source/sink categories. Tier 2 procedures are carried out for main key categories with special attention to the energy sector.

Following the Chapter 6 of the 2006 *IPCC Guidelines for National GHG Inventories*, Quality control (QC) covers routine technical activities carried out with the aim of quality control of national emissions and removals inventories allowing for:

- Maintaining the correctness and completeness of data,

Quality Control activities contain: checks for accuracy of data and estimations acquiring as well as application of approved procedures for calculation of emissions, uncertainty, archiving of information and reporting.

Activities aiming at **quality assurance (QA)** cover procedural system for control carried out by experts not involved directly in elaborating GHG inventory in a given sector. QA activities are conducted over a completed inventory and allow to ensure that national inventory represents top level of emissions and removals assessment at the present knowledge and available data and effectively support quality control (QC).

Verification activities – where possible – include comparisons with external emission analyses estimates and databases conducted by independent bodies or teams. They allow to improve inventory methods and outcomes in both short and long terms.

The Polish inventory is directly based on sectoral activity data and carried out in two main steps. First, calculations are produced around 12 months after the end of the inventoried year (n-1) depending primarily on the availability of required activity data. Initial check of activity data and estimation procedures is then done. When the official statistics are available the revision of data is made and final inventory is produced up to 15 months after given year. Additionally the recalculations of the previous inventories for selected categories are performed because of methodological changes and improvements. The timetable for inventory preparation and QA/QC activities conducted at respective stages of the inventory preparation are presented in Table 1.

The basic elements of QA/QC plan are implemented and co-ordinated by the National Centre for Emission and Management (KOBIZE), the unit responsible for Polish GHG inventory preparation. It follows the 2006 *IPCC Guidelines for National GHG Inventories* recommendations. The main procedures for QA/QC activities are described in the *National Quality Assurance / Quality Control and Verification Programme of the Polish Greenhouse Gas Inventory* and the detail check procedures are contained below as the examples of QC procedures performed by KOBIZE experts.

General timeframes of annual inventory preparation (including checking procedures),

approval and submission are presented in the table 1. The dates for particular stages are established based on country specific availability of statistical data as well as national (legal) and international obligations.

Table 1. Timetable for inventory preparation and check (n – submission year)

Timing	Activity
June -15 December (year n-1)	Data and emission factors collection (estimation) Check for consistency and correctness of the emission data, trends and factors, using all the relevant methods of both QC and verification outlined in the Programme (points 6-8 and 10) Initial calculations and checks of GHG emissions considering ERT recommendations Submission to the Ministry of Climate for acceptance
15 January (year n-2)	Submission of PL GHG inventory for the year n-2 and elements of NIR to the EIONET CDR (required by regulation (EU) No 525/2013 Article 7.1)
15 December – 15 February (year n-2)	Emission results and methodology verification based on remarks and comments made by ministerial emission experts (QA methods applied) Elaboration of final inventory, additional checks and final corrections to the inventory, preparation of NIR and CRT tables (QC and verification methods applied) Additional CRT and NIR quality upgrading on the basis of EEA control questions and remarks - corrections of any possible mistakes or deficiencies if found (QA methods applied) Submission to the Ministry of the Climate for acceptance
15 March (year n-2)	Emission results and methodology verification based on remarks and comments made by external sectoral experts within inter-ministerial and inter-institutional check of the report (QA methods applied) Submission of complete National Inventory Report and CRT tables to the EIONET CDR (required by regulation (EU) No 525/2013 Article 7.3)
15 April (year n-2)	Submission of GHG inventory for the year n-2 to the UNFCCC Secretariat (CRT and NIR) (required by decision 24/CP.19)

Each IPCC sector undergoes detail QC procedure which is carried out by expert responsible for given category/subcategory. Check for correctness of data, emission factors and calculation results are performed several times during the following stages of inventory elaboration: during its preparation, after completing the calculations, after CRT tables generation and after NIR report completing. Additionally part of the data, especially for Energy sector, are checked by other KOBIZE experts than those making inventory who are responsible for other sectors. As a part of QA activity the inventory team cooperates with specialists from different institutes, associations and individual experts who are involved in verification of data and assumptions to the inventory.

Procedures for quality assurance of the national inventories cover both actions performed by domestic agencies as well as by foreign (EU, UNFCCC). The National Inventory Report is delivered to the Ministry of Climate, where it is consulted in two stages: internally, among suitable departments, and externally - in inter-ministerial dialogue. In this second stage branch institutes supervised by ministers are engaged to review the inventory.

After including obtained comments and amendments into the NIR, according to recommendations delivered during the inter-ministerial compliance, the Ministry of Climate initiates the procedure for governmental acceptance of the NIR by the Committee for the European Affairs after which both NIR and underlying CRT tables are conveyed to the UNFCCC. The same report and data are sent earlier to the European Commission pursuant to the timeline determined in the regulation (EU) No 525/2013.

The inventory results and methodology applied for emission estimation are also subject to wide discussions during domestic conferences and seminars. Additionally National Inventory Reports are available, in Polish, at the website of KOBIZE. Broader participation of academic

circles in reviewing the overall inventory is planned under the QA procedures. For the time being such reviews were conducted occasionally.

The national inventory results are also verified by the European Union. Since 2012 this verification, being the element of inventory quality control, is performed in a wide range using the *EEA Emission Review Tool (EMRT)* available through the website. This verification is made in February and March after submission of emission results following Article 7.1 of the regulation (EU) No 525/2013. In the given time detail explanations are prepared what is accompanied by additional check of data and calculations. If the problem is acknowledged as solved, such information is set in the communication table. Potential corrections of data resulting from EU verification are introduced into emission inventory.

Two-stage procedures controlling the results of the national inventory submitted in the form of CRT files performed by the UNFCCC Secretariat also constitute important element for quality assurance of the Polish emission inventory. When analysis of questions sent is prepared under the stage 2 of the UNFCCC check, the inventory experts perform additional check of data and results and prepare the response for comments. This is the first step for international review performed by Expert Review Team. The international review of the Polish GHG inventory made on an annual basis under UNFCCC constitutes one of the key elements in the process of further improvement the quality of reported data.

There are also internal deliberations on the usefulness of an idea to engage systemically external reviewers from R&D Institutes, Branch Associations, Industrial Chambers, individual plants as well as independent experts in verification of the inventory assumptions and results. Such a scrutiny should help find cost-utility balance of this kind of an extensive review process.

Depending on methodology used for emission estimation within categories Tier 1 or Tier 2 check procedures are carried out. The extended QC procedure for checking the correctness of emissions estimations is used for these categories where country specific emission factors are established. This concerns the key categories especially for such sectors like: fuel combustion (1.A), transport (1.A.3), cement production (2.A.1), enteric fermentation (3.A), manure management (3.B), and others. For GHG emission sources for which Tier 1 method is used for emission calculation also Tier 1 method is applied for inventory checks.

Data Management Manual has been elaborated in KOBiZE for the purpose of efficient governance with all important information containing databases, software, worksheets, final reports as well as QA/QC documentation regarding to inventory process. For the purposes of documentation of data and calculations QC the files are archived in electronic and hardcopy forms.

Annex 5.1. Comparison of data on fuel consumption from the Eurostat database with the IEA database

Table 1. Analysis of consistency between data from Eurostat and IEA databases for *Other bituminous coal* consumption [kt]

	1990	1991	1992	1993	1994	1995
Production - IEA	118 700	114 236	105 616	103 639	106 610	107 476
Production - EUROSTAT	118 700	114 236	105 616	103 639	106 610	107 476
Production - difference	0	0	0	0	0	0
Imports - IEA	0	0	0	0	428	64
Imports - EUROSTAT	0	0	0	0	428	64
Imports - difference	0	0	0	0	0	0
Exports - IEA	16 839	12 697	11 761	10 139	17 001	19 572
Exports - EUROSTAT	16 839	12 697	11 761	10 139	17 001	19 572
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	0	0	0	2875	-2278	1474
Stock changes - EUROSTAT	0	0	0	2 875	-2 278	1 474
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	552	-1625	-2110	15	-3254	-2495
Statistical differences - EUROSTAT	552	-1 625	-2 110	15	-3 254	-2 495
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	78 013	74 921	69 788	63 293	60 780	55 911
Transformation input - EUROSTAT	78 013	74 921	69 788	63 293	60 780	55 911
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	460	354	273	1 065	2 540	2 718
Energy sector - EUROSTAT	460	354	273	1 065	2 540	2 718
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	23 079	28 238	26 211	32 434	28 499	34 284
Final consumption - EUROSTAT	23 079	28 238	26 211	32 434	28 499	34 284
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	6 740	6 869	6 074	10 861	10 266	16 114
Final consumption - Industry - EUROSTAT	6 740	6 869	6 074	10 861	10 266	16 114
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	147	77	17	14	7	7
Final consumption - Transport - EUROSTAT	147	77	17	14	7	7
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	16 178	21 270	20 101	21 534	18 208	18 144
Final consumption - Other sectors - EUROSTAT	16 178	21 270	20 101	21 534	18 208	18 144
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	12 133	15 952	15 076	16 526	13 929	13 917
Final consumption - Residential - EUROSTAT	12 133	15 952	15 076	16 526	13 929	13 917
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	2 427	2 766	2 325	2 234	1 558	1 560
Final consumption - Commercial and public services - EUROSTAT	2 427	2 766	2 325	2 234	1 558	1 560
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	1 618	2 552	2 700	2 774	2 721	2 667
Final consumption - Agriculture/forestry - EUROSTAT	1 618	2 552	2 700	2 774	2 721	2 667
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 1. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Other bituminous coal* consumption [kt]

	2000	2005	2010	2015	2016	2017
Production - IEA	84 997	83 039	64 514	59 191	57 181	52 999
Production - EUROSTAT	84 997	83 039	64 514	59 191	57 181	52 999
Production - difference	0	0	0	0	0	0
Imports - IEA	189	2762	10448	5597	5791	8813
Imports - EUROSTAT	189	2 762	10 448	5 597	5 791	8 813
Imports - difference	0	0	0	0	0	0
Exports - IEA	17 955	16 218	8 150	6 888	6 638	4 283
Exports - EUROSTAT	17 955	16 218	8 150	6 888	6 638	4 283
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	1696	-1096	5084	54	4546	2462
Stock changes - EUROSTAT	1 696	-1 096	5 084	54	4 546	2 462
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	-2358	-158	1375	-875	-32	-1325
Statistical differences - EUROSTAT	-2 358	-158	1 375	-875	-32	-1 325
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	51 627	50 945	50 470	42 385	43 748	44 339
Transformation input - EUROSTAT	51 627	50 945	50 470	42 385	43 748	44 339
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	1 459	517	101	80	76	64
Energy sector - EUROSTAT	1 459	517	101	80	76	64
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	19 311	17 977	20 506	16 874	17 486	17 409
Final consumption - EUROSTAT	19 311	17 977	20 506	16 874	17 486	17 409
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	9 697	5 683	5 479	4 559	4 434	4 584
Final consumption - Industry - EUROSTAT	9 697	5 683	5 479	4 559	4 434	4 584
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	9 602	12 208	14 943	12 151	12 898	12 709
Final consumption - Other sectors - EUROSTAT	9 602	12 208	14 943	12 151	12 898	12 709
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	7 500	9 811	11 900	9 750	10 350	10 200
Final consumption - Residential - EUROSTAT	7 500	9 811	11 900	9 750	10 350	10 200
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	602	997	1 283	1 001	1 048	1 029
Final consumption - Commercial and public services - EUROSTAT	602	997	1 283	1 001	1 048	1 029
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	1 500	1 400	1 760	1 400	1 500	1 480
Final consumption - Agriculture/forestry - EUROSTAT	1 500	1 400	1 760	1 400	1 500	1 480
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 2. Analysis of consistency between data from Eurostat and IEA databases for *Coking coal* consumption [kt]

	1990	1991	1992	1993	1994	1995
Production - IEA	28 793	25 791	25 697	26 408	26 517	28 714
Production - EUROSTAT	28 793	25 791	25 697	26 408	26 517	28 714
Production - difference	0	0	0	0	0	0
Imports - IEA	560	54	126	129	616	1433
Imports - EUROSTAT	560	54	126	129	616	1 433
Imports - difference	0	0	0	0	0	0
Exports - IEA	11 226	9 767	10 781	12 829	10 694	12 296
Exports - EUROSTAT	11 226	9 767	10 781	12 829	10 694	12 296
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	0	0	0	69	-77	-446
Stock changes - EUROSTAT	0	0	0	69	-77	-446
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	-247	756	109	-6	1038	2017
Statistical differences - EUROSTAT	-247	756	109	-6	1 038	2 017
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	18 374	15 322	14 933	13 783	15 324	15 388
Transformation input - EUROSTAT	18 374	15 322	14 933	13 783	15 324	15 388
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	0	0	0	0	0	0
Energy sector - EUROSTAT	0	0	0	0	0	0
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	0	0	0	0	0	0
Final consumption - EUROSTAT	0	0	0	0	0	0
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	0	0	0	0	0	0
Final consumption - Industry - EUROSTAT	0	0	0	0	0	0
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	0	0	0	0	0	0
Final consumption - Other sectors - EUROSTAT	0	0	0	0	0	0
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	0	0	0	0	0	0
Final consumption - Residential - EUROSTAT	0	0	0	0	0	0
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	0	0	0	0	0	0
Final consumption - Commercial and public services - EUROSTAT	0	0	0	0	0	0
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	0	0	0	0	0	0
Final consumption - Agriculture/forestry - EUROSTAT	0	0	0	0	0	0
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 2. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Coking coal* consumption [kt]

	2000	2005	2010	2015	2016	2017
Production - IEA	17 222	14 071	11 658	12 985	13 204	12 481
Production - EUROSTAT	17 222	14 071	11 658	12 985	13 204	12 481
Production - difference	0	0	0	0	0	0
Imports - IEA	1263	610	3155	2692	2210	3630
Imports - EUROSTAT	1 263	610	3 155	2 692	2 210	3 630
Imports - difference	0	0	0	0	0	0
Exports - IEA	5 290	3 151	1 815	2 303	2 438	2 753
Exports - EUROSTAT	5 290	3 151	1 815	2 303	2 438	2 753
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	137	-373	-662	83	202	-303
Stock changes - EUROSTAT	137	-373	-662	83	202	-303
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	839	-302	-783	54	-85	-7
Statistical differences - EUROSTAT	839	-302	-783	54	-85	-7
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	12 435	11 373	13 107	13 337	13 176	12 980
Transformation input - EUROSTAT	12 435	11 373	13 107	13 337	13 176	12 980
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	40	86	1	64	84	78
Energy sector - EUROSTAT	40	86	1	64	84	78
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	18	0	11	2	3	3
Final consumption - EUROSTAT	18	0	11	2	3	3
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	16	0	10	2	3	3
Final consumption - Industry - EUROSTAT	16	0	10	2	3	3
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	2	0	1	0	0	0
Final consumption - Other sectors - EUROSTAT	2	0	1	0	0	0
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	0	0	0	0	0	0
Final consumption - Residential - EUROSTAT	0	0	0	0	0	0
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	1	0	1	0	0	0
Final consumption - Commercial and public services - EUROSTAT	1	0	1	0	0	0
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	1	0	0	0	0	0
Final consumption - Agriculture/forestry - EUROSTAT	1	0	0	0	0	0
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 3. Consistency analysis between Eurostat and IEA data for *Lignite* consumption [kt]

	1990	1991	1992	1993	1994	1995
Production - IEA	67 584	69 406	66 852	68 105	66 770	63 547
Production - EUROSTAT	67 584	69 406	66 852	68 105	66 770	63 547
Production - difference	0	0	0	0	0	0
Imports - IEA	0	0	18	1	1	13
Imports - EUROSTAT	0	0	18	1	1	13
Imports - difference	0	0	0	0	0	0
Exports - IEA	193	1275	1063	909	719	368
Exports - EUROSTAT	193	1 275	1 063	909	719	368
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	0	-183	-415	24	-18	4
Stock changes - EUROSTAT	0	-183	-415	24	-18	4
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	0	0	-85	0	-205	-158
Statistical differences - EUROSTAT	0	0	-85	0	-205	-158
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	67 172	67 721	65 326	66 614	65 405	62 468
Transformation input - EUROSTAT	67 172	67 721	65 326	66 614	65 405	62 468
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	8	14	8	34	31	33
Energy sector - EUROSTAT	8	14	8	34	31	33
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	211	213	143	573	803	853
Final consumption - EUROSTAT	211	213	143	573	803	853
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	44	84	35	130	63	145
Final consumption - Industry - EUROSTAT	44	84	35	130	63	145
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	2	2	2	0	0	0
Final consumption - Transport - EUROSTAT	2	2	2	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	164	125	105	442	740	707
Final consumption - Other sectors - EUROSTAT	164	125	105	442	740	707
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	63	5	0	345	531	504
Final consumption - Residential - EUROSTAT	63	5	0	345	531	504
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	0	0	0	2	11	3
Final consumption - Commercial and public services - EUROSTAT	0	0	0	2	11	3
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	101	120	105	95	198	200
Final consumption - Agriculture/forestry - EUROSTAT	101	120	105	95	198	200
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 3. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Lignite* consumption [kt]

	2000	2005	2010	2015	2016	2017
Production - IEA	59 484	61 636	56 510	63 128	60 246	61 161
Production - EUROSTAT	59 484	61 636	56 510	63 128	60 246	61 161
Production - difference	0	0	0	0	0	0
Imports - IEA	0	0	24	281	289	328
Imports - EUROSTAT	0	0	24	281	289	328
Imports - difference	0	0	0	0	0	0
Exports - IEA	9	8	115	198	212	256
Exports - EUROSTAT	9	8	115	198	212	256
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	13	-39	174	-164	67	-49
Stock changes - EUROSTAT	13	-39	174	-164	67	-49
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	0	1	-160	2	0	86
Statistical differences - EUROSTAT	0	1	-160	2	0	86
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	59 149	61 075	55 733	62 411	59 846	60 526
Transformation input - EUROSTAT	59 149	61 075	55 733	62 411	59 846	60 526
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	44	19	129	10	7	8
Energy sector - EUROSTAT	44	19	129	10	7	8
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	295	494	891	624	537	563
Final consumption - EUROSTAT	295	494	891	624	537	563
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	48	11	28	64	82	123
Final consumption - Industry - EUROSTAT	48	11	28	64	82	123
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	247	483	861	560	455	440
Final consumption - Other sectors - EUROSTAT	247	483	861	560	455	440
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	137	231	484	380	320	310
Final consumption - Residential - EUROSTAT	137	231	484	380	320	310
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	0	0	177	40	30	30
Final consumption - Commercial and public services - EUROSTAT	0	0	177	40	30	30
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	110	252	200	140	105	100
Final consumption - Agriculture/forestry - EUROSTAT	110	252	200	140	105	100
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 4. Analysis of consistency between data from Eurostat and IEA databases for *Coke oven coke* consumption [kt]

	1990	1991	1992	1993	1994	1995
Production - IEA	13 516	11 356	11 066	10 275	11 455	11 578
Production - EUROSTAT	13 516	11 356	11 066	10 275	11 455	11 578
Production - difference	0	0	0	0	0	0
Imports - IEA	0	0	1	3	27	34
Imports - EUROSTAT	0	0	1	3	27	34
Imports - difference	0	0	0	0	0	0
Exports - IEA	3 662	3 467	2 566	1 892	3 105	3 331
Exports - EUROSTAT	3 662	3 467	2 566	1 892	3 105	3 331
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	0	-9	158	143	-60	13
Stock changes - EUROSTAT	0	-9	158	143	-60	13
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	0	4	0	191	-403	-150
Statistical differences - EUROSTAT	0	4	0	191	-403	-150
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	6 052	4 311	4 206	3 745	4 173	4 281
Transformation input - EUROSTAT	6 053	4 312	4 206	3 746	4 174	4 282
Transformation input - difference	-1	-1	0	-1	-1	-1
Energy sector - IEA	6	11	9	18	43	31
Energy sector - EUROSTAT	6	11	9	18	43	31
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	3 796	3 554	4 444	4 575	4 504	4 132
Final consumption - EUROSTAT	3 795	3 553	4 444	4 574	4 503	4 131
Final consumption - difference	1	1	0	1	1	1
Final consumption - Industry - IEA	1 694	1 830	1 841	2 031	2 261	1 996
Final consumption - Industry - EUROSTAT	1 693	1 829	1 841	2 030	2 260	1 995
Final consumption - Industry - difference	1	1	0	1	1	1
Final consumption - Transport - IEA	139	115	119	107	0	0
Final consumption - Transport - EUROSTAT	139	115	119	107	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	1 715	1 436	2 358	2 271	2 075	2 014
Final consumption - Other sectors - EUROSTAT	1 715	1 436	2 358	2 271	2 075	2 014
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	499	419	935	1 079	975	965
Final consumption - Residential - EUROSTAT	499	419	935	1 079	975	965
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	1 161	976	1 399	1 172	959	908
Final consumption - Commercial and public services - EUROSTAT	1 161	976	1 399	1 172	959	908
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	55	41	24	20	141	141
Final consumption - Agriculture/forestry - EUROSTAT	55	41	24	20	141	141
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 4. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Coke oven coke* consumption [kt]

	2000	2005	2010	2015	2016	2017
Production - IEA	8 972	8 404	9 844	9 792	9 718	9 418
Production - EUROSTAT	8 972	8 404	9 844	9 792	9 718	9 418
Production - difference	0	0	0	0	0	0
Imports - IEA	16	117	137	94	123	209
Imports - EUROSTAT	16	117	137	94	123	209
Imports - difference	0	0	0	0	0	0
Exports - IEA	3 691	4 624	6 347	6 459	6 970	6 494
Exports - EUROSTAT	3 691	4 624	6 347	6 459	6 970	6 494
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	465	-498	-469	-98	45	95
Stock changes - EUROSTAT	465	-498	-469	-98	45	95
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	-122	-1	420	-113	-292	-9
Statistical differences - EUROSTAT	-122	-1	420	-113	-292	-9
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	3 732	2 344	2 141	2 602	2 468	2 441
Transformation input - EUROSTAT	3 732	2 344	2 141	2 602	2 468	2 441
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	6	1	0	0	0	0
Energy sector - EUROSTAT	6	1	0	0	0	0
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	2 146	1 055	604	840	740	795
Final consumption - EUROSTAT	2 146	1 055	604	840	740	795
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	1 224	758	267	652	558	611
Final consumption - Industry - EUROSTAT	1 224	758	267	652	558	611
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	820	239	336	188	182	184
Final consumption - Other sectors - EUROSTAT	820	239	336	188	182	184
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	410	105	229	150	140	150
Final consumption - Residential - EUROSTAT	410	105	229	150	140	150
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	290	94	74	29	32	25
Final consumption - Commercial and public services - EUROSTAT	290	94	74	29	32	25
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	120	40	33	9	10	9
Final consumption - Agriculture/forestry - EUROSTAT	120	40	33	9	10	9
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 5. Analysis of consistency between data from Eurostat and IEA databases for *Natural gas* consumption [TJ] (GCV)

	1990	1991	1992	1993	1994	1995
Production - IEA	110 621	123 660	119 082	152 164	144 181	147 432
Production - EUROSTAT	110 621	123 660	119 082	152 164	144 181	147 432
Production - difference	0	0	0	0	0	0
Imports - IEA	315 104	265 645	248 080	217 866	232 581	271 470
Imports - EUROSTAT	315 104	265 645	248 080	217 866	232 581	271 470
Imports - difference	0	0	0	0	0	0
Exports - IEA	35	23	116	602	929	1184
Exports - EUROSTAT	35	23	116	602	929	1 184
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	-9 906	-1 566	-5 949	9 889	6 375	718
Stock changes - EUROSTAT	-9 906	-1 566	-5 949	9 889	6 375	718
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	4 430	12 308	0	11 000	-12 861	12 187
Statistical differences - EUROSTAT	4 430	12 308	0	11 000	-12 861	12 187
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	28 361	22 629	14 581	5 324	4 674	5 264
Transformation input - EUROSTAT	28 361	22 629	14 581	5 324	4 674	5 264
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	15 602	15 523	17 970	15 513	21 102	18 236
Energy sector - EUROSTAT	15 602	15 523	17 970	15 513	21 102	18 236
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	357 710	319 944	311 328	318 818	347 294	370 469
Final consumption - EUROSTAT	357 710	319 944	311 328	318 818	347 294	370 469
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	116 699	88 281	78 484	89 468	90 654	89 786
Final consumption - Industry - EUROSTAT	116 699	88 281	78 484	89 468	90 654	89 786
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	1	8
Final consumption - Transport - EUROSTAT	0	0	0	0	1	8
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	151 599	161 030	169 396	170 300	179 396	192 291
Final consumption - Other sectors - EUROSTAT	151 599	161 030	169 396	170 300	179 396	192 291
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	135 782	148 527	156 902	157 322	168 523	177 288
Final consumption - Residential - EUROSTAT	135 782	148 527	156 902	157 322	168 523	177 288
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	15 319	12 197	12 433	12 831	10 637	14 733
Final consumption - Commercial and public services - EUROSTAT	15 319	12 197	12 433	12 831	10 637	14 733
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	498	306	61	147	236	270
Final consumption - Agriculture/forestry - EUROSTAT	498	306	61	147	236	270
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 5. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Natural gas* consumption [TJ] (GCV)

	2000	2005	2010	2015	2016	2017
Production - IEA	154 138	180 700	171 797	171 329	165 272	163 373
Production - EUROSTAT	154 138	180 700	171 797	171 329	165 272	163 373
Production - difference	0	0	0	0	0	0
Imports - IEA	308 917	398 547	414 583	464 842	566 852	606 014
Imports - EUROSTAT	308 917	398 547	414 583	464 842	566 852	606 014
Imports - difference	0	0	0	0	0	0
Exports - IEA	1 562	1 667	1 752	2 112	33 294	47 232
Exports - EUROSTAT	1 562	1 667	1 752	2 112	33 294	47 232
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	1 832	-8 431	11 048	6 790	-18 084	-3 664
Stock changes - EUROSTAT	1 832	-8 431	11 048	6 790	-18 084	-3 664
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	0	-389	-7503	-6331	-2480	2289
Statistical differences - EUROSTAT	0	-389	-7 503	-6 331	-2 480	2 289
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	32 880	72 952	72 432	96 802	106 293	120 435
Transformation input - EUROSTAT	32 880	72 952	72 432	96 802	106 293	120 435
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	35 112	27 320	32 982	55 607	48 451	66 490
Energy sector - EUROSTAT	35 112	27 320	32 982	55 607	48 451	66 490
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	379 510	462 146	490 576	493 534	527 249	528 695
Final consumption - EUROSTAT	379 510	462 146	490 576	493 534	527 249	528 695
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	106 143	130 002	143 714	150 250	158 673	171 406
Final consumption - Industry - EUROSTAT	106 143	130 002	143 714	150 250	158 673	171 406
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	2 775	10 962	10 299	16 719	17 801	17 793
Final consumption - Transport - EUROSTAT	2 775	10 962	10 299	16 719	17 801	17 793
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	185 237	227 338	259 273	227 965	252 695	238 108
Final consumption - Other sectors - EUROSTAT	185 237	227 338	259 273	227 965	252 695	238 108
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	141 790	150 123	164 919	146 891	161 276	168 858
Final consumption - Residential - EUROSTAT	141 790	150 123	164 919	146 891	161 276	168 858
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	42 852	76 011	92 703	79 803	89 969	67 562
Final consumption - Commercial and public services - EUROSTAT	42 852	76 011	92 703	79 803	89 969	67 562
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	595	1 204	1 651	1 271	1 450	1 688
Final consumption - Agriculture/forestry - EUROSTAT	595	1 204	1 651	1 271	1 450	1 688
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 6. Analysis of consistency between data from Eurostat and IEA data for *Fuel oil* consumption [kt]

	1990	1991	1992	1993	1994	1995
Production - IEA	3 631	3 480	2 983	3 340	3 259	3 452
Production - EUROSTAT	3 631	3 480	2 983	3 340	3 259	3 452
Production - difference	0	0	0	0	0	0
Imports - IEA	101	12	1	0	11	18
Imports - EUROSTAT	101	12	1	0	11	18
Imports - difference	0	0	0	0	0	0
Exports - IEA	927	1043	839	1 005	894	899
Exports - EUROSTAT	927	1 043	839	1 005	894	899
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	0	-13	2	-4	1	0
Stock changes - EUROSTAT	0	-13	2	-4	1	0
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	-119	-11	-330	-303	-361	-186
Statistical differences - EUROSTAT	-119	-11	-330	-303	-361	-186
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	1 634	1 532	1 410	1 377	1 390	646
Transformation input - EUROSTAT	1 634	1 532	1 410	1 377	1 390	646
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	287	265	396	329	306	814
Energy sector - EUROSTAT	287	265	396	329	306	814
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	741	556	502	830	937	994
Final consumption - EUROSTAT	741	556	502	830	937	994
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	593	445	436	491	518	763
Final consumption - Industry - EUROSTAT	593	445	436	491	518	763
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	59	43	30	4	1	13
Final consumption - Transport - EUROSTAT	59	43	30	4	1	13
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	89	68	36	335	418	218
Final consumption - Other sectors - EUROSTAT	89	68	36	335	418	218
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	0	0	0	0	0	0
Final consumption - Residential - EUROSTAT	0	0	0	0	0	0
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	0	0	0	0	0	0
Final consumption - Commercial and public services - EUROSTAT	0	0	0	0	0	0
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	89	68	36	335	418	218
Final consumption - Agriculture/forestry - EUROSTAT	89	68	36	335	418	218
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 6. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Fuel oil* consumption [kt]

	2000	2005	2010	2015	2016	2017
Production - IEA	3 558	2 537	3 123	3 869	3 609	3 436
Production - EUROSTAT	3 558	2 537	3 123	3 869	3 609	3 436
Production - difference	0	0	0	0	0	0
Imports - IEA	113	13	86	2	47	38
Imports - EUROSTAT	113	13	86	2	47	38
Imports - difference	0	0	0	0	0	0
Exports - IEA	1 367	488	1 575	2 743	2 514	2 471
Exports - EUROSTAT	1 367	488	1 575	2 743	2 514	2 471
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	-12	0	18	-10	-2	-18
Stock changes - EUROSTAT	-12	0	18	-10	-2	-18
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	-10	-8	-93	18	35	9
Statistical differences - EUROSTAT	-10	-8	-93	18	35	9
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	544	596	542	399	416	379
Transformation input - EUROSTAT	544	596	542	399	416	379
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	708	678	808	563	537	449
Energy sector - EUROSTAT	708	678	808	563	537	449
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	802	584	198	91	93	95
Final consumption - EUROSTAT	802	584	198	91	93	95
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	662	401	173	81	79	80
Final consumption - Industry - EUROSTAT	662	401	173	81	79	80
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	140	183	25	10	14	15
Final consumption - Other sectors - EUROSTAT	140	183	25	10	14	15
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	0	0	0	0	0	0
Final consumption - Residential - EUROSTAT	0	0	0	0	0	0
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	0	0	2	0	0	0
Final consumption - Commercial and public services - EUROSTAT	0	0	2	0	0	0
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	140	180	23	10	14	15
Final consumption - Agriculture/forestry - EUROSTAT	140	180	23	10	14	15
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Table 7. Analysis of consistency between data from Eurostat and IEA databases for *Solid biomass* consumption [TJ]

	1990	1991	1992	1993	1994	1995
Production - IEA	60 643	51 434	56 983	158 944	154 590	156 943
Production - EUROSTAT	60 643	51 434	56 983	158 944	154 590	156 943
Production - difference	0	0	0	0	0	0
Imports - IEA	0	0	0	0	0	0
Imports - EUROSTAT	0	0	0	0	0	0
Imports - difference	0	0	0	0	0	0
Exports - IEA	0	0	0	0	0	0
Exports - EUROSTAT	0	0	0	0	0	0
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	0	0	0	0	-3	0
Stock changes - EUROSTAT	0	0	0	0	-3	0
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	0	0	0	0	594	49
Statistical differences - EUROSTAT	0	0	0	0	594	49
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	14 571	14 384	17 265	13 783	14 051	1 322
Transformation input - EUROSTAT	14 571	14 384	17 265	13 783	14 051	1 322
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	6	0	4	8	11	3
Energy sector - EUROSTAT	6	0	4	8	11	3
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	46 066	37 050	39 714	145 153	139 931	155 569
Final consumption - EUROSTAT	46 066	37 050	39 714	145 153	139 931	155 569
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	7 191	6 106	5 159	6 784	5 130	20 509
Final consumption - Industry - EUROSTAT	7 191	6 106	5 159	6 784	5 130	20 509
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	3	0	0	0
Final consumption - Transport - EUROSTAT	0	0	3	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	38 875	30 944	34 552	138 369	134 801	135 060
Final consumption - Other sectors - EUROSTAT	38 875	30 944	34 552	138 369	134 801	135 060
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	0	0	0	106 000	104 715	105 000
Final consumption - Residential - EUROSTAT	0	0	0	106 000	104 715	105 000
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	0	0	0	12 312	11 719	11 560
Final consumption - Commercial and public services - EUROSTAT	0	0	0	12 312	11 719	11 560
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	0	0	0	20 057	18 367	18 500
Final consumption - Agriculture/forestry - EUROSTAT	0	0	0	20 057	18 367	18 500
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

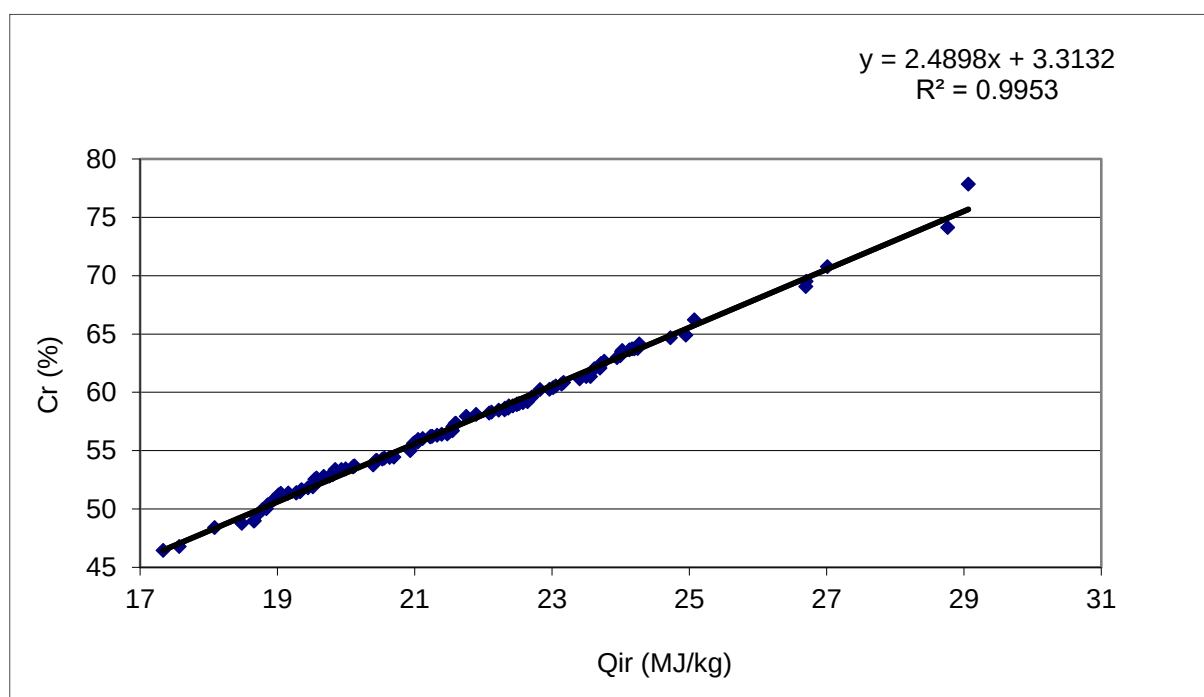
Table 7. (cont.) Analysis of consistency between data from Eurostat and IEA databases for *Solid biomass* consumption [TJ]

	2000	2005	2010	2015	2016	2017
Production - IEA	150 485	174 431	245 606	276 199	268 577	257 952
Production - EUROSTAT	150 485	174 431	245 606	276 199	268 577	257 952
Production - difference	0	0	0	0	0	0
Imports - IEA	0	0	0	27 343	24 305	16 581
Imports - EUROSTAT	0	0	0	27 343	24 305	16 581
Imports - difference	0	0	0	0	0	0
Exports - IEA	0	0	0	15 338	15 709	11 151
Exports - EUROSTAT	0	0	0	15 338	15 709	11 151
Exports - difference	0	0	0	0	0	0
Stock changes - IEA	-292	0	0	0	0	0
Stock changes - EUROSTAT	-292	0	0	0	0	0
Stock changes - difference	0	0	0	0	0	0
Statistical differences - IEA	0	0	0	0	0	0
Statistical differences - EUROSTAT	0	0	0	0	0	0
Statistical differences - difference	0	0	0	0	0	0
Transformation input - IEA	3 461	17 228	65 114	95 657	74 057	56 414
Transformation input - EUROSTAT	3 461	17 228	65 114	95 657	74 057	56 414
Transformation input - difference	0	0	0	0	0	0
Energy sector - IEA	6	2	349	0	26	15
Energy sector - EUROSTAT	6	2	349	0	26	15
Energy sector - difference	0	0	0	0	0	0
Final consumption - IEA	146 726	157 201	180 143	192 547	203 090	206 954
Final consumption - EUROSTAT	146 726	157 201	180 143	192 547	203 090	206 954
Final consumption - difference	0	0	0	0	0	0
Final consumption - Industry - IEA	26 112	31 283	38 280	56 853	62 482	67 950
Final consumption - Industry - EUROSTAT	26 112	31 283	38 280	56 853	62 482	67 950
Final consumption - Industry - difference	0	0	0	0	0	0
Final consumption - Transport - IEA	0	0	0	0	0	0
Final consumption - Transport - EUROSTAT	0	0	0	0	0	0
Final consumption - Transport - difference	0	0	0	0	0	0
Final consumption - Other sectors - IEA	120 614	125 918	141 863	135 694	140 608	139 004
Final consumption - Other sectors - EUROSTAT	120 614	125 918	141 863	135 694	140 608	139 004
Final consumption - Other sectors - difference	0	0	0	0	0	0
Final consumption - Residential - IEA	95 000	100 700	112 746	108 395	111 435	109 725
Final consumption - Residential - EUROSTAT	95 000	100 700	112 746	108 395	111 435	109 725
Final consumption - Residential - difference	0	0	0	0	0	0
Final consumption - Commercial and public services - IEA	8 514	6 171	8 029	7 043	7 715	8 003
Final consumption - Commercial and public services - EUROSTAT	8 514	6 171	8 029	7 043	7 715	8 003
Final consumption - Commercial and public services - difference	0	0	0	0	0	0
Final consumption - Agriculture/forestry - IEA	17 100	19 047	21 088	20 256	21 458	21 276
Final consumption - Agriculture/forestry - EUROSTAT	17 100	19 047	21 088	20 256	21 458	21 276
Final consumption - Agriculture/forestry - difference	0	0	0	0	0	0

Annex 5.2. Country specific CO₂ EFs for coal and lignite

Correlation Cr vs Qi for coal

- C - carbon content (%)
- Qi - net calorific value (MJ/kg)
- r - related to raw material



Parameters of the empirical function for coal: $a=2.4898$ $b=3.3132$

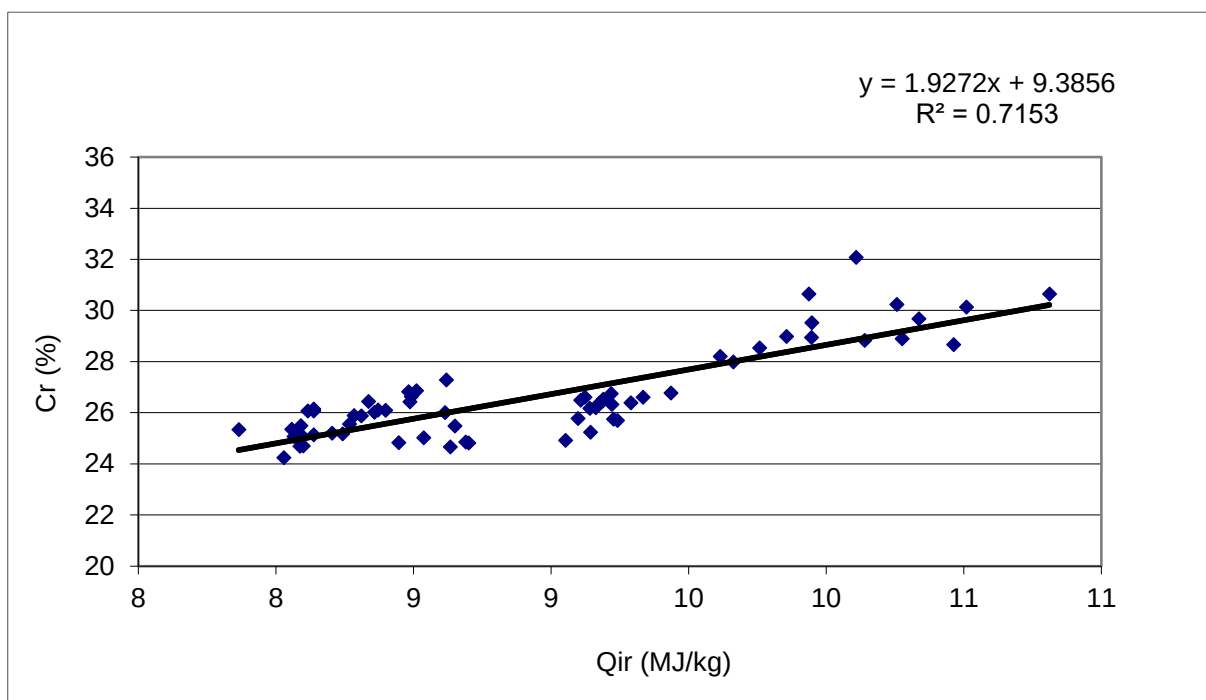
Aggregated measurement source data for the derivation of the function formula for lignite

Qir	17.33	17.57	18.08	18.48	18.66	18.66	18.70	18.78	18.84	18.86
Cr	46.45	46.77	48.40	48.75	48.95	48.99	49.45	49.94	50.03	50.37
Qir	18.94	19.01	19.05	19.16	19.27	19.28	19.33	19.34	19.35	19.45
Cr	50.77	51.19	51.35	51.36	51.36	51.40	51.47	51.62	51.64	51.81
Qir	19.52	19.53	19.54	19.57	19.67	19.76	19.80	19.82	19.84	19.93
Cr	51.91	52.08	52.54	52.65	52.80	52.82	52.93	52.99	53.39	53.39
Qir	19.99	20.10	20.11	20.12	20.39	20.43	20.44	20.53	20.56	20.63
Cr	53.44	53.61	53.65	53.68	53.78	54.14	54.16	54.26	54.35	54.42
Qir	20.69	20.93	20.98	21.00	21.04	21.05	21.11	21.22	21.23	21.25
Cr	54.43	55.01	55.61	55.71	55.73	55.95	56.05	56.18	56.20	56.22
Qir	21.32	21.39	21.47	21.50	21.55	21.56	21.56	21.58	21.60	21.75
Cr	56.31	56.41	56.43	56.59	56.70	57.03	57.11	57.32	57.35	57.95
Qir	21.89	22.09	22.12	22.22	22.31	22.31	22.36	22.37	22.42	22.49
Cr	58.10	58.21	58.29	58.48	58.51	58.64	58.64	58.84	58.84	58.94
Qir	22.49	22.52	22.57	22.64	22.70	22.82	22.96	23.01	23.05	23.14
Cr	59.01	59.04	59.11	59.19	59.60	60.22	60.26	60.41	60.53	60.70
Qir	23.17	23.40	23.50	23.56	23.62	23.70	23.71	23.76	23.94	23.99
Cr	60.84	61.16	61.34	61.36	62.03	62.09	62.46	62.67	62.96	63.13
Qir	24.01	24.02	24.13	24.17	24.20	24.24	24.27	24.72	24.95	25.07

Cr	63.49	63.60	63.65	63.72	63.74	63.75	64.14	64.68	64.89	66.22
Qir	26.70	26.70	27.01	28.76	29.06					
Cr	69.06	69.51	70.79	74.14	77.85					

Correlation Cr vs Qi for lignite

- C - carbon content (%)
 Qi - net calorific value (MJ/kg)
 r - related to raw material



Parameters of the empirical function for lignite: $a=1.9272$ $b=9.3856$

Aggregated measurement source data for the derivation of the function formula for lignite

Qir	7.865	8.028	8.057	8.066	8.070	8.087	8.087	8.091	8.099	8.116
Cr	25.34	24.24	25.35	25.07	25.06	25.17	24.68	25.49	24.70	26.07
Qir	8.137	8.137	8.137	8.204	8.242	8.267	8.284	8.336	8.398	8.358
Cr	26.07	26.14	25.14	25.20	25.17	25.55	25.89	26.44	26.09	26.02
Qir	8.482	8.487	8.510	8.619	8.650	8.700	8.689	8.633	8.537	8.446
Cr	26.82	26.43	26.86	27.28	25.48	24.82	24.85	24.66	25.02	24.83
Qir	8.310	8.371	8.491	8.614	9.188	9.162	9.221	9.143	9.052	9.241
Cr	25.87	26.11	26.63	26.00	26.47	26.20	26.32	25.24	24.92	25.70
Qir	9.290	9.123	9.107	9.226	9.098	9.218	9.141	9.189	9.175	9.334
Cr	26.39	26.60	26.49	25.75	25.77	26.74	26.17	26.53	26.38	26.60
Qir	9.435	9.614	9.662	9.758	9.856	9.937	9.946	9.947	10.109	10.139
Cr	26.77	28.20	27.98	28.53	28.98	30.65	28.95	29.52	32.08	28.83
Qir	10.257	10.275	10.337	10.463	10.509	10.811				
Cr	30.24	28.90	29.67	28.66	30.14	30.65				

Annex 5.3. Fuel consumption and GHG emission factors from selected categories of CRT sector 1.A

Table 1. Fuel consumption [PJ] in 1.A.1.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1752.496	1719.899	1590.796	1571.596	1511.372	1368.183	1311.991	1204.471	1271.818	1218.620	1154.492
Lignite	568.786	575.819	554.955	561.134	548.470	550.602	539.102	529.015	532.981	530.634	535.210
Hard coal briquettes (patent fuels)	5.001	3.888	1.958	0.252	0.091	0.046	0.045	0.000	0.000	0.045	0.000
Brown coal briquettes	0.354	0.247	0.125	0.053	0.181	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.274	21.900	21.641	16.329	9.562	3.106	4.095	4.738	7.157	7.950	10.769
Solid biomass	16.695	15.123	14.571	14.384	17.265	13.783	14.051	1.322	2.656	3.293	3.673
Biogas	0.004	0.006	0.014	0.003	0.024	0.000	0.006	0.125	0.137	0.088	0.204
Industrial wastes	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878	3.393	3.267	0.550
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	13.591	12.561	11.512	11.967	10.187	8.161	6.897	6.730	6.535	5.009	3.878
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.189
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.767	0.724	0.602	0.602	0.559	0.430	0.387	0.344	1.161	1.677	1.548
Fuel oil	73.080	70.760	66.014	61.893	56.964	55.631	56.156	26.098	27.997	27.553	25.694
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	1.287	1.188	0.990	0.743	0.644	0.842	1.238	0.050	0.000	0.000	0.000
Coke oven gas	5.568	6.565	7.125	7.555	8.863	8.144	13.147	12.828	13.975	16.450	13.697
Blast furnace gas	28.221	26.733	22.377	12.797	13.378	10.239	13.190	5.905	3.218	3.306	3.060
Gas works gas and other recovered gases	0.659	0.579	0.167	0.129	0.335	0.085	0.037	0.021	0.005	0.002	3.259
Fuels											
Liquid fuels	75.134	72.672	67.606	63.237	58.167	56.902	57.781	26.492	29.158	29.277	27.432
Gaseous fuels	21.274	21.900	21.641	16.329	9.562	3.106	4.095	4.738	7.157	7.950	10.769
Solid fuels	2374.674	2346.290	2189.015	2165.482	2092.877	1945.459	1884.409	1758.969	1828.531	1774.067	1713.596
Other fuels	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878	3.393	3.267	0.550
Biomass	16.699	15.129	14.585	14.387	17.289	13.783	14.057	1.447	2.793	3.381	3.877
Total	2491.522	2459.864	2298.112	2268.349	2185.248	2025.908	1967.218	1795.524	1871.032	1817.942	1756.223

Table 1. (cont.) Fuel consumption [PJ] in 1.A.1.a category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	1122.253	1115.244	1122.612	1087.727	1142.443	1128.755	1112.673	1171.766	1151.920	1065.169	1038.763
Lignite	521.062	504.993	512.217	494.036	518.249	514.274	533.979	525.817	501.140	521.178	494.048
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	16.210	21.626	28.242	38.700	45.495	53.627	57.099	52.877	49.691	51.163	51.653
Solid biomass	3.398	3.461	4.886	4.809	5.799	8.913	17.228	20.583	25.111	37.976	54.823
Biogas	0.349	0.443	0.563	0.615	0.843	0.526	0.561	0.944	1.158	2.025	2.199
Industrial wastes	0.575	0.883	1.031	1.520	0.372	0.459	0.541	0.477	0.440	0.209	0.314
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.384	0.368
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	2.742	1.912	1.620	1.199	0.852	0.571	0.320	0.162	0.135	0.081	0.055
Liquid petroleum gas (LPG)	0.237	0.189	0.189	0.189	0.047	0.000	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.634	2.451	2.150	2.537	2.322	1.548	1.247	1.247	0.774	0.860	0.996
Fuel oil	26.422	21.978	27.310	25.856	26.826	25.735	24.078	25.290	22.382	22.018	20.480
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.149	0.495	0.545	1.980	1.733	2.129
Coke oven gas	16.077	17.094	17.080	16.421	18.032	12.491	11.523	14.540	16.024	16.765	13.112
Blast furnace gas	3.286	4.317	4.976	4.783	5.715	7.053	4.489	8.677	6.395	10.204	7.730
Gas works gas and other recovered gases	2.507	2.390	2.338	3.109	2.592	3.694	4.806	4.876	4.463	4.502	4.828
Fuels											
Liquid fuels	28.292	24.618	29.650	28.582	29.195	27.431	25.820	27.082	25.136	24.611	23.604
Gaseous fuels	16.210	21.626	28.242	38.700	45.495	53.627	57.099	52.877	49.691	51.163	51.653
Solid fuels	1667.926	1645.950	1660.843	1607.298	1687.883	1666.839	1667.789	1725.837	1680.076	1617.899	1558.535
Other fuels	0.575	0.883	1.031	1.520	0.372	0.459	0.541	0.477	0.440	0.593	0.682
Biomass	3.747	3.904	5.449	5.424	6.642	9.439	17.789	21.527	26.269	40.001	57.022
Total	1716.750	1696.981	1725.215	1681.524	1769.587	1757.795	1769.038	1827.800	1781.611	1734.266	1691.497

Table 1. (cont.) Fuel consumption [PJ] in 1.A.1.a category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	1102.203	1059.693	995.936	999.211	925.468	932.228	954.064	950.167	951.263	890.874	813.041
Lignite	477.464	517.019	527.310	539.682	513.422	507.964	484.888	496.919	466.064	395.024	364.454
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.014	0.010	0.008
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	52.289	57.959	61.965	53.395	52.016	60.428	70.589	83.471	101.008	114.019	131.248
Solid biomass	65.114	78.589	105.585	87.694	96.989	95.657	74.057	56.414	58.484	71.201	78.849
Biogas	2.778	3.328	4.219	4.887	5.732	6.314	7.247	8.232	8.600	8.642	9.649
Industrial wastes	0.442	0.458	0.420	0.381	0.470	0.693	0.545	0.671	0.985	1.139	1.265
Municipal waste - non-biogenic fraction	0.367	0.403	0.371	0.337	0.343	0.859	3.833	5.488	7.516	9.104	8.691
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.016	0.009	0.331	1.420	1.544	2.055	3.576
Other petroleum products	0.060	0.000	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.055	0.026	0.026	0.027	0.027	0.000	0.000	0.012	0.039	0.030	0.027
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.010	0.012	0.011
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.909	1.083	0.866	0.953	0.909	1.247	1.204	1.822	1.899	2.202	2.167
Fuel oil	21.680	16.880	15.440	12.920	11.560	15.960	16.640	15.158	13.169	12.837	13.856
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	2.475	1.634	1.733	1.832	1.287	0.396	1.139	0.630	1.592	0.487	0.657
Coke oven gas	18.610	16.640	15.993	17.867	17.789	20.883	22.820	21.112	21.556	20.766	17.349
Blast furnace gas	9.954	11.001	11.328	11.729	13.937	16.242	14.630	15.884	16.215	13.933	11.428
Gas works gas and other recovered gases	5.072	5.357	5.202	5.307	5.069	4.723	3.510	1.693	1.446	1.589	1.696
Fuels											
Liquid fuels	25.124	19.596	18.070	15.704	13.756	17.603	18.983	17.617	16.670	15.538	16.691
Gaseous fuels	52.289	57.959	61.965	53.395	52.016	60.428	70.589	83.471	101.008	114.019	131.248
Solid fuels	1613.359	1609.737	1555.795	1573.823	1475.713	1482.039	1479.913	1485.793	1456.596	1322.226	1208.003
Other fuels	0.809	0.861	0.791	0.718	0.813	1.552	4.378	6.159	8.501	10.243	9.956
Biomass	67.892	81.917	109.804	92.581	102.737	101.980	81.635	66.065	68.628	81.898	92.074
Total	1759.473	1770.070	1746.424	1736.220	1645.036	1663.603	1655.498	1659.104	1651.403	1543.925	1457.972

Table 1. (cont.) Fuel consumption [PJ] in 1.A.1.a category

Fuels	2021	2022	2023	2024
Hard coal	951.403	884.506	734.089	662.365
Lignite	433.503	442.319	326.192	335.473
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000
Brown coal briquettes	0.007	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	128.891	100.272	136.087	167.183
Solid biomass	75.106	69.552	74.204	70.391
Biogas	9.702	10.339	11.291	12.154
Industrial wastes	1.689	1.508	1.456	1.289
Municipal waste - non-biogenic fraction	7.767	8.834	8.177	8.563
Municipal waste – biogenic fraction	4.411	4.181	4.116	4.029
Other petroleum products	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000
Coke	0.042	0.041	0.028	0.014
Liquid petroleum gas (LPG)	0.018	0.015	0.038	0.050
Motor gasoline	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	3.619	3.369	2.806	3.234
Fuel oil	14.880	17.373	15.092	14.919
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.526	0.866	0.495	1.594
Coke oven gas	20.590	17.989	16.931	16.704
Blast furnace gas	11.838	11.319	9.680	10.889
Gas works gas and other recovered gases	1.139	1.283	0.942	1.100
Fuels				
Liquid fuels	19.043	21.623	18.431	19.796
Gaseous fuels	128.891	100.272	136.087	167.183
Solid fuels	1418.522	1357.458	1087.862	1026.545
Other fuels	9.456	10.341	9.633	9.852
Biomass	89.219	84.072	89.611	86.575
Total	1665.130	1573.766	1341.625	1309.951

Table 2. Fuel consumption [PJ] in 1.A.1.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	0.114	0.113	0.045	0.090	0.070	0.248	0.067	1.296	1.509	1.315	0.620
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244
Solid biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.044	0.000	0.000	0.523	1.085	0.884
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.028	0.028	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.095
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.043	0.043	0.000	0.086	0.086	0.172	0.172	0.215	0.344
Fuel oil	14.800	13.800	11.554	10.666	15.918	12.928	12.080	32.724	40.925	32.522	32.320
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	8.860	9.306	7.475	7.623	8.514	9.257	10.445	12.029	8.960	10.197	6.287
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.081
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	23.660	23.106	19.072	18.332	24.432	22.314	22.610	44.968	50.579	44.067	39.930
Gaseous fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244
Solid fuels	0.142	0.140	0.045	0.118	0.070	0.248	0.067	1.296	1.509	1.315	0.701
Other fuels	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	33.921	33.129	26.010	20.261	26.691	24.172	24.527	49.745	54.187	48.073	48.875

Table 2. (cont.) Fuel consumption [PJ] in 1.A.1.b category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	0.558	0.199	0.065	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.130
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	10.832	12.110	11.354	10.124	12.770	15.535	14.482	14.900	20.816	18.816	17.511
Solid biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.310	0.219	0.095	0.253	0.176	0.221	0.285	0.224	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	1.729	0.000	0.040	0.040	0.040	0.362	0.322	0.442	0.362	0.672	0.986
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.189	0.284	0.000	0.047	0.095	0.000	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.089	0.133	0.000	0.000	0.133	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.044	0.000	0.000	0.000	0.000
Diesel oil	0.043	0.903	0.301	0.645	0.215	0.989	0.258	0.645	0.129	0.387	0.173
Fuel oil	25.896	28.361	30.219	30.462	29.169	27.755	27.108	24.967	29.532	29.452	30.360
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	6.386	9.059	10.445	10.049	10.049	11.484	10.197	12.425	14.603	15.692	13.118
Coke oven gas	0.051	0.069	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	34.331	38.739	41.005	41.243	39.700	40.590	37.929	38.479	44.626	46.202	44.637
Gaseous fuels	10.832	12.110	11.354	10.124	12.770	15.535	14.482	14.900	20.816	18.816	17.511
Solid fuels	0.610	0.269	0.135	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.130
Other fuels	0.310	0.219	0.095	0.253	0.176	0.221	0.285	0.224	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	46.082	51.337	52.589	51.642	52.646	56.346	52.696	53.603	65.442	65.018	62.278

Table 2. (cont.) Fuel consumption [PJ] in 1.A.1.b category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	0.134	0.130	0.106	0.130	0.182	1.037	0.935	0.890	0.778	0.695	0.539
Lignite	0.000	0.042	0.016	0.048	0.016	0.008	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	19.363	27.467	30.639	34.778	35.102	25.958	25.801	43.844	36.056	42.920	41.086
Solid biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.450	0.660	1.271	0.992	0.960	0.752	1.014	0.868	1.121	1.315	1.297
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.000	0.092	0.092	0.092	0.138	0.644	0.828	0.285	0.326	0.205	0.372
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.087	0.130	0.087	0.000	0.043	0.000	0.000	0.007	0.003	0.019	0.017
Fuel oil	32.240	29.400	22.280	14.840	14.680	22.520	21.480	17.947	16.732	16.227	16.214
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	20.394	19.899	26.483	19.157	14.157	18.513	20.691	11.630	15.309	13.886	15.180
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	53.171	50.181	50.212	35.081	29.978	42.429	44.013	30.737	33.491	31.653	33.079
Gaseous fuels	19.363	27.467	30.639	34.778	35.102	25.958	25.801	43.844	36.056	42.920	41.086
Solid fuels	0.134	0.171	0.122	0.178	0.198	1.045	0.935	0.890	0.778	0.695	0.539
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	72.668	77.819	80.973	70.037	65.278	69.433	70.749	75.470	70.325	75.268	74.704

Table 2. (cont.) Fuel consumption [PJ] in 1.A.1.b category

Fuels	2021	2022	2023	2024
Hard coal	0.602	0.589	0.599	0.676
Lignite	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	33.795	21.204	31.131	33.257
Solid biomass	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.858	0.056	0.064	0.032
Petroleum coke	0.000	0.000	0.000	0.000
Coke	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.655	0.108	0.138	0.133
Motor gasoline	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	0.007	0.120	0.000	0.000
Fuel oil	17.543	22.132	20.338	20.725
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	17.461	16.968	19.305	20.186
Coke oven gas	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	36.523	39.383	39.846	41.076
Gaseous fuels	33.795	21.204	31.131	33.257
Solid fuels	0.602	0.589	0.599	0.676
Other fuels	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000
Total	70.920	61.177	71.575	75.009

Table 3. Fuel consumption [PJ] in 1.A.1.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	12.314	10.347	10.294	7.866	6.296	23.762	56.968	58.730	62.410	54.793	52.552
Lignite	0.416	0.057	0.067	0.119	0.069	0.291	0.257	0.280	0.320	0.310	0.249
Hard coal briquettes (patent fuels)	0.023	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.035	0.018	0.018	0.017	0.000	0.036	0.018	0.018	0.036	0.034	0.016
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.085	0.085	0.085
Natural gas	13.736	15.364	12.371	12.432	14.666	12.353	17.401	14.851	23.270	21.155	17.779
Solid biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.003	0.003	0.003	0.003
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.028	0.023
Industrial wastes	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.044	0.044	0.044	0.044	0.044	0.044	0.080	0.080	0.084
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.173	0.522	0.546	0.500	0.278	0.505	1.225	0.866	0.596	0.141	0.080
Liquid petroleum gas (LPG)	0.092	0.092	0.095	0.095	0.095	0.047	0.047	0.047	0.047	0.000	0.047
Motor gasoline	0.088	0.088	0.089	0.089	0.089	0.177	0.310	0.266	0.089	0.089	0.044
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	2.130	1.960	1.849	2.150	2.279	4.429	3.569	3.784	3.268	2.838	2.236
Fuel oil	0.240	0.040	0.040	0.040	0.081	0.364	0.283	0.162	0.162	0.081	0.525
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	50.866	50.938	43.557	38.488	39.121	34.604	40.489	37.038	35.105	37.000	33.710
Blast furnace gas	5.632	4.440	3.961	1.995	1.430	2.123	2.488	1.954	1.582	1.893	1.695
Gas works gas and other recovered gases	0.005	0.008	0.005	0.180	0.010	0.120	0.000	0.006	0.061	0.019	0.168
Fuels											
Liquid fuels	2.550	2.180	2.116	2.417	2.587	5.061	4.253	4.303	3.731	3.173	3.022
Gaseous fuels	13.736	15.364	12.371	12.432	14.666	12.353	17.401	14.851	23.270	21.155	17.779
Solid fuels	70.465	66.330	58.471	49.165	47.205	61.441	101.445	98.892	100.110	94.190	88.470
Other fuels	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.000
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004	0.014	0.031	0.026
Total	86.815	83.875	72.964	64.014	64.461	79.174	123.345	118.233	127.283	118.686	109.296

Table 3. (cont.) Fuel consumption [PJ] in 1.A.1.c category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	42.960	33.267	30.513	15.890	19.087	19.270	15.693	13.093	21.001	16.060	10.636
Lignite	0.249	0.375	0.283	0.907	0.577	0.492	0.165	0.191	1.284	2.021	0.888
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.018	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.085	0.043	0.000	0.043	0.128	0.127	0.000	0.000	0.000	0.000	0.000
Natural gas	19.458	19.490	12.987	12.515	9.741	11.190	10.106	10.363	9.680	9.239	8.858
Solid biomass	0.005	0.006	0.039	0.029	0.008	0.004	0.002	0.011	0.057	0.020	0.134
Biogas	0.022	0.027	0.012	0.018	0.018	0.016	0.012	0.015	0.028	0.017	0.003
Industrial wastes	0.000	0.010	0.008	0.005	0.013	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.124	0.080	0.000	0.040	0.040	0.040	0.080	0.040	0.040	0.032	0.029
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.029	0.171	0.028	0.000	0.104	0.050	0.026	0.000	0.024	0.592	0.000
Liquid petroleum gas (LPG)	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.047	0.000	0.046
Motor gasoline	0.044	0.044	0.044	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.806	1.806	1.591	1.247	1.247	1.118	1.333	1.290	1.247	1.376	1.516
Fuel oil	0.162	0.242	0.081	0.364	0.242	0.162	0.283	0.040	0.162	0.040	0.040
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	29.871	32.634	33.111	32.027	36.095	40.940	35.719	40.127	43.722	44.789	32.527
Blast furnace gas	0.847	0.840	0.149	0.086	0.021	0.030	0.042	0.045	0.037	0.000	0.000
Gas works gas and other recovered gases	0.168	0.005	0.004	0.004	0.004	0.004	0.003	0.004	0.005	0.006	0.012
Fuels											
Liquid fuels	2.268	2.216	1.716	1.738	1.657	1.447	1.696	1.418	1.496	1.448	1.631
Gaseous fuels	19.458	19.490	12.987	12.515	9.741	11.190	10.106	10.363	9.680	9.239	8.858
Solid fuels	74.141	67.310	64.088	48.914	55.888	60.786	51.647	53.458	66.074	63.469	44.062
Other fuels	0.000	0.014	0.008	0.005	0.013	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.027	0.037	0.052	0.047	0.026	0.020	0.014	0.026	0.085	0.037	0.137
Total	95.894	89.067	78.851	63.218	67.325	73.443	63.464	65.265	77.335	74.193	54.687

Table 3. (cont.) Fuel consumption [PJ] in 1.A.1.c category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	2.596	4.928	2.614	2.286	2.586	2.928	3.521	3.108	3.348	4.360	3.118
Lignite	1.075	1.379	0.523	0.169	0.201	0.074	0.065	0.067	0.490	0.153	0.042
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	10.322	9.804	11.206	12.013	12.823	24.092	18.211	16.210	15.154	18.944	22.676
Solid biomass	0.349	0.162	0.160	0.122	0.039	0.000	0.026	0.015	0.033	0.020	0.026
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.002	0.010	0.001	0.002	0.002	0.002	0.005	0.006	0.012	0.001	0.001
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.030	0.060	0.062	0.032	0.000	0.000	0.000	0.020	0.015	0.014	0.011
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.049	0.000	0.000	0.000	0.000	0.000	0.004	0.001	0.001	0.001
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.013	0.002	0.002
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.034	0.025	0.015
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.645	2.078	1.472	1.819	1.429	1.892	1.376	1.335	1.274	1.685	1.126
Fuel oil	0.080	0.040	0.040	0.040	0.000	0.000	0.000	0.015	0.106	0.109	0.145
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	43.667	41.153	38.653	40.220	40.298	42.385	40.631	40.299	41.132	39.759	34.910
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.012	0.009	0.012	0.008	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	1.755	2.178	1.574	1.891	1.429	1.892	1.376	1.414	1.441	1.835	1.297
Gaseous fuels	10.322	9.804	11.206	12.013	12.823	24.092	18.211	16.210	15.154	18.944	22.676
Solid fuels	47.350	47.519	41.801	42.683	43.085	45.386	44.217	43.478	44.972	44.272	38.071
Other fuels	0.002	0.010	0.001	0.002	0.002	0.002	0.005	0.006	0.012	0.001	0.001
Biomass	0.349	0.162	0.160	0.122	0.039	0.000	0.026	0.015	0.033	0.020	0.026
Total	59.778	59.674	54.742	56.711	57.379	71.372	63.835	61.122	61.611	65.072	62.072

Table 3. (cont.) Fuel consumption [PJ] in 1.A.1.c category

Fuels	2021	2022	2023	2024
Hard coal	3.114	2.650	2.585	2.199
Lignite	0.061	0.070	0.064	0.041
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	24.627	23.193	25.954	26.183
Solid biomass	0.019	0.022	0.026	0.028
Biogas	0.000	0.000	0.000	0.000
Industrial wastes	0.001	0.001	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.010	0.010	0.009	0.003
Petroleum coke	0.000	0.000	0.000	0.000
Coke	0.000	0.029	0.001	0.001
Liquid petroleum gas (LPG)	0.002	0.001	0.002	0.001
Motor gasoline	0.007	0.006	0.005	0.002
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	1.150	1.108	0.975	1.159
Fuel oil	0.009	0.011	0.007	0.000
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	41.444	37.914	37.899	36.191
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	1.179	1.136	0.998	1.165
Gaseous fuels	24.627	23.193	25.954	26.183
Solid fuels	44.620	40.663	40.548	38.432
Other fuels	0.001	0.001	0.000	0.000
Biomass	0.019	0.022	0.026	0.028
Total	70.445	65.015	67.527	65.808

Table 4. Fuel consumption [PJ] in 1.A.2.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	2.367	1.278	1.138	1.243	1.494	9.159	8.513	25.320	28.922	23.636	21.085
Lignite	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.009	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993
Solid biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941	0.498	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044	0.044	0.657	0.044
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	12.258	7.268	9.568	19.593	22.076	27.128	33.104	26.669	24.368	28.401	23.197
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.128	0.128	0.172	0.129	0.172	0.344	0.559	0.774	0.903	0.559	0.301
Fuel oil	18.120	15.400	11.110	7.878	5.333	4.323	2.990	2.060	0.970	4.767	1.616
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	32.570	30.997	26.038	22.091	22.568	21.605	25.480	27.686	24.404	24.257	24.742
Blast furnace gas	43.812	40.192	36.484	27.903	25.909	25.676	28.350	37.610	34.205	36.120	29.520
Gas works gas and other recovered gases	4.316	3.219	2.174	1.462	0.718	0.613	0.067	0.068	0.080	0.059	0.007
Fuels											
Liquid fuels	18.248	15.528	11.282	8.007	5.505	4.667	3.549	2.878	1.916	6.031	1.961
Gaseous fuels	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993
Solid fuels	95.323	82.955	75.403	72.311	72.764	84.180	95.514	117.353	111.979	112.482	98.551
Other fuels	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941	0.498	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006
Total	190.236	165.159	143.615	121.048	111.334	118.697	128.320	147.416	140.297	146.795	124.511

Table 4. (cont.) Fuel consumption [PJ] in 1.A.2.a category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	19.075	18.262	14.701	12.424	12.593	16.840	10.744	9.071	11.748	3.950	4.784
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.023	0.023	0.023	0.000	0.000	0.023	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.440	22.024	18.329	15.463	14.827	19.964	20.455	20.998	22.716	20.397	16.595
Solid biomass	0.004	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
Coke	20.900	20.906	16.288	20.126	21.368	22.096	14.900	12.479	4.849	5.569	2.585
Liquid petroleum gas (LPG)	0.047	0.189	0.189	0.237	0.189	0.142	0.000	0.000	0.000	0.047	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.344	0.516	0.172	0.129	0.129	0.129	0.086	0.129	0.086	0.086	0.087
Fuel oil	1.818	1.050	0.646	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	15.875	17.574	16.994	15.122	16.132	15.302	12.570	12.835	13.885	9.850	5.296
Blast furnace gas	24.034	31.874	26.768	23.876	25.282	26.721	18.896	20.226	28.194	18.347	9.873
Gas works gas and other recovered gases	0.008	0.000	0.277	0.706	1.195	1.654	0.965	1.015	1.313	0.993	0.474
Fuels											
Liquid fuels	2.209	1.843	1.008	0.366	0.318	0.271	0.086	0.129	0.086	0.133	0.133
Gaseous fuels	21.440	22.024	18.329	15.463	14.827	19.964	20.455	20.998	22.716	20.397	16.595
Solid fuels	79.891	88.616	75.051	72.276	76.592	82.612	58.075	55.649	59.989	38.709	23.012
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.004	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001
Total	103.544	112.486	94.393	88.108	91.741	102.851	78.619	76.777	82.792	59.240	39.740

Table 4. (cont.) Fuel consumption [PJ] in 1.A.2.a category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	2.638	2.521	2.605	2.030	2.541	0.762	0.637	1.827	2.357	3.287	1.662
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	16.916	17.208	16.905	16.242	16.096	16.702	19.457	23.716	25.022	21.212	21.382
Solid biomass	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.032	0.064	0.096	0.064	0.064	0.064	0.060	0.040	0.033	0.041
Coke	2.920	7.584	9.405	10.333	9.527	11.212	8.570	11.481	8.732	1.066	0.560
Liquid petroleum gas (LPG)	0.046	0.046	0.092	0.046	0.046	0.046	0.046	0.045	0.055	0.052	0.041
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.005	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.087	0.087	0.043	0.043	0.087	0.086	0.086	0.130	0.134	0.140	0.096
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	8.378	8.420	8.231	8.518	9.014	5.555	4.361	4.981	5.282	4.436	4.058
Blast furnace gas	12.059	11.258	11.352	10.797	11.863	10.228	10.528	11.281	10.162	10.394	8.015
Gas works gas and other recovered gases	0.187	0.203	0.047	0.028	0.099	0.770	0.607	0.554	0.351	0.477	0.517
Fuels											
Liquid fuels	0.133	0.165	0.199	0.185	0.197	0.196	0.196	0.238	0.232	0.230	0.179
Gaseous fuels	16.916	17.208	16.905	16.242	16.096	16.702	19.457	23.716	25.022	21.212	21.382
Solid fuels	26.182	29.987	31.663	31.706	33.044	28.527	24.703	30.124	26.884	19.660	14.812
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Total	43.231	47.359	48.768	48.134	49.338	45.426	44.357	54.079	52.139	41.103	36.373

Table 4. (cont.) Fuel consumption [PJ] in 1.A.2.a category

Fuels	2021	2022	2023	2024
Hard coal	2.734	1.054	2.265	2.573
Lignite	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.003	0.003
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	23.123	16.227	17.982	19.929
Solid biomass	0.008	0.009	0.006	0.006
Biogas	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000
Petroleum coke	0.050	0.036	0.048	0.060
Coke	0.738	0.806	1.269	0.371
Liquid petroleum gas (LPG)	0.046	0.049	0.074	0.065
Motor gasoline	0.001	0.006	0.007	0.001
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	0.098	0.095	0.085	0.070
Fuel oil	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	5.329	4.703	4.367	2.961
Blast furnace gas	8.499	6.623	6.200	7.666
Gas works gas and other recovered gases	0.525	0.717	0.856	0.884
Fuels				
Liquid fuels	0.196	0.187	0.214	0.195
Gaseous fuels	23.123	16.227	17.982	19.929
Solid fuels	17.825	13.903	14.961	14.459
Other fuels	0.000	0.000	0.000	0.000
Biomass	0.008	0.009	0.006	0.006
Total	41.152	30.326	33.164	34.589

Table 5. Fuel consumption [PJ] in 1.A.2.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1.411	1.323	0.455	0.565	0.850	1.916	1.771	4.172	4.285	3.907	3.331
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.639
Solid biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	9.754	8.730	5.706	4.953	2.149	2.659	6.061	5.927	6.324	6.248	5.983
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.043	0.043	0.043	0.043	0.129	0.086	0.129	0.172	0.215	0.215	0.258
Fuel oil	0.640	0.760	0.768	0.808	0.808	0.768	0.808	0.727	0.687	0.646	0.525
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.461	0.437	0.397	0.178	0.186	0.043	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.375	0.341	0.042	0.006	0.000	0.000	0.000	0.000	0.000	0.000	2.164
Fuels											
Liquid fuels	0.683	0.803	0.811	0.851	0.937	0.854	0.937	0.899	0.949	0.905	0.783
Gaseous fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.639
Solid fuels	12.001	10.832	6.601	5.703	3.186	4.618	7.831	10.099	10.609	10.156	11.478
Other fuels	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026
Total	19.191	17.823	12.449	11.670	5.850	7.947	14.913	18.595	19.226	18.888	17.925

Table 5. (cont.) Fuel consumption [PJ] in 1.A.2.b category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	3.117	3.108	3.790	2.560	2.115	1.092	0.024	0.024	0.570	0.000	0.000
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.660	5.814	5.700	5.589	5.868	6.402	6.464	6.880	6.740	6.537	5.846
Solid biomass	0.010	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	5.919	6.050	6.111	6.132	5.937	5.821	5.693	5.929	6.297	6.481	6.078
Liquid petroleum gas (LPG)	0.000	0.047	0.095	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.172	0.258	0.172	0.172	0.129	0.172	0.172	0.172	0.172	0.172	0.173
Fuel oil	0.566	0.566	0.525	0.404	0.323	0.404	0.404	0.404	0.162	0.162	0.160
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	2.070	2.268	2.551	2.739	2.539	1.763	0.961	0.951	0.949	1.220	1.086
Fuels											
Liquid fuels	0.738	0.871	0.792	0.623	0.500	0.664	0.623	0.623	0.381	0.381	0.379
Gaseous fuels	5.660	5.814	5.700	5.589	5.868	6.402	6.464	6.880	6.740	6.537	5.846
Solid fuels	11.106	11.426	12.452	11.431	10.590	8.675	6.678	6.904	7.816	7.701	7.164
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.010	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	17.514	18.122	18.949	17.644	16.958	15.741	13.765	14.407	14.937	14.619	13.389

Table 5. (cont.) Fuel consumption [PJ] in 1.A.2.b category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	0.000	0.250	0.114	0.113	0.091	0.023	0.068	0.085	0.394	0.748	0.438
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	6.039	6.670	6.890	6.703	6.950	7.225	7.226	7.555	7.958	7.958	7.663
Solid biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	5.922	5.985	6.245	6.150	6.389	6.588	5.518	4.701	4.878	5.024	4.723
Liquid petroleum gas (LPG)	0.046	0.046	0.000	0.000	0.000	0.000	0.000	0.027	0.027	0.027	0.025
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.217	0.173	0.173	0.173	0.173	0.129	0.172	0.183	0.187	0.214	0.106
Fuel oil	0.120	0.120	0.120	0.120	0.080	0.120	0.240	0.463	0.258	0.292	0.337
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.039	0.043	0.039	0.051	0.047	0.053	0.086	0.072	0.069	0.075
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.960	0.967	0.928	1.066	1.275	1.316	1.202	1.337	1.394	1.255	1.303
Fuels											
Liquid fuels	0.383	0.339	0.293	0.293	0.253	0.249	0.412	0.675	0.474	0.533	0.468
Gaseous fuels	6.039	6.670	6.890	6.703	6.950	7.225	7.226	7.555	7.958	7.958	7.663
Solid fuels	6.882	7.241	7.329	7.367	7.806	7.974	6.841	6.209	6.738	7.096	6.539
Other fuels	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	13.305	14.250	14.512	14.363	15.009	15.448	14.480	14.439	15.170	15.588	14.671

Table 5. (cont.) Fuel consumption [PJ] in 1.A.2.b category

Fuels	2021	2022	2023	2024
Hard coal	0.462	0.244	0.264	0.051
Lignite	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	7.982	7.320	7.071	7.171
Solid biomass	0.000	0.001	0.001	0.001
Biogas	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000
Coke	4.930	6.505	4.786	4.789
Liquid petroleum gas (LPG)	0.030	0.028	0.028	0.030
Motor gasoline	0.000	0.001	0.001	0.000
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	0.057	0.040	0.061	0.038
Fuel oil	0.257	0.260	0.249	0.262
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.087	0.077	0.070	0.075
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	1.158	1.288	1.146	1.217
Fuels				
Liquid fuels	0.344	0.330	0.339	0.330
Gaseous fuels	7.982	7.320	7.071	7.171
Solid fuels	6.637	8.114	6.266	6.132
Other fuels	0.000	0.000	0.000	0.000
Biomass	0.000	0.001	0.001	0.001
Total	14.963	15.765	13.677	13.633

Table 6. Fuel consumption [PJ] in 1.A.2.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	9.197	9.059	7.216	6.623	4.550	13.125	7.945	70.221	71.191	63.913	54.992
Lignite	0.056	0.038	0.039	0.038	0.027	0.047	0.029	0.428	0.460	0.389	0.429
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408
Solid biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Industrial wastes	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	0.672
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.044	0.000	0.263	2.963	3.070	3.545
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.763	4.530	2.542	1.868	1.746	1.790	1.832	3.257	2.835	1.379	1.455
Liquid petroleum gas (LPG)	3.726	4.554	0.000	0.000	0.000	0.047	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.406	1.363	0.989	0.860	0.774	0.731	0.731	0.946	1.075	1.075	1.419
Fuel oil	6.080	6.120	2.747	1.899	2.788	2.505	3.636	8.242	9.413	9.454	17.736
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	3.614	1.930	0.396	3.465	5.445	4.455	0.198	1.584	6.584	9.653	18.513
Coke oven gas	1.053	0.993	0.701	0.522	0.440	1.548	0.276	0.729	0.784	0.140	0.174
Blast furnace gas	0.148	0.136	0.047	0.010	0.006	0.011	0.014	0.023	0.004	0.013	0.004
Gas works gas and other recovered gases	0.190	0.230	0.214	0.192	0.133	0.126	0.110	0.070	0.052	0.000	0.000
Fuels											
Liquid fuels	14.825	13.968	4.132	6.224	9.007	7.782	4.565	11.034	20.035	23.251	41.212
Gaseous fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408
Solid fuels	12.407	14.986	10.759	9.252	6.903	16.648	10.206	74.727	75.325	65.835	57.054
Other fuels	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	0.672
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.001
Total	46.241	50.503	37.011	38.440	37.390	52.511	41.905	113.670	118.925	114.465	108.347

Table 6. (cont.) Fuel consumption [PJ] in 1.A.2.c category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	50.522	50.115	48.485	45.458	27.959	26.665	27.446	25.398	26.780	43.781	42.011
Lignite	0.138	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	9.041	9.464	8.481	7.199	6.457	7.494	8.061	9.009	8.754	7.950	9.707
Solid biomass	0.000	0.000	0.000	0.001	0.153	0.094	0.153	0.000	0.121	0.000	0.058
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.582	0.607	0.618	0.567	0.875	1.070	0.570	0.671	0.707	0.509	0.584
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	2.576	0.482	0.526	0.325	0.241	0.000	0.040	0.040	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.555	1.499	1.574	1.684	1.513	1.821	1.367	2.916	1.928	1.159	0.852
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.090
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.333	1.032	4.773	4.257	4.343	3.913	3.784	4.085	3.741	3.698	4.590
Fuel oil	15.837	13.655	7.434	7.716	7.151	7.353	3.919	3.878	3.596	0.646	1.080
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	19.602	23.315	20.543	20.741	21.830	22.424	18.266	21.335	22.473	19.157	20.889
Coke oven gas	0.131	0.050	0.150	0.285	0.635	0.606	0.608	0.547	0.658	0.654	0.483
Blast furnace gas	0.007	0.011	0.008	0.004	0.013	0.019	0.006	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	39.348	38.484	33.275	33.039	33.565	33.689	26.009	29.338	29.810	23.501	26.741
Gaseous fuels	9.041	9.464	8.481	7.199	6.457	7.494	8.061	9.009	8.754	7.950	9.707
Solid fuels	52.352	51.675	50.217	47.431	30.119	29.110	29.427	28.861	29.366	45.594	43.347
Other fuels	0.582	0.607	0.618	0.567	0.875	1.070	0.570	0.671	0.707	0.509	0.584
Biomass	0.000	0.000	0.000	0.001	0.153	0.094	0.153	0.000	0.121	0.000	0.058
Total	101.324	100.230	92.591	88.238	71.168	71.458	64.220	67.879	68.758	77.554	80.437

Table 6. (cont.) Fuel consumption [PJ] in 1.A.2.c category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	47.304	47.704	46.768	47.308	46.501	42.588	44.241	49.090	49.068	48.164	43.772
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	11.807	13.886	13.568	14.696	14.500	14.861	12.068	13.021	15.171	14.969	17.034
Solid biomass	0.058	0.053	0.131	0.050	0.103	0.088	0.138	0.099	0.142	0.370	0.352
Biogas	0.000	0.000	0.000	0.000	0.008	0.006	0.006	0.005	0.004	0.001	0.001
Industrial wastes	0.770	0.732	0.581	1.092	1.082	0.936	0.652	1.494	0.744	0.393	0.330
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.003
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.791	1.260	3.089	2.944	2.942	3.151	3.456	1.496	1.819	2.258	2.796
Liquid petroleum gas (LPG)	0.138	0.138	0.138	0.184	0.138	0.230	0.276	0.300	0.307	0.337	0.272
Motor gasoline	0.000	0.045	0.045	0.045	0.000	0.000	0.000	0.008	0.010	0.009	0.001
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	4.200	3.637	3.334	4.027	2.468	1.806	1.505	1.744	1.714	1.976	1.857
Fuel oil	0.600	0.720	0.560	0.440	0.400	0.560	0.400	0.348	0.332	0.282	0.204
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	17.177	12.276	9.702	11.979	10.296	7.722	8.019	10.697	10.367	15.804	17.298
Coke oven gas	0.627	0.616	0.595	0.639	0.645	0.624	0.598	0.623	0.613	0.580	0.256
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	22.115	16.816	13.779	16.675	13.302	10.318	10.200	13.099	12.732	18.412	19.634
Gaseous fuels	11.807	13.886	13.568	14.696	14.500	14.861	12.068	13.021	15.171	14.969	17.034
Solid fuels	48.722	49.579	50.452	50.892	50.088	46.363	48.295	51.209	51.499	51.002	46.825
Other fuels	0.770	0.732	0.581	1.092	1.082	0.936	0.652	1.494	0.744	0.393	0.330
Biomass	0.058	0.053	0.131	0.050	0.111	0.094	0.144	0.104	0.146	0.371	0.353
Total	83.473	81.067	78.511	83.404	79.083	72.571	71.358	78.927	80.293	85.147	84.176

Table 6. (cont.) Fuel consumption [PJ] in 1.A.2.c category

Fuels	2021	2022	2023	2024
Hard coal	45.948	41.048	33.179	28.173
Lignite	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	18.888	12.927	15.933	18.773
Solid biomass	0.253	0.261	0.277	0.204
Biogas	0.001	0.010	0.017	0.056
Industrial wastes	0.408	0.239	0.057	0.051
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.003	0.002	0.287	0.002
Petroleum coke	0.000	0.000	0.000	0.000
Coke	2.111	2.022	2.460	2.408
Liquid petroleum gas (LPG)	0.329	0.377	0.374	0.381
Motor gasoline	0.000	0.065	0.040	0.000
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	0.339	3.616	1.832	1.297
Fuel oil	0.257	0.179	0.186	0.076
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	19.658	10.257	8.549	12.966
Coke oven gas	0.493	0.528	0.291	0.448
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	20.586	14.497	11.268	14.722
Gaseous fuels	18.888	12.927	15.933	18.773
Solid fuels	48.552	43.599	35.930	31.029
Other fuels	0.408	0.239	0.057	0.051
Biomass	0.255	0.271	0.293	0.261
Total	88.689	71.532	63.481	64.835

Table 7. Fuel consumption [PJ] in 1.A.2.d category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1.639	1.940	1.548	1.741	1.379	4.524	3.836	22.318	22.233	23.979	18.936
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563
Solid biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.044	0.000	0.088	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.331	0.247	0.243	0.271	0.242	0.298	0.269	0.267	0.245	0.135	0.081
Liquid petroleum gas (LPG)	0.046	0.046	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.095	0.189
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.085	0.085	0.043	0.086	0.043	0.043	0.086	0.129	0.602	0.989	1.118
Fuel oil	1.240	1.160	1.293	1.212	1.333	1.576	1.414	2.384	1.050	1.050	1.333
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.004	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.001	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.003	0.003	0.003	0.014	0.002	0.000	0.000	0.000	0.004	0.000	0.000
Fuels											
Liquid fuels	1.371	1.291	1.383	1.345	1.424	1.710	1.547	2.648	1.700	2.134	2.640
Gaseous fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563
Solid fuels	1.976	2.192	1.797	2.027	1.624	4.825	4.108	22.587	22.482	24.114	19.017
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476
Total	3.803	3.850	3.282	3.434	3.074	8.181	7.515	40.903	40.881	43.816	38.697

Table 7. (cont.) Fuel consumption [PJ] in 1.A.2.d category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	17.528	15.696	15.564	14.317	14.050	13.797	13.430	11.592	9.452	7.850	8.515
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.007	1.211	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.973
Solid biomass	15.545	15.938	15.138	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.171
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.088	0.000	0.000	0.000	0.000	0.040	0.040	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.027	0.026	0.028	0.055	0.028	0.027	0.028	0.028	0.028	0.000
Liquid petroleum gas (LPG)	0.095	0.142	0.095	0.047	0.047	0.095	0.047	0.095	0.189	0.047	0.092
Motor gasoline	0.000	0.000	0.000	0.000	0.089	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.817	0.602	0.473	0.430	0.473	0.473	0.344	0.387	0.430	0.301	0.303
Fuel oil	1.333	1.374	1.495	1.576	1.616	1.697	1.616	1.616	1.737	1.656	1.600
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	2.245	2.205	2.062	2.053	2.225	2.264	2.048	2.138	2.356	2.005	1.995
Gaseous fuels	1.007	1.211	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.973
Solid fuels	17.528	15.723	15.591	14.345	14.105	13.824	13.457	11.620	9.480	7.879	8.515
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	15.545	15.938	15.138	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.189
Total	36.325	35.076	34.236	34.480	36.374	37.703	36.403	36.113	34.567	34.435	34.671

Table 7. (cont.) Fuel consumption [PJ] in 1.A.2.d category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	10.086	11.301	10.643	11.460	11.291	10.922	9.628	8.744	7.024	7.751	6.637
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.135	4.587	5.535	6.271	6.994	7.166	7.991	8.709	8.513	9.935	9.314
Solid biomass	19.581	19.402	20.358	27.152	26.987	27.070	30.415	33.742	36.138	38.625	40.403
Biogas	0.049	0.073	0.083	0.091	0.105	0.086	0.111	0.139	0.096	0.105	0.109
Industrial wastes	0.000	0.000	0.000	0.037	0.125	0.108	0.190	0.295	0.360	0.427	0.531
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.001	0.001	0.001
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.107	0.111	0.122	0.137
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.019	0.021	0.001
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.260	0.217	0.173	0.260	0.173	0.258	0.473	0.574	0.478	0.591	0.434
Fuel oil	1.640	1.680	1.520	1.520	1.280	1.480	1.320	1.058	0.930	0.990	0.942
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	1.992	1.989	1.785	1.872	1.545	1.830	1.885	1.752	1.539	1.725	1.514
Gaseous fuels	5.135	4.587	5.535	6.271	6.994	7.166	7.991	8.709	8.513	9.935	9.314
Solid fuels	10.113	11.301	10.643	11.460	11.291	10.922	9.628	8.744	7.024	7.751	6.637
Other fuels	0.000	0.000	0.000	0.037	0.125	0.108	0.190	0.295	0.360	0.427	0.531
Biomass	19.630	19.475	20.441	27.243	27.092	27.156	30.526	33.881	36.234	38.730	40.512
Total	36.870	37.351	38.404	46.883	47.047	47.182	50.220	53.381	53.671	58.568	58.508

Table 7. (cont.) Fuel consumption [PJ] in 1.A.2.d category

Fuels	2021	2022	2023	2024
Hard coal	7.194	6.183	4.558	4.369
Lignite	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.002	0.001
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	9.855	9.467	9.474	9.898
Solid biomass	22.756	26.770	26.927	26.775
Biogas	0.170	0.182	0.245	0.301
Industrial wastes	0.406	0.608	0.840	0.798
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	1.374	0.581	0.448	0.736
Other petroleum products	0.001	0.001	0.001	0.001
Petroleum coke	0.000	0.000	0.000	0.000
Coke	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.158	0.191	0.184	0.162
Motor gasoline	0.001	0.047	0.050	0.001
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	0.775	0.774	0.413	0.360
Fuel oil	1.063	1.123	0.849	0.816
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	1.998	2.137	1.497	1.341
Gaseous fuels	9.855	9.467	9.474	9.898
Solid fuels	7.194	6.184	4.560	4.370
Other fuels	0.406	0.608	0.840	0.798
Biomass	24.300	27.534	27.619	27.812
Total	43.753	45.929	43.990	44.219

Table 8. Fuel consumption [PJ] in 1.A.2.e category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	25.200	31.694	31.914	35.940	32.724	55.643	53.801	73.024	88.777	78.207	64.659
Lignite	0.085	0.104	0.058	0.019	0.018	0.369	0.195	0.265	0.380	0.250	0.317
Hard coal briquettes (patent fuels)	0.023	0.023	0.000	0.000	0.000	0.163	0.162	0.046	0.025	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839	15.051	12.927	10.694
Solid biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.101
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
Industrial wastes	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.080	0.080	0.040
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	3.609	3.569	3.164	2.788	2.499	3.093	2.559	2.403	3.053	2.705	1.967
Liquid petroleum gas (LPG)	0.046	0.046	0.047	0.047	0.047	0.047	0.095	0.142	0.189	0.189	0.284
Motor gasoline	0.440	0.264	0.133	0.089	0.133	0.177	0.133	0.177	0.177	0.044	0.089
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	2.087	1.534	1.247	1.032	0.903	1.204	1.075	0.903	5.461	5.203	6.837
Fuel oil	1.840	1.640	1.656	1.495	1.333	3.313	3.959	6.181	2.747	2.424	2.707
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.336	0.120	0.111	0.125	0.124	0.102	0.003	0.025	0.004	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.027	0.032	0.051	0.014	0.001	0.001	0.000	0.000	0.003	0.000	0.000
Fuels											
Liquid fuels	4.413	3.484	3.084	2.663	2.416	4.741	5.262	7.491	8.655	7.941	9.956
Gaseous fuels	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839	15.051	12.927	10.694
Solid fuels	29.280	35.542	35.298	38.886	35.366	59.370	56.721	75.762	92.241	81.162	66.942
Other fuels	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000	0.000	0.000	0.000
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.104
Total	35.775	41.043	40.443	43.627	40.224	67.436	69.222	87.175	116.041	102.104	87.696

Table 8. (cont.) Fuel consumption [PJ] in 1.A.2.e category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	46.327	43.417	40.020	41.803	39.030	36.095	35.894	30.864	31.164	26.777	25.813
Lignite	0.237	0.191	0.149	0.192	0.175	0.129	0.092	0.074	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950
Solid biomass	0.069	0.049	0.062	0.060	0.323	0.373	0.214	0.239	0.164	0.365	0.192
Biogas	0.020	0.063	0.042	0.037	0.063	0.074	0.068	0.072	0.084	0.094	0.109
Industrial wastes	0.000	0.001	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.637	1.526	1.259	1.491	1.293	1.186	0.911	0.841	0.907	0.650	0.632
Liquid petroleum gas (LPG)	0.473	0.710	0.899	1.466	1.419	1.608	1.466	1.230	0.946	1.041	0.966
Motor gasoline	0.044	0.133	0.044	0.089	0.089	0.000	0.044	0.044	0.044	0.044	0.045
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	7.482	7.353	7.267	6.880	6.880	6.192	5.418	4.515	4.085	4.515	3.161
Fuel oil	2.303	2.545	2.747	2.990	3.070	3.313	3.192	2.949	2.788	2.020	1.440
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	10.302	10.741	10.957	11.425	11.458	11.113	10.120	8.738	7.863	7.620	5.612
Gaseous fuels	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950
Solid fuels	48.201	45.134	41.444	43.486	40.497	37.409	36.898	31.779	32.072	27.427	26.446
Other fuels	0.000	0.001	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.089	0.112	0.104	0.097	0.386	0.447	0.282	0.311	0.248	0.459	0.301
Total	67.847	66.481	63.883	67.498	67.416	65.133	64.756	59.451	60.796	56.231	53.309

Table 8. (cont.) Fuel consumption [PJ] in 1.A.2.e category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	25.903	25.613	26.172	24.724	24.429	22.011	22.555	22.972	23.170	23.123	21.423
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.001	0.001
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.610	22.127	23.705	24.474	25.093	26.009	27.589	29.944	36.319	35.407	34.270
Solid biomass	0.441	0.534	0.436	0.664	0.747	1.134	1.383	1.072	1.244	0.780	0.650
Biogas	0.101	0.145	0.199	0.202	0.350	0.345	0.407	0.422	0.374	0.546	0.601
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.600	0.509	0.306	0.361	0.448	0.624	0.646	0.726	0.759	0.740	0.679
Liquid petroleum gas (LPG)	0.828	0.782	0.690	0.828	0.966	0.966	1.104	1.195	1.135	1.005	1.044
Motor gasoline	0.045	0.000	0.000	0.000	0.000	0.000	0.043	0.016	0.041	0.018	0.007
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	2.901	2.382	2.944	1.992	1.516	1.290	1.419	1.473	1.358	1.233	0.942
Fuel oil	1.240	1.360	1.360	1.080	1.000	0.600	0.760	0.721	0.799	0.664	0.506
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	5.014	4.524	4.994	3.900	3.482	2.856	3.326	3.405	3.333	2.920	2.498
Gaseous fuels	21.610	22.127	23.705	24.474	25.093	26.009	27.589	29.944	36.319	35.407	34.270
Solid fuels	26.503	26.123	26.478	25.085	24.877	22.635	23.201	23.701	23.936	23.864	22.103
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.542	0.679	0.635	0.866	1.097	1.479	1.790	1.494	1.618	1.326	1.251
Total	53.670	53.452	55.812	54.325	54.549	52.979	55.906	58.545	65.207	63.518	60.122

Table 8. (cont.) Fuel consumption [PJ] in 1.A.2.e category

Fuels	2021	2022	2023	2024
Hard coal	20.313	20.112	18.941	19.230
Lignite	0.001	0.129	0.028	0.000
Hard coal briquettes (patent fuels)	0.001	0.001	0.000	0.000
Brown coal briquettes	0.003	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	35.687	33.965	36.056	38.749
Solid biomass	0.405	0.989	0.951	0.955
Biogas	0.501	0.598	0.689	0.726
Industrial wastes	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.006	0.000	0.000	0.003
Other petroleum products	0.000	0.001	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000
Coke	0.704	0.766	0.896	1.040
Liquid petroleum gas (LPG)	1.143	1.615	2.120	2.357
Motor gasoline	0.003	0.184	0.196	0.008
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.001	0.001	0.001	0.001
Diesel oil	0.883	2.633	1.880	0.930
Fuel oil	0.429	0.813	0.365	0.259
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	2.459	5.246	4.562	3.555
Gaseous fuels	35.687	33.965	36.056	38.749
Solid fuels	21.022	21.008	19.865	20.270
Other fuels	0.000	0.000	0.000	0.000
Biomass	0.912	1.587	1.640	1.684
Total	60.079	61.807	62.123	64.259

Table 9. Fuel consumption [PJ] in 1.A.2.f category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	102.301	98.072	72.637	72.514	68.894	76.924	83.926	79.647	86.930	81.562	66.639
Lignite	0.263	0.180	0.156	0.150	0.091	0.161	0.117	0.163	0.150	0.185	0.153
Hard coal briquettes (patent fuels)	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.035	0.018	0.017	0.018	0.000	0.000	0.000	0.000	0.000	0.035	0.035
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	28.729	28.108	24.575	22.704	22.246	21.986	21.506	25.518	26.650	25.655	27.097
Solid biomass	1.778	1.924	1.155	0.455	0.042	0.033	0.004	0.010	0.010	0.005	0.006
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.382	0.446	0.068	0.023	0.267	0.250	0.145	0.197	0.144	0.047	0.207
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.407	1.250
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	18.984	18.997	13.225	10.745	10.479	10.200	10.774	9.477	10.657	8.223	9.537
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.095	0.142	0.047	0.095	0.237
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.133	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.321	1.108	0.946	0.817	0.774	0.774	0.946	1.333	1.806	2.795	2.021
Fuel oil	6.000	6.720	4.202	2.828	3.596	4.000	4.363	6.141	3.798	4.161	6.747
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	2.685	2.241	2.101	1.821	1.341	1.234	0.482	0.887	0.509	0.353	0.988
Blast furnace gas	0.140	0.118	0.101	0.106	0.079	0.108	0.120	0.053	0.053	0.036	0.010
Gas works gas and other recovered gases	3.926	3.761	3.270	3.137	2.706	2.392	2.090	1.788	1.033	0.501	0.330
Fuels											
Liquid fuels	7.321	7.828	5.148	3.645	4.370	4.774	5.404	7.616	5.651	8.591	10.254
Gaseous fuels	28.729	28.108	24.575	22.704	22.246	21.986	21.506	25.518	26.650	25.655	27.097
Solid fuels	128.357	123.387	91.506	88.490	83.590	91.020	97.509	92.014	99.333	90.895	77.693
Other fuels	0.382	0.446	0.068	0.023	0.267	0.250	0.145	0.197	0.144	0.047	0.207
Biomass	1.778	1.924	1.155	0.455	0.042	0.033	0.004	0.010	0.010	0.005	0.006
Total	166.566	161.692	122.451	115.318	110.515	118.062	124.569	125.355	131.788	125.193	115.257

Table 9. (cont.) Fuel consumption [PJ] in 1.A.2.f category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	59.965	53.349	41.103	33.981	30.332	32.309	31.182	31.523	43.846	36.975	26.468
Lignite	0.069	0.057	0.009	0.019	0.000	0.000	0.000	0.000	0.000	0.063	0.000
Hard coal briquettes (patent fuels)	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.035	0.035	0.017	0.018	0.034	0.035	0.035	0.035	0.035	0.035	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	23.917	27.977	31.858	33.233	35.584	38.225	38.955	41.274	42.465	39.696	41.394
Solid biomass	0.002	0.006	0.275	0.292	0.102	0.261	0.110	0.139	0.116	0.223	0.285
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.529	0.472	0.524	0.508	1.471	1.818	2.701	5.043	5.961	7.400	7.715
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.003	0.013	0.717	1.620	1.776	0.378	4.419
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.029
Other petroleum products	0.446	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	4.485	3.283	7.183	3.640	1.593	1.170	2.752
Coke	7.667	6.451	4.485	4.279	4.703	4.524	2.439	3.001	4.480	2.657	2.200
Liquid petroleum gas (LPG)	0.331	0.520	0.757	1.656	1.419	1.703	0.899	0.378	0.331	0.378	0.460
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.045
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.720	1.634	1.978	2.150	2.279	2.795	2.193	1.892	1.849	2.193	1.992
Fuel oil	5.979	3.919	4.363	4.646	4.565	4.525	4.121	2.909	2.141	2.424	1.960
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.804	0.413	0.897	0.767	0.746	1.505	1.370	1.465	1.614	1.523	1.233
Blast furnace gas	0.005	0.011	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Gas works gas and other recovered gases	0.304	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	8.476	6.073	7.098	8.452	12.748	12.305	14.395	8.819	5.914	6.165	7.209
Gaseous fuels	23.917	27.977	31.858	33.233	35.584	38.225	38.955	41.274	42.465	39.696	41.394
Solid fuels	68.849	60.340	46.515	39.067	35.815	38.373	35.025	36.024	49.975	41.253	29.902
Other fuels	0.529	0.472	0.524	0.508	1.474	1.831	3.418	6.663	7.737	7.778	12.134
Biomass	0.002	0.006	0.275	0.292	0.102	0.261	0.110	0.139	0.117	0.224	0.314
Total	101.773	94.867	86.270	81.552	85.724	90.994	91.903	92.919	106.207	95.117	90.952

Table 9. (cont.) Fuel consumption [PJ] in 1.A.2.f category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	28.045	34.403	26.766	22.808	23.013	20.539	19.346	21.245	21.733	19.818	16.964
Lignite	0.224	0.283	0.549	0.347	0.487	0.545	0.584	0.646	0.688	0.721	0.598
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001
Brown coal briquettes	0.000	0.000	0.000	0.157	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	42.874	44.490	42.350	40.911	40.872	40.516	43.982	44.577	43.117	46.329	44.359
Solid biomass	0.299	0.348	0.407	0.498	0.724	0.623	0.511	0.176	0.216	0.208	0.295
Biogas	0.000	0.000	0.000	0.004	0.044	0.040	0.038	0.030	0.035	0.025	0.000
Industrial wastes	10.454	11.729	12.170	12.763	15.171	15.068	17.249	19.538	24.693	26.289	25.316
Municipal waste - non-biogenic fraction	4.512	5.017	3.913	3.752	4.060	4.011	8.179	8.588	7.682	6.982	7.193
Municipal waste – biogenic fraction	0.123	1.338	1.360	1.391	1.528	1.664	2.094	2.411	2.554	2.214	2.422
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	1.792	0.064	0.160	0.128	0.032	0.000	0.928	1.670	1.917	2.231	1.459
Coke	2.429	2.519	2.449	2.305	2.466	3.151	2.698	2.164	2.089	2.038	2.428
Liquid petroleum gas (LPG)	0.414	0.368	0.230	0.322	0.414	0.368	0.322	0.369	0.361	0.342	0.255
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.043	0.043	0.034	0.021	0.024	0.005
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.992	2.338	1.862	1.472	1.299	1.290	1.247	1.032	1.395	1.616	0.944
Fuel oil	1.840	1.640	1.400	1.320	0.680	0.280	0.200	0.212	0.182	0.094	0.170
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	1.614	1.866	1.687	1.552	1.951	1.841	2.006	1.940	1.689	1.688	1.644
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	6.038	4.410	3.652	3.242	2.425	1.981	2.740	3.318	3.876	4.306	2.833
Gaseous fuels	42.874	44.490	42.350	40.911	40.872	40.516	43.982	44.577	43.117	46.329	44.359
Solid fuels	32.311	39.070	31.450	27.169	27.917	26.075	24.634	25.996	26.200	24.266	21.635
Other fuels	14.966	16.746	16.083	16.515	19.231	19.079	25.428	28.126	32.375	33.271	32.509
Biomass	0.422	1.686	1.767	1.893	2.296	2.327	2.643	2.617	2.805	2.447	2.716
Total	96.610	106.402	95.302	89.730	92.740	89.978	99.427	104.635	108.373	110.620	104.052

Table 9. (cont.) Fuel consumption [PJ] in 1.A.2.f category

Fuels	2021	2022	2023	2024
Hard coal	16.704	12.650	9.167	8.985
Lignite	0.985	0.565	0.512	0.682
Hard coal briquettes (patent fuels)	0.002	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	51.813	45.555	40.718	42.602
Solid biomass	4.046	3.829	4.010	4.015
Biogas	0.000	0.000	0.000	0.000
Industrial wastes	23.737	26.704	24.319	25.488
Municipal waste - non-biogenic fraction	6.741	4.747	4.660	4.390
Municipal waste – biogenic fraction	0.041	0.000	0.000	0.000
Other petroleum products	0.002	0.000	0.000	0.000
Petroleum coke	1.322	2.325	2.780	2.115
Coke	2.920	3.200	2.393	2.587
Liquid petroleum gas (LPG)	0.288	0.288	1.870	1.089
Motor gasoline	0.007	0.044	0.039	0.004
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	1.113	0.959	0.538	0.504
Fuel oil	0.192	0.352	0.186	0.119
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	1.901	1.433	1.061	1.234
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	2.924	3.969	5.412	3.832
Gaseous fuels	51.813	45.555	40.718	42.602
Solid fuels	22.513	17.848	13.133	13.489
Other fuels	30.478	31.451	28.979	29.878
Biomass	4.087	3.829	4.010	4.015
Total	111.814	102.652	92.253	93.816

Table 10. Fuel consumption [PJ] in 1.A.2.g category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	56.386	49.492	38.515	36.641	29.690	80.735	73.256	81.015	105.124	88.132	65.259
Lignite	0.789	0.662	0.175	0.564	0.183	0.653	0.274	0.621	0.600	0.389	0.317
Hard coal briquettes (patent fuels)	0.210	0.139	0.069	0.027	0.000	0.000	0.000	0.000	0.025	0.000	0.000
Brown coal briquettes	0.088	0.071	0.035	0.036	0.035	0.035	0.035	0.035	0.035	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	24.039	22.347	15.645	11.756	13.811	17.922	17.337	15.177	14.210	16.061	17.640
Solid biomass	8.335	7.545	5.826	5.518	5.035	4.995	3.410	4.968	6.519	8.194	8.231
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.001	0.002
Industrial wastes	0.082	0.058	0.022	0.012	0.134	0.298	1.593	2.294	2.675	1.133	2.080
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.044	0.175	0.219	0.175	0.569	0.383	0.749	0.654
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	20.610	18.284	12.143	9.527	10.371	9.902	6.276	5.259	5.370	3.760	1.913
Liquid petroleum gas (LPG)	0.184	0.138	0.142	0.095	0.095	0.095	0.142	0.047	0.142	0.426	0.473
Motor gasoline	1.716	1.584	1.108	1.285	0.886	0.930	0.532	1.019	0.620	2.171	0.753
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088
Diesel oil	14.228	13.078	10.449	8.815	7.310	7.740	7.181	8.299	18.576	15.609	13.244
Fuel oil	3.720	3.240	2.182	1.858	2.424	3.353	3.757	5.090	3.232	3.313	3.798
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	2.499	2.357	1.674	0.984	0.734	0.475	0.055	0.049	0.022	0.010	0.011
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	1.457	1.056	0.732	0.458	0.212	0.022	0.063	0.016	0.001	0.001	0.000
Fuels											
Liquid fuels	19.848	18.040	13.880	12.097	10.890	12.337	11.787	15.025	22.954	22.267	19.010
Gaseous fuels	24.039	22.347	15.645	11.756	13.811	17.922	17.337	15.177	14.210	16.061	17.640
Solid fuels	82.038	72.062	53.343	48.237	41.225	91.821	79.959	86.995	111.176	92.291	67.499
Other fuels	0.082	0.058	0.022	0.012	0.134	0.298	1.593	2.294	2.675	1.133	2.080
Biomass	8.335	7.545	5.826	5.518	5.035	4.995	3.410	4.970	6.520	8.195	8.233
Total	134.342	120.051	88.715	77.619	71.095	127.373	114.085	124.461	157.534	139.948	114.462

Table 10. (cont.) Fuel consumption [PJ] in 1.A.2.g category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	49.965	40.661	31.997	26.863	25.046	21.926	20.047	18.023	16.541	14.069	10.977
Lignite	0.247	0.210	0.149	0.106	0.055	0.009	0.009	0.019	0.000	0.009	0.163
Hard coal briquettes (patent fuels)	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.070	0.095
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	16.352	18.545	18.320	19.273	21.156	22.582	23.324	23.290	23.540	26.264	22.861
Solid biomass	8.604	10.105	10.716	12.300	11.897	12.184	12.193	11.624	13.235	14.043	14.004
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003
Industrial wastes	1.482	2.075	1.802	2.078	2.503	1.661	1.700	3.789	0.937	1.154	1.392
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.000	0.000
Other petroleum products	0.449	0.285	0.084	0.124	0.080	0.121	0.124	0.164	0.080	0.064	0.029
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	2.756	2.141	2.151	1.850	1.705	1.076	0.590	0.841	0.822	0.678	0.440
Liquid petroleum gas (LPG)	0.804	1.514	1.135	1.135	1.277	1.372	1.372	1.277	1.183	1.230	0.966
Motor gasoline	0.354	0.310	0.177	0.133	0.222	0.177	0.177	0.222	0.133	0.089	0.135
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.088	0.088	0.088	0.044	0.044	0.044	0.044	0.088	0.088	0.044	0.043
Diesel oil	11.481	10.793	9.890	9.804	10.191	9.632	10.492	11.094	9.976	9.159	9.093
Fuel oil	3.596	3.636	3.111	2.868	2.747	2.909	2.949	2.666	1.495	1.293	1.280
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.006	0.005	0.020	0.016	0.117	0.436	0.110	0.062	0.059	0.047	0.033
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.013	0.013	0.000	0.000	0.000	0.006
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	16.773	16.626	14.485	14.109	14.561	14.254	15.158	15.512	12.955	11.878	11.546
Gaseous fuels	16.352	18.545	18.320	19.273	21.156	22.582	23.324	23.290	23.540	26.264	22.861
Solid fuels	52.974	43.040	34.317	28.834	26.923	23.460	20.769	18.945	17.440	14.873	11.715
Other fuels	1.482	2.075	1.802	2.078	2.503	1.661	1.700	3.789	0.938	1.154	1.392
Biomass	8.604	10.105	10.716	12.300	11.897	12.184	12.193	11.626	13.240	14.044	14.007
Total	96.185	90.391	79.640	76.594	77.040	74.141	73.144	73.162	68.112	68.214	61.521

Table 10. (cont.) Fuel consumption [PJ] in 1.A.2.g category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	11.348	10.096	7.618	7.287	6.675	7.602	6.464	6.647	6.518	6.003	5.016
Lignite	0.089	0.363	0.269	0.431	0.159	0.182	0.319	0.659	0.649	0.569	0.668
Hard coal briquettes (patent fuels)	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.004	0.003	0.001	0.002
Brown coal briquettes	0.068	0.184	0.081	0.035	0.030	0.030	0.030	0.055	0.060	0.050	0.043
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	24.965	23.874	23.020	26.035	23.394	22.751	24.488	26.750	27.581	27.911	27.473
Solid biomass	17.901	20.051	20.854	24.842	25.929	27.937	30.034	32.860	31.082	35.447	39.326
Biogas	0.000	0.000	0.000	0.000	0.000	0.044	0.042	0.013	0.033	0.022	0.026
Industrial wastes	0.070	0.052	0.069	0.098	0.064	0.045	0.037	0.105	0.107	0.050	0.043
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.090	0.090	0.093	0.064	0.096	0.065	0.065	0.076	0.088	0.027	0.020
Petroleum coke	0.000	0.000	1.024	0.320	0.736	0.832	0.128	0.000	0.000	0.000	0.000
Coke	0.355	0.214	0.167	0.194	0.140	0.085	0.140	0.086	0.080	0.069	0.119
Liquid petroleum gas (LPG)	1.150	1.196	0.966	1.150	1.334	1.150	1.380	1.539	1.605	1.639	1.601
Motor gasoline	0.270	0.135	0.090	0.090	0.176	0.086	0.086	0.187	0.117	0.209	0.044
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.043	0.043	0.000	0.043	0.043	0.000	0.043	0.022	0.020	0.012	0.016
Diesel oil	8.660	8.703	7.101	6.538	6.668	6.063	6.536	6.641	7.026	7.607	6.841
Fuel oil	1.480	1.480	0.960	0.560	0.560	0.200	0.240	0.391	0.359	0.293	0.280
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.020	0.025	0.010	0.010	0.005	0.003	0.005	0.128	0.084	0.003	0.002
Blast furnace gas	0.009	0.012	0.004	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	11.693	11.647	10.234	8.765	9.613	8.396	8.478	8.857	9.216	9.789	8.802
Gaseous fuels	24.965	23.874	23.020	26.035	23.394	22.751	24.488	26.750	27.581	27.911	27.473
Solid fuels	11.889	10.918	8.149	7.961	7.010	7.901	6.959	7.581	7.394	6.696	5.850
Other fuels	0.070	0.052	0.069	0.098	0.064	0.045	0.037	0.105	0.107	0.050	0.043
Biomass	17.901	20.051	20.854	24.842	25.929	27.981	30.076	32.873	31.115	35.469	39.353
Total	66.518	66.542	62.326	67.702	66.011	67.075	70.038	76.166	75.412	79.914	81.521

Table 10. (cont.) Fuel consumption [PJ] in 1.A.2.g category

Fuels	2021	2022	2023	2024
Hard coal	5.497	5.716	3.797	3.402
Lignite	0.901	1.318	1.123	1.113
Hard coal briquettes (patent fuels)	0.009	0.006	0.005	0.004
Brown coal briquettes	0.048	0.042	0.056	0.050
Crude oil	0.000	0.000	0.000	0.000
Natural gas	30.170	27.690	26.122	26.153
Solid biomass	37.596	33.612	34.139	34.081
Biogas	0.104	0.107	0.088	0.061
Industrial wastes	0.117	0.122	0.144	0.131
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.024	0.000	0.000	0.000
Other petroleum products	0.031	0.045	0.031	0.031
Petroleum coke	0.000	0.163	0.398	0.140
Coke	0.193	0.720	0.646	0.355
Liquid petroleum gas (LPG)	1.945	2.009	2.023	1.738
Motor gasoline	0.066	1.017	1.312	0.085
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.015	0.015	0.015	0.016
Diesel oil	6.989	7.076	7.317	7.755
Fuel oil	0.394	0.474	0.467	0.447
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.002	0.002	0.001	0.002
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	9.440	10.799	11.564	10.212
Gaseous fuels	30.170	27.690	26.122	26.153
Solid fuels	6.649	7.804	5.628	4.926
Other fuels	0.117	0.122	0.144	0.131
Biomass	37.724	33.719	34.227	34.142
Total	84.101	80.134	77.685	75.563

Table 11. Fuel consumption [PJ] in 1.A.4.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	207.335	163.251	54.547	62.166	54.214	50.334	34.666	34.267	25.608	18.696	16.200
Lignite	0.540	0.390	0.000	0.000	0.000	0.017	0.091	0.025	0.026	0.009	0.009
Hard coal briquettes (patent fuels)	5.749	1.581	0.000	0.000	0.000	0.000	0.000	0.255	0.000	0.000	0.000
Brown coal briquettes	0.548	0.476	0.375	0.000	0.000	1.605	1.622	1.729	0.217	0.466	0.098
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769
Solid biomass	0.000	0.000	0.000	0.000	0.000	12.312	11.719	11.560	10.046	9.028	8.437
Biogas	0.084	0.123	0.379	0.187	0.206	0.062	0.249	0.423	0.579	0.599	0.648
Industrial wastes	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.482	0.569	1.796	2.102
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	80.500	77.450	33.714	27.952	39.634	32.890	26.880	25.224	25.627	28.355	12.621
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	1.372	0.804	0.804	1.797	1.608
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.989	4.300	6.235
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.081	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	1.417	1.135	1.224	1.088	0.877	0.428	0.123	0.053	0.034	0.127	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.937	0.330	0.312	0.554	0.576	0.091	0.014	0.014	0.014	0.072	0.041
Fuels											
Liquid fuels	0.000	0.000	0.000	0.000	0.000	0.000	1.372	1.286	2.363	7.974	9.946
Gaseous fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769
Solid fuels	297.025	244.614	90.171	91.760	95.301	85.366	63.396	61.568	51.525	47.725	28.968
Other fuels	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003
Biomass	0.084	0.123	0.379	0.187	0.206	12.374	11.968	11.983	10.625	9.627	9.085
Total	312.322	257.481	104.842	103.005	106.708	109.640	86.398	88.097	83.408	89.581	80.770

Fuel consumption from the 1.A.4.a.ii category is included in 1.A.3.b category

Table 11. (cont.) Fuel consumption [PJ] in 1.A.4.a category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	15.104	13.355	13.460	21.676	21.539	22.502	25.405	29.320	25.291	28.763	31.393
Lignite	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.474	0.341	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	37.697	38.567	49.971	61.001	67.057	69.564	68.410	63.517	65.489	71.250	75.746
Solid biomass	8.553	8.514	5.736	5.747	5.752	6.028	6.171	4.580	5.482	5.020	7.104
Biogas	0.663	0.678	0.860	0.683	0.700	1.325	1.602	1.582	1.438	1.795	1.675
Industrial wastes	0.004	0.004	0.091	0.092	0.060	0.002	0.022	0.000	0.000	0.000	0.092
Municipal waste - non-biogenic fraction	0.000	0.020	0.000	0.009	0.011	0.000	0.000	0.000	0.000	0.037	0.031
Municipal waste – biogenic fraction	0.000	0.019	0.000	0.010	0.014	0.013	0.030	0.028	0.029	0.008	0.000
Other petroleum products	2.570	2.680	3.672	0.756	1.991	2.010	0.000	0.000	0.000	0.044	0.086
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	12.229	8.255	3.801	8.099	8.197	5.794	2.625	2.825	2.535	2.027	2.072
Liquid petroleum gas (LPG)	2.129	2.365	3.358	3.453	5.676	5.156	4.730	5.392	5.061	4.588	3.772
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	7.654	13.373	15.050	19.135	16.813	14.319	13.244	23.306	22.919	22.919	21.910
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.005	0.005	0.004	0.003	0.004	0.003	0.003	0.003	0.014	0.018	0.017
Fuels											
Liquid fuels	12.353	18.418	22.080	23.344	24.480	21.485	17.974	28.698	27.980	27.551	25.768
Gaseous fuels	37.697	38.567	49.971	61.001	67.057	69.564	68.410	63.517	65.489	71.250	75.746
Solid fuels	27.821	21.956	17.265	29.795	29.740	28.299	28.032	32.148	27.840	30.808	33.484
Other fuels	0.004	0.024	0.091	0.101	0.071	0.002	0.022	0.000	0.000	0.037	0.123
Biomass	9.216	9.211	6.596	6.440	6.466	7.366	7.803	6.190	6.949	6.823	8.779
Total	87.090	88.176	96.003	120.681	127.815	126.716	122.241	130.553	128.257	136.470	143.900

Fuel consumption from the 1.A.4.a.ii category is included in 1.A.3.b category

Table 11. (cont.) Fuel consumption [PJ] in 1.A.4.a category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	34.504	31.119	32.855	30.116	27.068	25.958	27.222	27.017	24.319	19.663	20.801
Lignite	1.475	0.702	0.531	0.515	0.402	0.327	0.280	0.242	0.198	0.146	0.056
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.340	0.301	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	83.435	78.275	80.890	76.500	67.428	71.826	80.969	60.809	56.324	56.462	47.900
Solid biomass	8.029	7.818	6.833	7.433	6.556	7.043	7.715	8.003	7.556	7.307	7.451
Biogas	1.830	1.963	2.280	2.123	2.118	2.361	2.700	2.502	2.568	2.797	2.742
Industrial wastes	0.021	0.011	0.009	0.388	0.079	0.145	0.116	0.119	0.123	0.137	0.171
Municipal waste - non-biogenic fraction	0.005	0.035	0.028	0.033	0.152	0.050	0.239	0.131	0.096	0.058	0.418
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.131	0.040	0.019	0.002	0.011
Other petroleum products	0.103	0.043	0.043	0.086	0.043	0.000	0.000	0.029	0.000	0.005	0.010
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	2.068	1.758	0.725	1.062	0.563	0.795	0.891	0.704	0.644	0.457	0.412
Liquid petroleum gas (LPG)	3.404	3.312	4.048	2.852	2.990	2.990	3.220	3.287	3.059	3.454	2.300
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	27.409	25.634	18.403	15.155	14.722	14.577	14.534	15.088	15.677	13.646	13.871
Fuel oil	0.080	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.001	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.583
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.017	0.018	0.014	0.010	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	30.996	29.029	22.494	18.093	17.755	17.567	17.754	18.404	18.735	17.106	16.182
Gaseous fuels	83.435	78.275	80.890	76.500	67.428	71.826	80.969	60.809	56.324	56.462	47.900
Solid fuels	38.065	33.598	34.126	31.703	28.036	27.080	28.394	27.963	25.502	20.567	21.852
Other fuels	0.026	0.046	0.037	0.421	0.231	0.195	0.355	0.250	0.219	0.195	0.589
Biomass	9.859	9.781	9.113	9.556	8.674	9.404	10.546	10.544	10.143	10.106	10.204
Total	162.381	150.728	146.660	136.273	122.123	126.071	138.018	117.970	110.924	104.436	96.727

Fuel consumption from the 1.A.4.a.ii category is included in 1.A.3.b category

Table 11. (cont.) Fuel consumption [PJ] in 1.A.4.a category

Fuels	2021	2022	2023	2024
Hard coal	24.933	12.114	10.420	9.115
Lignite	0.024	0.019	0.134	0.123
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000
Brown coal briquettes	0.001	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	67.306	64.525	59.169	58.048
Solid biomass	8.355	6.717	6.596	6.167
Biogas	2.546	2.941	2.952	3.261
Industrial wastes	0.155	0.143	0.583	0.821
Municipal waste - non-biogenic fraction	0.576	0.075	0.424	0.634
Municipal waste – biogenic fraction	0.010	0.011	0.186	0.297
Other petroleum products	0.020	0.011	0.006	0.083
Petroleum coke	0.000	0.000	0.000	0.000
Coke	1.452	0.279	0.168	0.140
Liquid petroleum gas (LPG)	2.162	1.748	1.626	1.380
Motor gasoline	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	15.480	13.561	9.460	15.480
Fuel oil	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.385	0.436	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	17.662	15.320	11.092	16.943
Gaseous fuels	67.306	64.525	59.169	58.048
Solid fuels	26.794	12.848	10.723	9.379
Other fuels	0.731	0.219	1.007	1.456
Biomass	10.911	9.669	9.735	9.725
Total	123.405	102.580	91.725	95.551

Fuel consumption from the 1.A.4.a.ii category is included in 1.A.3.b category

Table 12. Fuel consumption [PJ] in 1.A.4.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	543.559	489.774	272.689	358.521	351.542	372.347	309.920	305.701	326.681	271.980	213.584
Lignite	2.911	1.180	0.526	0.042	0.000	2.956	4.403	4.279	3.420	2.626	1.772
Hard coal briquettes (patent fuels)	17.200	4.742	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	1.627	1.427	1.106	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268
Solid biomass	33.615	32.351	38.875	30.944	34.552	106.000	104.715	105.000	101.000	100.000	100.700
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	31.927	30.721	14.444	11.979	26.448	30.280	27.328	26.808	27.409	32.446	18.677
Liquid petroleum gas (LPG)	6.762	7.452	1.750	1.041	1.892	6.244	9.224	13.197	16.555	18.920	18.920
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.150	6.450	8.600
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	15.996	15.134	15.155	13.706	11.334	6.779	3.560	1.723	0.226	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	4.655	3.697	3.088	1.307	0.739	0.431	0.418	0.258	0.222	0.181	0.164
Fuels											
Liquid fuels	6.762	7.452	1.750	1.041	1.892	6.244	9.224	13.197	18.705	25.370	27.520
Gaseous fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268
Solid fuels	617.874	546.675	307.009	385.556	390.063	412.793	345.629	338.768	357.959	307.233	234.197
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	33.615	32.351	38.875	30.944	34.552	106.000	104.715	105.000	101.000	100.000	100.700
Total	760.831	694.097	469.838	551.214	567.718	666.627	611.238	616.524	620.721	582.625	500.685

Fuel consumption from the 1.A.4.b.ii category is included in 1.A.3.b category

Table 12. (cont.) Fuel consumption [PJ] in 1.A.4.b category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	223.330	166.013	184.731	209.771	207.214	219.654	249.994	284.628	257.388	276.073	279.808
Lignite	1.286	1.169	1.373	1.482	1.605	1.919	2.006	2.168	1.972	2.565	2.219
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	135.995	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857
Solid biomass	95.000	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	18.528	11.671	11.912	8.525	8.569	6.964	2.932	3.216	1.393	1.111	5.747
Liquid petroleum gas (LPG)	19.866	20.812	21.285	21.995	26.015	24.596	23.650	23.650	24.596	25.069	25.254
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	9.804	17.200	21.500	23.005	23.005	21.500	19.350	19.350	15.480	11.610	8.011
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.163	0.158	0.151	0.134	0.128	0.113	0.095	0.099	0.081	0.071	0.069
Fuels											
Liquid fuels	29.670	38.012	42.785	45.000	49.020	46.096	43.000	43.000	40.076	36.679	33.265
Gaseous fuels	135.995	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857
Solid fuels	243.307	179.010	198.167	219.913	217.515	228.651	255.027	290.111	260.834	279.820	287.843
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	95.000	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500
Total	503.972	439.633	479.189	496.505	497.239	504.483	533.838	576.297	535.532	550.449	558.465

Fuel consumption from the 1.A.4.b.ii category is included in 1.A.3.b category

Table 12. (cont.) Fuel consumption [PJ] in 1.A.4.b category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	319.753	275.817	291.964	280.095	257.420	252.837	268.841	267.709	251.533	205.184	216.037
Lignite	4.035	3.593	3.619	4.023	3.214	3.105	2.989	2.502	2.501	1.874	0.721
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	148.431	135.464	141.401	143.186	131.595	132.207	145.144	151.979	149.111	152.348	160.833
Solid biomass	112.746	115.000	116.850	116.850	105.450	108.395	111.435	109.725	237.671	219.724	203.228
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	6.401	5.495	5.297	5.591	4.786	4.112	3.900	4.194	3.637	1.393	0.961
Liquid petroleum gas (LPG)	24.840	23.000	23.000	21.620	21.390	21.390	21.620	22.080	23.000	24.380	23.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	4.547	4.763	3.767	3.464	3.031	3.182	3.010	3.010	3.440	2.795	2.838
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.067	0.059	0.040	0.047	0.036	0.003	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	29.387	27.763	26.767	25.084	24.421	24.572	24.630	25.090	26.440	27.175	25.838
Gaseous fuels	148.431	135.464	141.401	143.186	131.595	132.207	145.144	151.979	149.111	152.348	160.833
Solid fuels	330.255	284.965	300.920	289.756	265.455	260.056	275.731	274.404	257.671	208.452	217.719
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	112.746	115.000	116.850	116.850	105.450	108.395	111.435	109.725	237.671	219.724	203.228
Total	620.819	563.192	585.938	574.876	526.922	525.230	556.939	561.198	670.893	607.699	607.618

Fuel consumption from the 1.A.4.b.ii category is included in 1.A.3.b category

Table 12. (cont.) Fuel consumption [PJ] in 1.A.4.b category

Fuels	2021	2022	2023	2024
Hard coal	201.600	168.840	169.000	148.980
Lignite	0.640	1.280	1.440	1.312
Hard coal briquettes (patent fuels)	0.000	0.700	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	191.171	181.655	176.065	177.272
Solid biomass	207.136	196.917	183.250	184.775
Biogas	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000
Coke	1.128	1.644	1.232	1.134
Liquid petroleum gas (LPG)	21.850	21.298	19.807	17.940
Motor gasoline	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	4.214	3.655	3.440	4.214
Fuel oil	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	26.064	24.953	23.247	22.154
Gaseous fuels	191.171	181.655	176.065	177.272
Solid fuels	203.368	172.464	171.672	151.426
Other fuels	0.000	0.000	0.000	0.000
Biomass	207.136	196.917	183.250	184.775
Total	627.739	575.989	554.234	535.627

Fuel consumption from the 1.A.4.b.ii category is included in 1.A.3.b category

Table 13. Fuel consumption [PJ] in 1.A.4.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	38.608	38.489	36.365	57.356	62.959	62.501	60.542	58.583	62.611	52.483	46.050
Lignite	1.581	1.139	0.844	1.018	0.911	0.814	1.642	1.698	1.299	1.292	1.419
Hard coal briquettes (patent fuels)	0.598	0.527	0.506	0.114	0.065	0.047	0.045	0.000	0.000	0.000	0.000
Brown coal briquettes	0.106	0.106	0.036	0.017	0.018	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.869
Solid biomass	0.039	0.113	0.000	0.000	0.000	20.057	18.367	18.500	17.567	17.000	17.100
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.786	1.754	1.532	1.158	0.677	0.561	3.952	3.917	4.011	5.079	5.336
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.473	0.710	1.183	1.419	1.419
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.665	1.108	1.108	1.108	1.196	1.108
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	53.967	51.972	54.094	52.116	60.802	75.164	81.571	85.656	94.600	109.736	99.330
Fuel oil	10.264	9.469	9.267	8.207	7.147	18.200	22.219	14.044	8.282	11.039	8.919
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.012	0.010	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.001	0.002	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001
Fuels											
Liquid fuels	64.230	61.441	63.361	60.323	67.949	94.028	105.370	101.517	105.172	123.390	110.775
Gaseous fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.869
Solid fuels	42.691	42.026	39.285	59.666	64.630	63.925	66.182	64.198	67.920	58.853	52.806
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.039	0.113	0.000	0.000	0.000	20.057	18.367	18.500	17.567	17.000	17.100
Total	107.467	104.025	103.094	120.264	132.634	178.142	190.131	184.458	191.087	199.814	181.550

Table 13. (cont.) Fuel consumption [PJ] in 1.A.4.c category

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	49.162	33.232	36.976	30.820	29.693	31.728	35.673	42.074	37.748	41.640	41.538
Lignite	1.097	0.939	1.236	1.395	1.528	2.086	2.188	2.489	2.125	2.770	2.485
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.000	0.000	0.046	0.023
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.035	0.000	0.035	0.035
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.476	0.536	0.777	0.914	1.197	1.182	1.084	1.492	1.841	1.900	1.577
Solid biomass	17.100	17.100	19.043	19.010	19.017	19.878	19.047	19.978	19.062	19.024	19.030
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.094	0.097
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.006	0.012	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.006	0.013	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	5.131	3.416	3.687	2.842	2.856	1.950	1.117	1.398	0.836	0.805	0.829
Liquid petroleum gas (LPG)	1.656	1.892	2.365	2.838	3.311	3.311	3.311	2.365	2.365	2.412	2.070
Motor gasoline	1.329	1.373	0.930	0.266	0.310	0.222	0.266	0.310	0.222	0.222	0.225
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	101.695	112.230	104.834	104.490	105.350	107.457	109.650	81.700	75.250	75.250	73.610
Fuel oil	8.729	8.484	8.273	6.844	8.254	8.665	9.527	3.863	3.409	3.487	4.311
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	113.408	123.979	116.402	114.438	117.225	119.655	122.754	88.238	81.245	81.371	80.216
Gaseous fuels	0.476	0.536	0.777	0.914	1.197	1.182	1.084	1.492	1.841	1.900	1.577
Solid fuels	55.390	37.586	41.898	35.057	34.078	35.787	38.979	45.996	40.708	45.296	44.910
Other fuels	0.006	0.012	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	17.106	17.113	19.053	19.010	19.017	19.878	19.047	19.978	19.062	19.118	19.127
Total	186.386	179.226	178.141	169.419	171.517	176.501	181.863	155.704	142.856	147.685	145.829

Table 13. (cont.) Fuel consumption [PJ] in 1.A.4.c category

Fuels	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hard coal	47.291	41.488	43.715	41.611	39.003	36.305	38.963	38.844	36.541	29.571	31.148
Lignite	1.667	1.337	1.327	1.609	1.286	1.144	0.981	0.807	0.670	0.543	0.207
Hard coal briquettes (patent fuels)	0.024	0.046	0.163	0.233	0.209	0.118	0.301	0.273	0.302	0.211	0.002
Brown coal briquettes	0.000	0.000	0.018	0.461	1.195	0.618	0.350	0.407	0.350	0.340	0.059
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.486	1.531	1.796	1.501	1.438	1.144	1.305	1.519	1.267	1.558	1.806
Solid biomass	21.088	23.931	20.948	20.937	19.310	20.256	21.458	21.276	20.735	19.618	20.068
Biogas	0.039	0.223	0.252	0.286	0.328	0.385	0.373	0.395	0.359	0.360	0.370
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.922	0.962	0.279	0.559	0.619	0.247	0.279	0.252	0.224	0.111	0.163
Liquid petroleum gas (LPG)	2.300	2.346	2.300	2.300	2.438	2.622	2.760	2.852	2.852	2.990	2.852
Motor gasoline	0.045	0.045	0.045	0.045	0.044	0.043	0.043	0.038	0.044	0.049	0.046
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	73.480	74.130	74.693	73.177	70.579	69.832	73.960	88.150	92.880	96.535	97.438
Fuel oil	3.451	3.926	4.039	3.436	3.096	3.133	3.498	3.658	3.467	3.561	3.465
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	79.277	80.447	81.077	78.958	76.157	75.630	80.261	94.698	99.243	103.135	103.801
Gaseous fuels	1.486	1.531	1.796	1.501	1.438	1.144	1.305	1.519	1.267	1.558	1.806
Solid fuels	49.905	43.833	45.502	44.474	42.312	38.431	40.873	40.583	38.087	30.776	31.579
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	21.127	24.154	21.200	21.223	19.638	20.641	21.831	21.672	21.093	19.977	20.438
Total	151.795	149.965	149.575	146.156	139.545	135.846	144.271	158.472	159.690	155.446	157.624

Table 13. (cont.) Fuel consumption [PJ] in 1.A.4.c category

Fuels	2021	2022	2023	2024
Hard coal	25.200	20.160	18.200	13.000
Lignite	0.160	0.161	0.248	0.205
Hard coal briquettes (patent fuels)	0.005	0.070	0.001	0.213
Brown coal briquettes	0.062	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000
Natural gas	2.176	1.528	1.668	1.845
Solid biomass	23.889	19.215	17.835	16.384
Biogas	0.349	0.588	0.467	0.544
Industrial wastes	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000
Coke	0.474	0.012	0.001	0.001
Liquid petroleum gas (LPG)	2.667	0.856	2.069	1.839
Motor gasoline	0.064	0.059	0.081	0.084
Aviation gasoline	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000
Diesel oil	97.843	101.806	102.542	88.608
Fuel oil	3.166	2.628	2.651	2.269
Feedstocks	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000
Gas works gas and other recovered gases	0.000	0.000	0.000	0.000
Fuels				
Liquid fuels	103.741	105.350	107.343	92.800
Gaseous fuels	2.176	1.528	1.668	1.845
Solid fuels	25.901	20.404	18.450	13.419
Other fuels	0.000	0.000	0.000	0.000
Biomass	24.237	19.802	18.302	16.928
Total	156.055	147.083	145.762	124.992

Table 15. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.1.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.72	94.65	94.80
Lignite	-	-	-	-	-	-	-	-	-	-	-	-
Natural gas	55.35	55.32	55.32	55.31	55.38	55.35	55.3	55.31	55.3	55.31	55.31	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.85	94.94	94.87	-	-	-	-	-	-	94.05	93.9	94.06
Lignite	-	-	-	-	-	-	-	-	-	-	-	109.61
Natural gas	55.32	55.31	55.32	55.29	55.29	54.85	54.84	55.06	55.36	55.41	55.33	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	93.96	94.04	94.05	94.06	94.05	94.00	94.22	94.40	94.24	94.19	94.19	94.05
Lignite	111.18	111.17	111.22	110.53	-	-	-	-	-	-	-	-
Natural gas	55.37	55.63	55.34	55.58	55.54	55.41	55.42	55.44	55.48	55.47	55.73	56.18
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.4	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.05											
Lignite	-											
Natural gas	56.06											
Fuel oil	76.36											

Table 16. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.1.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	95.3	95.37	94.76	94.76	94.57	94.75	94.77	94.86	94.4	94.68	94.62	94.75
Lignite	111.39	110.71	109.61	108.99	108.11	108.61	109.92	108.97	108.2	108.42	108.47	108.6
Natural gas	55.35	55.32	55.32	55.31	55.38	55.35	55.30	55.31	55.30	55.31	55.31	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.80	94.90	94.80	94.67	94.14	94.04	93.90	94.12	93.98	93.98	93.92	93.84
Lignite	108.78	108.56	107.93	108.97	109.67	108.09	108.14	108.92	102.12	107.25	109.71	109.61
Natural gas	55.32	55.31	55.32	55.29	55.29	54.85	54.84	55.06	55.36	55.41	55.33	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	93.66	93.69	93.66	93.70	93.66	93.63	93.68	93.86	93.67	93.65	93.62	93.60
Lignite	111.18	111.17	111.22	110.53	105.35	111.04	102.96	103.44	109.96	111.41	111.41	111.41
Natural gas	55.37	55.63	55.34	55.58	55.54	55.41	55.42	55.44	55.48	55.47	55.73	56.18
Fuel oil	76.26	76.93	-	-	-	77.38	77.40	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	93.61											
Lignite	110.38											
Natural gas	56.06											
Fuel oil	-											

Table 17. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.2.a category

[illegible]

Table 18. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.2.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite	-	-	-	-	-	-	-	-	-	-	-	-
Natural gas	55.35	55.32	55.32	55.31	55.38	55.35	55.30	55.31	55.3	55.31	55.31	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.52	94.37	94.49	94.53	94.59	94.34	94.52	93.64	-	-	-	94.7
Lignite	-	-	-	-	-	-	-	-	-	-	-	-
Natural gas	55.32	55.31	55.32	55.29	55.29	54.85	54.84	55.06	55.36	55.41	55.33	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	94.70	94.74	94.73	94.67	94.70	94.46	94.61	94.60	94.48	94.41	94.70	94.74
Lignite	-	-	-	-	-	-	-	-	-	-	-	-
Natural gas	55.37	55.63	55.34	55.58	55.54	55.41	55.42	55.44	55.48	55.47	55.73	56.18
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.4	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.64											
Lignite	-											
Natural gas	56.06											
Fuel oil	76.36											

Table 19. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.2.c category

[illegible]

Table 20. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.2.d category

[illegible]

Table 22. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.2.f category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.55
Lignite	105.15	104.93	103.89	105.11	106.21	104.86	103.76	102.38	103.00	105.70	102.25	103.41
Natural gas	55.35	55.32	55.32	55.31	55.38	55.35	55.30	55.31	55.30	55.31	55.31	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.45	94.69	94.75	94.68	94.70
Lignite	104.60	105.50	104.31	-	-	-	-	-	106.86	-	99.41	102.67
Natural gas	55.32	55.31	55.32	55.29	55.29	54.85	54.84	55.06	55.36	55.41	55.33	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	94.70	94.74	94.73	94.67	94.61	94.56	94.54	94.50	94.54	94.53	94.68	94.74
Lignite	99.37	101.31	99.04	98.97	99.87	100.93	98.65	99.25	96.31	94.17	94.58	96.55
Natural gas	55.37	55.63	55.34	55.58	55.54	55.41	55.42	55.44	55.48	55.47	55.73	56.18
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.40	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.64											
Lignite	98.59											
Natural gas	56.06											
Fuel oil	76.36											

Table 23. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.2.g category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.55
Lignite	105.15	104.92	103.89	105.11	106.21	104.86	103.76	102.38	103.00	105.70	102.25	103.41
Natural gas	55.35	55.32	55.32	55.31	55.38	55.35	55.30	55.31	55.30	55.31	55.31	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.68	94.70
Lignite	104.60	105.50	104.31	105.93	105.99	105.80	105.70	-	106.86	106.41	99.41	102.67
Natural gas	55.32	55.31	55.32	55.29	55.29	54.85	54.84	55.06	55.36	55.41	55.33	55.32
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	94.70	94.74	94.73	94.67	94.70	94.70	94.68	94.61	94.66	94.65	94.53	94.69
Lignite	99.37	101.31	99.04	98.97	99.87	100.93	98.65	99.25	96.31	94.17	94.58	96.55
Natural gas	55.37	55.63	55.34	55.58	55.54	55.41	55.42	55.44	55.48	55.47	55.73	56.18
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.40	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.64											
Lignite	98.59											
Natural gas	56.06											
Fuel oil	76.36											

Table 24. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.4.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.71	94.64	94.80
Lignite	111.07	110.71	-	-	-	108.61	109.92	108.97	108.20	108.42	108.47	108.60
Natural gas	55.23	55.24	55.23	55.23	55.22	55.23	55.23	55.22	55.22	55.22	55.23	55.21
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.84	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.90	94.06
Lignite	-	-	-	-	-	-	-	-	-	-	109.71	109.61
Natural gas	55.21	55.21	55.21	55.21	55.20	54.74	54.76	54.98	55.20	55.27	55.16	55.19
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	93.96	94.04	94.05	94.06	94.05	94.00	94.22	94.40	94.24	94.19	94.19	94.04
Lignite	111.18	111.17	111.22	110.53	105.35	111.04	102.96	103.44	109.96	111.41	111.41	111.41
Natural gas	55.25	55.51	55.22	55.43	55.43	55.33	55.35	55.33	55.39	55.37	55.65	56.16
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.40	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.04											
Lignite	110.38											
Natural gas	56.06											
Fuel oil	76.36											

Table 25. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.4.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.72	94.65	94.80
Lignite	111.07	110.71	109.61	108.99	-	108.61	109.92	108.97	108.20	108.42	108.47	108.60
Natural gas	55.23	55.24	55.23	55.23	55.22	55.23	55.23	55.22	55.22	55.22	55.23	55.21
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.85	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.90	94.06
Lignite	108.78	108.56	107.93	108.97	109.67	108.09	108.14	108.92	102.12	107.25	109.71	109.61
Natural gas	55.21	55.21	55.21	55.21	55.20	54.74	54.76	54.98	55.20	55.27	55.16	55.19
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	93.96	94.04	94.05	94.06	94.05	94.00	94.22	94.40	94.24	94.19	94.19	94.05
Lignite	111.18	111.17	111.22	110.53	105.35	111.04	102.96	103.44	109.96	111.41	111.41	111.41
Natural gas	55.25	55.51	55.22	55.43	55.43	55.33	55.35	55.33	55.39	55.37	55.65	56.16
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.40	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.04											
Lignite	110.38											
Natural gas	56.06											
Fuel oil	76.36											

Table 26. CO₂ EFs [kg/GJ] for coal, lignite, natural gas and fuel oil in 1.A.4.c category (stationary sources)

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.71	94.65	94.80
Lignite	111.07	110.71	109.61	108.99	108.11	108.61	109.92	108.97	108.20	108.42	108.47	108.60
Natural gas	55.23	55.24	55.23	55.23	55.22	55.23	55.23	55.22	55.22	55.22	55.23	55.21
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20	77.20
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hard coal	94.84	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.90	94.06
Lignite	108.78	108.56	107.93	108.97	109.67	108.09	108.14	108.92	102.12	107.25	109.71	109.61
Natural gas	55.21	55.21	55.21	55.21	55.20	54.74	54.76	54.98	55.20	55.27	55.16	55.19
Fuel oil	77.20	77.20	77.20	77.20	77.20	77.20	77.28	77.56	77.45	77.87	76.97	77.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hard coal	93.96	94.04	94.05	94.06	94.05	94.00	94.22	94.40	94.24	94.19	94.19	94.05
Lignite	111.18	111.17	111.22	110.53	105.35	111.04	102.96	103.44	109.96	111.41	111.41	111.41
Natural gas	55.25	55.51	55.22	55.43	55.43	55.33	55.35	55.33	55.39	55.37	55.65	56.16
Fuel oil	76.26	76.93	77.17	76.53	77.45	77.38	77.40	76.56	77.75	77.62	76.86	76.32
	2024											
Hard coal	94.04											
Lignite	110.38											
Natural gas	56.06											
Fuel oil	76.36											

Table 27. CO₂ EFs [kg/GJ] applied for other fuels in the years 1988-2024 for stationary sources in 1.A.1, 1.A.2 and 1.A.4 categories [IPCC 2006]

Fuels	EF
Hard coal briquettes (patent fuels)	97.50
Brown coal briquettes	97.50
Crude oil	73.30
Solid biomass	112.00
Biogas	54.60
Industrial wastes	143.00
Municipal waste – non-biogenic fraction	91.70
Municipal waste – biogenic fraction	100.00
Other petroleum products	73.30
Petroleum coke	97.50
Coke	107.00
Liquid petroleum gas (LPG)	63.10
Motor gasoline	69.30
Aviation gasoline	70.00
Jet kerosene	71.50
Diesel oil	74.10
Feedstocks	73.30
Refinery gas	57.60
Coke oven gas	44.40
Blast furnace gas	260.00
Gas works gas	44.40

Table 28. CH₄ EFs [kg/GJ] applied for the years 1988-2024 for stationary sources (CS EFs [ENERGOPOMIAR 2022]; D EFs [IPCC 2006])

Fuels	1.A.1	1.A.2	1.A.4.a	1.A.4.b-c
Hard coal	0.00011*	0.0100	0.0100	0.3000
Lignite	0.000335*	0.0100	0.0100	0.3000
Hard coal briquettes (patent fuels)	0.0010	0.0100	0.0100	0.3000
Brown coal briquettes	0.0010	0.0100	0.0100	0.3000
Crude oil	0.0030	0.0030	0.0100	0.0100
Natural gas	0.0010	0.0010	0.0050	0.0050
Solid biomass	0.0006*	0.0300	0.3000	0.3000
Biogas	0.0010	0.0010	0.0050	0.0050
Industrial wastes	0.0300	0.0300	0.3000	0.3000
Municipal waste – non-biogenic fraction	0.0300	0.0300	0.3000	0.3000
Municipal waste – biogenic fraction	0.0300	0.0300	0.3000	0.3000
Other petroleum products	0.0030	0.0030	0.0100	0.0100
Petroleum coke	0.0030	0.0030	0.0100	0.0100
Coke	0.0010	0.0100	0.0100	0.3000
Liquid petroleum gas (LPG)	0.0010	0.0010	0.0050	0.0050
Motor gasoline	0.0030	0.0030	0.0100	0.0100
Aviation gasoline	0.0030	0.0030	0.0100	0.0100
Jet kerosene	0.0030	0.0030	0.0100	0.0100
Diesel oil	0.0030	0.0030	0.0100	0.0100
Fuel oil	0.0030	0.0030	0.0100	0.0100
Feedstocks	0.0030	0.0030	0.0100	0.0100
Refinery gas	0.0010	0.0010	0.0050	0.0050
Coke oven gas	0.0010	0.0010	0.0050	0.0050
Blast furnace gas	0.0010	0.0010	0.0050	0.0050
Gas works gas and other recovered gases	0.0010	0.0010	0.0050	0.0050

*CS EFs calculated based on Polish study [ENERGOPOMIAR 2022]

Table 29. N₂O EFs [kg/GJ] applied for the years 1988-2024 for stationary sources in 1.A.1, 1.A.2 and 1.A.4 categories [IPCC 2006]

Fuels	EF
Hard coal	0.0015
Lignite	0.0015
Hard coal briquettes (patent fuels)	0.0015
Brown coal briquettes	0.0015
Crude oil	0.0006
Natural gas	0.0001
Solid biomass	0.0040
Biogas	0.0001
Industrial wastes	0.0040
Municipal waste – non-biogenic fraction	0.0040
Municipal waste – biogenic fraction	0.0040
Other petroleum products	0.0006
Petroleum coke	0.0006
Coke	0.0015
Liquid petroleum gas (LPG)	0.0001
Motor gasoline	0.0006
Aviation gasoline	0.0006
Jet kerosene	0.0006
Diesel oil	0.0006
Fuel oil	0.0006
Feedstocks	0.0006
Refinery gas	0.0001
Coke oven gas	0.0001
Blast furnace gas	0.0001
Gas works gas and other recovered gases	0.0001

Annex 5.4. Differences between RA and SA related to the Statistical differences and Distribution losses in energy balance

Table 30. Ratio of the statistical difference [TJ] to gross inland consumption [TJ] for Solid fuels

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gross inland consumption	3 301 900	3 251 958	3 155 250	3 113 064	2 882 738	2 944 275	3 023 301	2 947 724	2 655 502	2 549 164	2 356 421	2 331 713	2 298 613	2 352 692
Statistical differences	172 667	117 017	108 453	81 972	-36 145	18 139	-13 556	72 274	49 142	60 453	-12 030	-14 300	17 361	-4 526
Ratio of the statistical difference to gross inland consumption	5.23%	3.60%	3.44%	2.63%	-1.25%	0.62%	-0.45%	2.45%	1.85%	2.37%	-0.51%	-0.61%	0.76%	-0.19%
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gross inland consumption	2 270 706	2 288 361	2 395 998	2 335 558	2 293 814	2 142 495	2 312 044	2 287 622	2 104 359	2 226 982	2 062 956	2 025 355	2 074 009	2 079 660
Statistical differences	-62 797	-9 882	-9 086	-22 821	8 099	-13 264	22 074	41 957	-95 614	20 454	-23 156	-47 228	-7 229	-17 973
Ratio of the statistical difference to gross inland consumption	-2.77%	-0.43%	-0.38%	-0.98%	0.35%	-0.62%	0.95%	1.83%	-4.54%	0.92%	-1.12%	-2.33%	-0.35%	-0.86%
	2018	2019	2020	2021	2022	2023	2024							
Gross inland consumption	2 062 002	1 835 531	1 713 017	1 922 328	1 764 553	1 425 101	1 340 090							
Statistical differences	15 162	-394	14 736	13 397	-13 693	-47 598	-38 416							
Ratio of the statistical difference to gross inland consumption	0.74%	-0.02%	0.86%	0.70%	-0.78%	-3.34%	-2.87%							

Table 31. Ratio of the statistical difference [TJ] and distribution losses [TJ] to gross inland consumption [TJ] for Natural gas

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gross inland consumption	374 206	348 944	324 987	341 385	343 987	376 592	395 454	394 289	398 345	387 833	416 993	434 447	423 419	471 462
Distribution losses	8 713	15 581	15 496	25 796	19 799	11 052	34 531	18 148	16 432	11 141	14 241	12 670	6 937	9 176
Statistical differences	3 987	11 077	0	9 900	-11 575	10 968	-5 786	-12 007	-1 928	2 064	0	6 440	4 502	6 071
Ratio of the statistical difference and distribution losses to gross inland consumption	3.39%	7.64%	4.77%	10.46%	2.39%	5.85%	7.27%	1.56%	3.64%	3.40%	3.42%	4.40%	2.70%	3.23%
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gross inland consumption	497 416	512 234	526 764	523 124	526 109	505 027	536 111	537 432	572 764	575 094	561 212	576 765	612 663	646 647
Disribution losses	8 480	6 408	4 716	2 685	2 359	5 340	6 470	1 264	4 777	1 928	1 133	1 113	1 110	525
Statistical differences	2 947	-350	13 014	9 567	6 882	31	-6 765	-2 427	-3 739	-3 052	1 287	-5 723	-2 627	2 515
Ratio of the statistical difference and distribution losses to gross inland consumption	2.30%	1.18%	3.37%	2.34%	1.76%	1.06%	-0.06%	-0.22%	0.18%	-0.20%	0.43%	-0.80%	-0.25%	0.47%

Annex 5.5. Calculation of CO₂ emission from 2.A.4.d *Other processes uses of carbonates - other*

Table 1. Estimation of CO₂ emission from calcite use as limestone sorbents to desulfurize the off-gases by wet method (lime WFGD) in the years 1988-2024 (all values in the table are expressed in kilotons [kt])

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Desulphurization plaster production in lime wet FGD	0	0	0	0	0	0	0	175	474	583	674	860	1140	1134	1038	1109	1250
Consumption of limestone sorbents to desulfurize the off-gases by wet method (lime WFGD)	0	0	0	0	0	0	0	104	282	346	400	511	677	673	617	659	742
Limestone consumption in lime WFGD	0	0	0	0	0	0	0	99	268	329	380	485	643	640	586	626	705
CO₂ emission from decomposition of calcium carbonate in WFGD	0	0	0	0	0	0	0	43	118	145	167	214	283	281	258	275	310
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Desulphurization plaster production in lime wet FGD	1177	1240	1338	1596	2076	2389	2505	2572	2768	2768	2768	2921	2937	2985	3040	2996	3084
Consumption of limestone sorbents to desulfurize the off-gases by wet method (lime WFGD)	699	736	795	948	1233	1418	1487	1527	1644	1644	1644	1735	1744	1772	1805	1779	1831
Limestone consumption in lime WFGD	664	700	755	900	1171	1347	1413	1451	1561	1561	1561	1648	1657	1684	1715	1690	1740
CO₂ emission from decomposition of calcium carbonate in WFGD	292	308	332	396	515	593	622	638	687	687	687	725	729	741	754	744	766
	2022	2023	2024														
Desulphurization plaster production in lime wet FGD	3679	2973	4511														
Consumption of limestone sorbents to desulfurize the off-gases by wet method (lime WFGD)	2185	1765	2678														
Limestone consumption in lime WFGD	2076	1677	2545														
CO₂ emission from decomposition of calcium carbonate in WFGD	913	738	1120														

Table 2. Estimation of CO₂ emission from decomposition of calcite use to desulfurize the off-gases in fluid bed boilers (FGD in FBB) and in other method of flue gas desulfurization (FGD other than lime WFGD) in the years 1988-2024 (all values in the table are expressed in kilotons [kt])

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SO₂ emission captured by FGD in power plants and autoproducers CHP	916	924	766	786	857	900	990	1048	1178	1321	1379	1426	1620	1630	1699	1881	1939
SO₂ captured with use of lime wet FGD method	0	0	0	0	0	0	0	65	176	217	251	320	424	422	386	413	465

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SO ₂ captured with use of other FGD method	916	924	766	786	857	900	990	983	1002	1104	1128	1106	1196	1208	1313	1468	1474
Consumption of limestone sorbents to desulfurize the off-gases in FBB and in FGD other than lime wet FGD	1574	1588	1317	1351	1473	1547	1702	1689	1721	1898	1939	1901	2055	2076	2256	2524	2533
Limestone consumption in FGD in FBB and in FGD other than lime wet FGD	1543	1556	1290	1324	1444	1516	1668	1656	1687	1860	1900	1863	2014	2035	2211	2473	2482
CO ₂ emission from calcium carbonate in FGD in FBB and in FGD other than lime WFGD	679	685	568	583	635	667	734	728	742	818	836	820	886	895	973	1088	1092
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SO ₂ emission captured by FGD in power plants and autoproducers CHP	1967	2075	2091	2178	2136	2299	2524	2297	2302	2322	2275	2415	2438	2602	2748	2680	3061
SO ₂ captured with use of lime wet FGD method	438	461	498	594	773	889	932	957	1030	1030	1030	1087	1093	1111	1131	1115	1148
SO ₂ captured with use of other FGD method	1529	1614	1593	1584	1363	1410	1592	1340	1272	1292	1245	1328	1345	1491	1617	1565	1913
Consumption of limestone sorbents to desulfurize the off-gases in FBB and in FGD other than lime wet FGD	2628	2773	2738	2723	2343	2424	2736	2303	2186	2220	2140	2283	2312	2563	2779	2690	3289
Limestone consumption in FGD in FBB and in FGD other than lime wet FGD	2575	2718	2683	2668	2297	2375	2681	2257	2142	2176	2097	2237	2266	2512	2724	2636	3223
CO ₂ emission from calcium carbonate in FGD in FBB and in FGD other than lime WFGD	1133	1196	1181	1174	1010	1045	1180	993	943	957	923	984	997	1105	1198	1160	1418
	2022	2023	2024														
SO ₂ emission captured by FGD in power plants and autoproducers CHP	3273	2625	2563														
SO ₂ captured with use of lime wet FGD method	1369	1106	1678														
SO ₂ captured with use of other FGD method	1904	1519	885														
Consumption of limestone sorbents to desulfurize the off-gases in FBB and in FGD other than lime wet FGD	3272	2610	1520														
Limestone consumption in FGD in FBB and in FGD other than lime wet FGD	3207	2558	1490														
CO ₂ emission from calcium carbonate in FGD in FBB and in FGD other than lime WFGD	1411	1126	656														

Table 3. CO₂ emission values from carbonate use in 2.A.4.d subcategory for the years 1988-2024 (all values in the table are expressed in kilotons [kt])

[illegible]

Annex 5.6. Calculation of CO₂ process emission from ammonia production (2.B.1)

Table 1. Calculation of CO₂ process emission from ammonia production

Activity/emission data	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Natural gas consumption	[10 ³ m ³]	2 184 552	2 230 523	1 447 064	1 447 326	1 337 619	1 401 804	1 688 887	1 942 704	1 907 689	1 937 127	1 789 006	1 587 228
Natural gas consumption	TJ	76 413	77 862	50 625	50 911	47 044	49 522	60 161	69 070	67 919	69 049	64 163	56 105
Coke oven gas consumption	[10 ³ m ³]	183 960	113 672	30 560									
Coke oven gas consumption	TJ	3 204	1 970	537									
CO ₂ emission from natural gas use	kt	4 357	4 449	2 886	2 887	2 668	2 796	3 369	3 875	3 805	3 864	3 568	3 166
CO ₂ emission from coke oven gas use	kt	142	87	24									
Process CO ₂ emission from ammonia production	kt	4 500	4 537	2 910	2 887	2 668	2 796	3 369	3 875	3 805	3 864	3 568	3 166
Ammonia production	kt	2389.353	2433.726	1531.552	1560.883	1480.798	1630.946	1945.470	2248.317	2185.188	2251.616	2047.948	1784.726
Activity/emission data	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Natural gas consumption	[10 ³ m ³]	1 965 162	1 873 685	1 455 329	2 122 465	2 177 127	2 310 818	2 197 622	2 186 299	2 221 406	1 814 589	1 881 957	2 061 524
Natural gas consumption	TJ	70 483	68 096	52 144	76 053	77 817	82 219	78 591	78 072	79 351	63 478	67 234	73 798
Coke oven gas consumption	[10 ³ m ³]												
Coke oven gas consumption	TJ												
CO ₂ emission from natural gas use	kt	3 920	3 737	2 903	4 234	4 343	4 609	4 384	4 361	4 431	3 620	3 754	4 112
CO ₂ emission from coke oven gas use	kt												
Process CO ₂ emission from ammonia production	kt	3 920	3 737	2 903	4 234	4 343	4 609	4 384	4 361	4 431	3 620	3 754	4 112
Ammonia production	kt	2243.108	2103.805	1594.797	2246.505	2451.557	2523.790	2326.621	2417.543	2485.148	2010.891	2059.437	2321.849
Activity/emission data	Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Natural gas consumption	[10 ³ m ³]	2 242 281	2 207 620	2 295 270	2 363 754	2 286 461	2 371 634	2 180 709	2 078 609	2 262 887	2 243 340	1 800 113	1 567 743
Natural gas consumption	TJ	81 150	79 269	83 391	86 145	83 951	87 446	80 952	75 787	82 978	82 181	66 625	58 508
Coke oven gas consumption	[10 ³ m ³]												
Coke oven gas consumption	TJ												
CO ₂ emission from natural gas use	kt	4 473	4 403	4 565	4 720	4 625	4 797	4 414	4 194	4 592	4 540	3 669	3 258
CO ₂ emission from coke oven gas use	kt												
Process CO ₂ emission from ammonia production	kt	4 473	4 403	4 565	4 720	4 625	4 797	4 414	4 194	4 592	4 540	3 669	3 258
Ammonia production	kt	2467.458	2228.303	2634.506	2720.446	2625.757	2783.187	2535.233	2451.973	2647.356	2597.557	2106.545	1799.390

Activity/emission data	Unit	2024
Natural gas consumption	[10 ³ m ³]	1 772 339
Natural gas consumption	TJ	65 783
Coke oven gas consumption	[10 ³ m ³]	
Coke oven gas consumption	TJ	
CO ₂ emission from natural gas use	kt	3 682
CO ₂ emission from coke oven gas use	kt	
Process CO ₂ emission from ammonia production	kt	3 682
Ammonia production	kt	2243.108

Table 2. CO₂ amount connected with fertilizer urea production deducted from CO₂ process emission from ammonia production

Activity/emission data	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fertilizer urea production	kt	775.527	808.932	771.812	660.998	606.719	567.208	698.866	824.372	742.790	588.957	496.479	512.603
CO ₂ amount used in fertilizer urea production which is deducted from CO ₂ emission generated in ammonia production	kt	568.720	593.217	565.996	484.732	444.928	415.953	512.502	604.539	544.713	431.901	364.084	375.909
Total CO ₂ emission from 2.B.1	kt	3930.885	3943.317	2344.257	2402.200	2223.177	2380.178	2856.265	3270.508	3260.490	3432.021	3204.386	2790.081
Activity/emission data	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Fertilizer urea production	kt	565.795	368.552	486.326	628.048	618.41	700.642	705.319	734.52	781.464	867.261	723.719	979.722
CO ₂ amount used in fertilizer urea production which is deducted from CO ₂ emission generated in ammonia production	kt	414.916	270.271	356.639	460.569	453.501	513.804	517.234	538.648	573.074	635.991	530.727	718.463
Total CO ₂ emission from 2.B.1	kt	3504.927	3467.105	2546.256	3773.041	3889.141	4095.508	3866.290	3822.291	3857.892	2983.509	3223.150	3393.590
Activity/emission data	Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fertilizer urea production	kt	1078.683	1036.753	1122.85	1158.011	1106.873	1076.911	1267.135	1152.160	1216.202	1193.053	1035.807	728.751
CO ₂ amount used in fertilizer urea production which is deducted from CO ₂ emission generated in ammonia production	kt	791.034	760.286	823.423	849.208	811.707	789.735	929.232	844.917	891.881	874.906	759.592	534.417
Total CO ₂ emission from 2.B.1	kt	3681.569	3643.181	3741.539	3870.485	3813.599	4006.834	3484.515	3349.124	3700.107	3665.424	2909.328	2723.148
Activity/emission data	Unit	2024											
Fertilizer urea production	kt	730.882											
CO ₂ amount used in fertilizer urea production which is deducted from CO ₂ emission generated in ammonia production	kt	535.980											
Total CO ₂ emission from 2.B.1	kt	3145.632											

Fertilizer urea production amount was estimated according to data from [GUS 1989e-2025e]. CO₂ amount used in fertilizer urea production and deducted from CO₂ emission generated in ammonia production was calculated based on assumption on the complete conversion of NH₃ and CO₂ to urea, what means that 0.733 t of CO₂ per tonne of urea produced was required (2006 GLs, box 3.3, p. 3.16).

Annex 5.7. Methodical notes related to elaboration of representative research on livestock population performed by Statistics Poland

1. Sources of data

The data in this publication were compiled on the basis of:

- generalized results of sample surveys⁴ on poultry and pigs, as well as, the animal output in private farms,
- statistical reports in the scope of livestock in state and cooperative farms and companies with public and private property share,
- administrative register - Animal Identification and Registration System kept by the Agency for Restructuring and Modernization of Agriculture (IRZ ARMA) as regards of cattle, sheep and goats,
- statistical reports from slaughterhouses of farm animals,
- statistical reports from poultry⁵ hatcheries,
- own estimates.

Surveys on poultry population and animal output were conducted in private farms breeding the above-listed species of animals; this sample amounted to 30 thousand farms.

Surveys on pigs and production of pigs for slaughter were carried out in a sample of private farms breeding pigs; this sample amounted to 30 thousand farms.

The results of the survey of farm animal stocks and animal output were compiled by voivodship and NUTS 2 regions, according to the residence of the farm user, i.e. for private farms - according to the official residence (place of residence) of the farm user, while for state owned farms, cooperative farms and companies – according to the official residence of the holding. Data from the administrative register of the ARMA are presented according to the seat of the herd.

2. Major definitions, terms and enumeration rules

Agricultural holding is understood as an organised economic and technical unit with separate management (a holder or a manager), conducting agricultural activity.

Agricultural activity includes activity associated with crop production, which covers: all agricultural crops (including mushroom production), vegetable production and horticulture, arboriculture, agricultural and horticultural crop and seed production, as well as animal production in a holding, i.e. cattle, sheep, goats, horses, pigs, poultry, rabbits, other fur

⁴ The surveys on pig stock is conducted twice a year, i.e. in June and in December.

⁵ The surveys on poultry stock is conducted once a year, in December (since 2022).

animals, game kept for slaughter, bees, and activity consisting of maintaining unused agricultural land for production purposes according to the rules of a good agricultural conditions in compliance with environmental protection requirements.

Natural person's holding (private farm) is understood as a holding used by a natural person with an area of 1.0 ha or more of agricultural land, or a holding of the area of less than 1.0 ha of agricultural land (including holdings without agricultural land), which meets at least one of the thresholds mentioned below:

- 0.5 ha of fruit trees plantation,
- 0.5 ha of fruit shrubs plantation, soil-grown vegetables, soil-grown strawberries, hop,
- 0.3 ha of fruit and ornamental nurseries,
- 0.1 ha of vegetables under cover,
- 0.1 ha of strawberries under cover, flowers and ornamental plants under cover, tobacco,
- 25 m² of edible mushrooms,
- 10 head of cattle in total,
- 5 head of cows in total,
- 50 head of pigs in total,
- 10 head of sows,
- 20 head of sheep and goats in total,
- 100 head of poultry in total,
- 5 head of horses in total,
- 50 head of female rabbits,
- 5 head of other female fur animals,
- 10 head of game (e.g. wild boars, roe deer, fallow deer) kept for slaughter,
- 20 beehives
- or, regardless of the above thresholds, is an organic farm.

The holding of a legal person or an organisational unit without a legal personality is an agricultural holding run by legal person or an organisational unit without legal personality, the basic activity of which is classified, according to the Polish Classification of Activities, to Section A, division 01, group:

- 01.1 – growing of non-perennial crops,
- 01.2 – growing of perennial crops,
- 01.3 – plant propagation,
- 01.4 – animal production,
- 01.5 – mixed farming,
- 01.6, class 01.61 – support activities for crop production (maintaining the land in accordance with cultivation principles with respect for environment protection requirements), and also, irrespective of the basic activity classification, when the area of agricultural land used by the holding is 1 ha or more or when livestock is reared or bred.

Holder of an agricultural farm is understood as a natural person or a legal person or an organisational unit without a legal personality actually using the farm, regardless of whether

he or she is an owner or a leaseholder, or uses the farm in any other respect, and regardless of whether land constituting the farm is situated in one or in several gminas.

Livestock

The survey covered the livestock staying in the agricultural holding during the survey, as well as animals sent to herding, grazing and shepherd's huts. All animals were registered, i.e. the ones owned by a holder or members of his/her household, as well as animals temporarily or permanently kept in the holding, i.e. taken for rearing, fattening, etc., irrespective whether they were taken from private holdings, state-owned holdings, cooperative entities, or companies.

Dairy cows - heads of female bovine animals which have already calved (including those less than 2 years old) and which, by reason of their breed or particular qualities, are kept exclusively or principally to produce milk for human consumption or for processing into dairy products.

Other cows - heads of female bovine animals which have already calved (including those less than 2 years old) and which, by reason of their breed or particular qualities, are kept exclusively or principally for the production of calves and whose milk is not intended for human consumption nor for processing into dairy products.

In the case of holdings engaged in the production of poultry on a large scale (such as a largescale holding producing broilers or hen eggs), in which no poultry has been recorded on the survey day due to the current technological break in production, whenever such break does not exceed 8 weeks, the poultry stocks from the period before emptying the rooms (poultry houses) have been adopted.

Information on the number of pigs, cattle, sheep and goats contained in this publication refers to the stock in June and in December. Data on number of poultry refers to the stock in December.

The percentages are presented with one decimal point and due to the electronic technique of rounding may not sum up into 100%. These figures are substantially correct.

Administrative data

Until 2021, data on the stock of cattle and sheep were compiled on the basis of the generalized results of the R-ZW-B survey, which combined a representative survey of the stock of cattle, sheep and poultry as well as livestock production in individual farms and statistical reports on the stock of cattle, sheep and poultry and animal production on farms of legal persons, as well as in entities without legal personality (state-owned, cooperative and companies with the share of public and private sector property). The "Survey of cattle, sheep and poultry stocks and livestock production (R-ZW-B)" was carried out twice a year (i.e. in June and December).

From 2022, the Statistics Poland replaced the above-mentioned livestock data obtained so far from the R-ZW-B survey with data from the Animal Identification and Registration System. This system is maintained by the Agency for Restructuring and Modernization of Agriculture (ARMA) in accordance with the Act of 2 April 2004 on the system of identification and registration of animals, as amended.

The legal basis enabling the transfer of data, among others about the livestock from the Animal Identification and Registration System - IRZ maintained by ARMA to the Statistics Poland are records in the Program of Statistical Research of Public Statistics (PBSSP) for a given year.

Sampling scheme

SURVEY ON THE LIVESTOCK OF POULTRY AND ANIMAL PRODUCTION

1. Introductory notes

The purpose of the survey conducted by the Statistics Poland once a year (i.e. in December) is to obtain detailed information on the number of poultry, cattle (cows) both by regions, voivodships and for Poland, and on the number of sheep for Poland only. The surveyed population consists of private agricultural farms which, according to the sampling frame were keeping cows, or poultry, or sheep. The surveyed population in 2024 consisted of 417 thousand farms. It was assumed that the sample for the survey would consist of about 30,000 farms. This sample size was a consequence of taking into account several factors: the costs of the study, the analysis of data from previous years and the need to ensure the quality of results at the national and regional level.

2. Sampling frame

Sampling frame for all agricultural research as the registry was created by the Statistics Poland on the basis of individual results of the Agricultural Census 2020.

Information on farms in this frame are updated using data from administrative sources and from the results of the following agricultural sample surveys. An individual agricultural farm constituted a sampling unit. The following information was recorded for each farm voivodship:

- code and NUTS 2 region code,
- farm number,
- total farm area,
- agricultural land in the farm,
- number of cows,
- number of poultry,
- number of sheep.

3. Sampling scheme

Before sampling, the population of farms was divided into three subpopulations. The first subpopulation included farms fulfilling at least one of the following criteria, i.e. farms with at least one head of cows or farms with more than 50 head of poultry and without sheep. This part of population included 223 369 farms. The second subpopulation consisted of farms with no cows or sheep, and with no more than 50 head of poultry. The second subpopulation amounted to 194 223 farms. Finally, the third part included farms keeping sheep, and it amounted to 12 017 farms.

Sample drawing was done with a stratified and optimal sampling scheme. Variables available in the sampling frame and at the same time most closely corresponding to the definition of the key characteristics defined in the survey were used as stratifying characteristics; the assumed existence of a high correlation between the variables adopted for stratification and the survey variables (confirmed by the analysis of historical data) allows for optimal selection of stratum boundaries and sample allocation within the stratified sampling scheme.

The number of cows and poultry was used in the first part of the population as the criteria for stratification and allocation of the sample between the strata. In the second part, the strata were established on the basis of the agricultural land, whereas in the third part – on the basis of the number of head of sheep. There were created 8 strata in each region, of which 5 related to farms from the first subpopulation, and 3 related to farms from the second subpopulation. In the third subpopulation, 6 national strata were established, i.e. strata that covered farms from all regions.

It was decided that from the first subpopulation farms a sample consisting of approx. 22.7 thousand farms will be drawn.

The following assumptions were made while drawing the sample from this category of farms:

- 1) the size of sample n established for the population of farms in Poland, and not for individual regions, where n consists of approx. 22 700 farms,
- 2) the sample is drawn in individual regions according to the stratified and optimal sampling scheme, with the use of the Neyman method,
- 3) the population in each region is first divided into 5 strata ($h = 1, 2, \dots, 5$), and the sample is then allocated between these strata,
- 4) stratum no. 5 (i.e. $h = 5$) in each region consists of such sampling units for which the value of variables adopted as the stratification basis is above the specified threshold. The stratum created in this way, so called the upper stratum, includes the units which are not drawn, but which are all included in the sample, it has been assumed that the expected accuracy of the survey results, measured with the variation coefficient of the livestock of cows or poultry, will be identical for each region and will be approximately equal to 1.0% (a specific numerical parameter was set empirically to meet the imposed limits on the sample size).

The above assumptions were taken into account using numerical optimization methods. The population was divided into strata whose boundaries (upper) expressed in the number of cows and poultry are presented in Table 1.

Table 1. Boundaries of strata by region in the survey on the livestock of poultry and animal production in 2024

NUTS 2	B - cows D - poultry	b1	b2	b3	b4
PL51	B	2	9	23	54
	D	1 176	2 805	2 853	5 5710
PL61	B	3	10	22	54
	D	2 669	5 546	5 653	18 998
PL81	B	3	10	23	57
	D	1 161	1 227	1 235	1 334
PL43	B	2	10	26	100
	D	476	5 342	6 779	81 378
PL71	B	5	13	26	59

NUTS 2	B - cows D - poultry	b1	b2	b3	b4
	D	2 456	11 108	11 876	14 624
PL21	B	2	4	10	30
	D	731	3 651	4 698	4 705
PL91	B	1	5	12	24
	D	1 215	2 125	2 437	2 866
PL92	B	5	17	38	128
	D	7 251	11 748	13 623	25 836
PL52	B	5	13	29	55
	D	1 767	2 510	23 215	104 901
PL82	B	2	5	16	66
	D	480	2 641	2 782	96 000
PL84	B	13	31	71	212
	D	556	721	777	25 072
PL63	B	3	9	20	40
	D	3 159	20 627	21 145	21 475
PL22	B	4	9	23	75
	D	365	4 995	20 995	220 112
PL72	B	3	8	21	131
	D	819	935	960	81 886
PL62	B	8	19	35	83
	D	606	610	631	663
PL41	B	11	22	43	99
	D	2 158	23 247	23 829	23 999
PL42	B	3	5	23	82
	D	265	3 295	28 495	224 795

The boundaries of stratum 4 (*b4*) presented in Table 1, constitute also a threshold above which the farms are included in stratum 5, which means that they are not subject to sampling, but are all included in the sample. For other strata, i.e. $h = 1, 2, 3, 4$, the Neyman optimal allocation method was applied for establishing the values of nwh i.e. size of the samples drawn from the h -stratum in w -region.

After that, 22 721 farms were drawn to the sample, based on the assumed allocation, including 5 963 farms from stratum no. 5.

Before sampling, 3 strata were established in each region in the **second subpopulation** ($h = 6, 7, 8$). These strata were created in respect to agricultural land, i.e.: $h = 6$: farms of less than 15 ha; $h = 7$: farms of 15 ha to 49,99; $h = 8$: farms of 50 ha or more. Identical accuracy of the number of poultry in each region was adopted as the criterion for allocation of the sample between regions, while within regions the sample was allocated by means of the Neyman optimal method. From this subpopulation of the population 5 093 farms were drawn.

In the **third subpopulation**, in which 6 national strata were established ($h = 9, 10, \dots, 14$), 2 186 farms were drawn for the sample. All farms from stratum 14 were included in the sample. These were farms keeping sheep and simultaneously 50 or more head of cows, or at least 400 head of poultry (i.e. 60 farms). The boundaries of other strata, and the assumed number of the sample allocated between these strata, were established with the above mentioned numerical optimization method. The upper stratum ($h = 13$) was also established, from which no farms were drawn. This stratum included farms which had not been previously included in stratum 14, and which kept more than 51 head of sheep. The upper boundaries of the remaining strata were the following: $b_9 = 2, b_{10} = 6, b_{11} = 10, b_{12} = 22$. The aim of establishing this category of farms as a separate one, as well as optimizing the division into strata, was to accurately estimate the data on the livestock of sheep in country terms, with no regional breakdown.

Eventually, the entire sample for the survey on cattle, poultry and sheep consisted of 30 000 farms.

4. Results generalization and the accuracy assessment method

The sum of X variable value, such as cows stock in total, is the basic parameter estimated in the survey of poultry stocs and livestock production.

This parameter for w-region is calculated according to the formula:

$$(1) \hat{x}_w = \sum_h \sum_i W1_{whi} * x_{whi}, (i = 1, 2, \dots, n_{wh}; h = 1, 2, \dots, 14)$$

where:

x_{whi} – the value of X variable in i -farm (sampling unit) drawn from h -stratum in w -region,

$W1_{whi}$ – the weight assigned to i -farm drawn from h -stratum of w -region,

whereas this weight is calculated according to this formula:

$$(2) W1_{whi} = \frac{N_{wh}}{n_{wh}},$$

where:

N_{wh} – the number of sampling units in h -stratum of w -region,

n_{wh} – the number of sampling units drawn for the sample from h -stratum of w -region.

The $W1_{whi}$ weight might be used to estimate the survey results only if the survey is realized for all sampled units. This weight must be corrected if some of the sampled farms refuse to participate in the survey. For this purpose, the drawn sample is divided into 4 groups based on information on the survey performance:

- 1) the surveyed farms,
- 2) farms that refused to participate in the survey,
- 3) closed down farms,
- 4) farms with which the contact was not established during the survey performance.

For each stratum separately in each region, the size of the above groups, namely $n1_{wh}$, $n2_{wh}$, $n3_{wh}$, and $n4_{wh}$ is established, and then the likelihood function of surveyed and not surveyed among the farms with a determined status is established, that is:

$$(3) \quad c_{wh} = \frac{n1_{wh} + n2_{wh}}{n_{wh} - n4_{wh}}$$

Then the number of the n_{awh} active farms in h -stratum of w -region is calculated for the drawn sample:

$$(4) \quad n_{awh} = n1_{wh} + n2_{wh} + c_{wh} * n4_{wh}$$

On this basis, the R_{wh} correction factor is calculated for a given stratum:

$$(5) \quad R_{wh} = \frac{n_{awh}}{n1_{wh}}$$

The purpose of this factor is to correct the $W1_{whi}$ weight in order to obtain final W_{whi} : weight:

$$(6) \quad W_{whi} = R_{wh} * W1_{whi}$$

The sum of X variable value for Poland is the sum of values obtained for particular regions, i.e.:

$$(7) \quad \hat{x} = \sum_w \hat{x}_w, \quad (w = 1, 2, \dots, 17)$$

Original weights resulting from sampling are corrected not only due to incompleteness of the survey but also due to the occurrence of so called unusual farms (outliers). This pertains to farms with high assigned weight (drawn with a high likelihood function) and, at the same time, with relatively high values for some of the analysed variables. In this case, the weight correction is to prevent significant overestimation of the value of the surveyed variable.

For the selected major assessments of the parameters, their variation coefficients were calculated as the accuracy measures. For an estimator expressed by formula (1) i.e. for w region, its variation coefficient estimation is expressed in the following formula:

$$(8) \quad v(\hat{x}_w) = \frac{\sqrt{d^2(\hat{x}_w)}}{\hat{x}_w}$$

where $d^2(x_w)$ is an estimate of the so-called variance of the estimator $\hat{x}_w$ and is calculated according to the formula (which follows from the classical survey sampling theory for stratified sampling scheme):

$$(9) \quad d^2(\hat{x}_w) = \sum_h \left(1 - \frac{n1_{wh}}{\sum_i W_{whi}} \right) \frac{n1_{wh}}{n1_{wh} - 1} \sum_i \left(W_{whi} x_{whi} - \frac{\sum_j W_{whj} x_{whj}}{n1_{wh}} \right)^2$$

For Poland the variation coefficient of the sum X estimated with the formula (7) is expressed by the following formula:

$$(10) \quad v(\hat{x}) = \frac{\sqrt{d^2(\hat{x})}}{\hat{x}}$$

whereas:

$$(11) \quad d^2(\hat{x}) = \sum_w d^2(\hat{x}_w)$$

In the tables presenting the precision of the estimates, the coefficients of variation are given as a percentage.

Survey on pigs

1. Introductory notes

The purpose of the survey on pigs stocks, conducted by the Statistics Poland twice a year in June and December, is to obtain detailed information on the number of pigs by regions, voivodships and for Poland. The surveyed population consisted of individual farms which, according to the data available in the sampling frame, were keeping pigs. The surveyed population in 2024 consisted of 87.3 thousand farms. It was assumed that the sample for the survey would consist of about 30,000 farms. This sample size was a consequence of taking into account several factors: the costs of the study, the analysis of data from previous years and the need to ensure the quality of results at the national and regional level.

2. Sampling frame

Sampling frame for all agricultural surveys as the frame was created by the Statistics Poland on the basis of individual results of the Agricultural Census 2020.

Information on farms in this frame are updated using data from administrative sources and from the results of the following agricultural sample surveys. An individual agricultural farm constituted a sampling unit. The following information was recorded for each farm:

- voivodship code and NUTS 2 region code,
- farm number,
- total farm area,
- agricultural land,
- number of pigs.

3. Sampling scheme

In order to draw sample, a stratified sampling and optimal scheme was used with respect to farms which, according to the sampling frame, reared pigs. It was decided that a sample consisting of approx. 30 thousand farms will be drawn from all farms breeding and rearing pigs.

The following assumptions were made while drawing the sample from this category of farms:

- 1) the size of n sample is established for the population of farms in Poland, and not for individual regions, where n consists of approx. 30 thousand farms,
- 2) the sample is drawn in individual regions according to the stratified and optimal sampling scheme, by means of the Neyman method,

- 3) the population in each region is first divided into 5 strata ($h = 1, 2, \dots, 5$), and then the sample is allocated between these strata,
- 4) stratum no. 5 (i.e. $h = 5$) in each region consists of such sampling units, for which the value of at least one of the variables adopted as the stratification basis is above the specified threshold. The stratum created this way, regarded as the upper stratum, includes the units which are not drawn, but which are all included in the sample,
- 5) it has been assumed that the expected accuracy of the survey results, measured with the variation coefficient of the livestock of pigs, will be identical for each region and will be equal approximately to 0.1 % (a specific numerical parameter was set empirically to meet the imposed limits on the sample size).

The above assumptions were taken into account using numerical optimization methods. The population was divided into strata whose boundaries (upper) expressed in the number of pigs were presented in Table 2 below.

Table 2. Boundaries of strata by region in the survey on pigs stock in 2024

NUTS 2	b1	b2	b3
PL51	6	14	26
PL61	15	32	58
PL81	7	17	37
PL43	7	16	117
PL71	12	30	67
PL21	3	7	13
PL91	3	9	195
PL92	26	78	190
PL52	9	24	235
PL82	4	8	50
PL84	10	31	326
PL63	12	30	61
PL22	6	13	172
PL72	6	15	31
PL62	33	679	738
PL41	23	59	131
PL42	30	103	1 269

The boundary of stratum 3 (b_3), presented in Table 2, also constitutes a threshold, above which the sampling units are included in stratum 4, which means they are not subject to sampling, but are all included in the sample. For other strata, i.e. $h = 1, 2, 3$, the Neyman optimal allocation method was employed for establishing the values of n_{wh} , i.e. size of the samples drawn from the h -stratum in w -region. After that, 30 000 farms were drawn to the sample, based on the assumed allocation, including 14 402 farms from stratum no. 4.

4. Results generalization and the accuracy assessment method

The sum of X variable value, such as pigs stock in total, is the basic parameter estimated during the survey on the livestock of pigs.

This parameter for w -region is calculated according to the formula:

$$(1) \hat{x}_w = \sum_h \sum_i W1_{whi} * x_{whi}, (i = 1, 2, \dots, n_{wh}; h = 1, 2, \dots, 5)$$

where:

x_{whi} – the value of X variable in i -farm (sampling unit) drawn from h -stratum in w -region,

$W1_{whi}$ – the weight assigned to i -farm drawn from h -stratum of w -region, whereas this weight is calculated according to this formula:

$$(2) W1_{whi} = \frac{N_{wh}}{n_{wh}}$$

N_{wh} – the number of sampling units in h -stratum of w -region,

n_{wh} – the number of sampling units drawn for the sample from h -stratum of w -region.

The $W1_{whi}$ weight might be used to estimate the survey results only if the survey is realized for all sampled units. This weight must be corrected if some of the sampled farms refuse to participate in the survey. For this purpose, the drawn sample is divided into 4 groups based on information on the survey performance:

- the surveyed farms,
- farms that refused to participate in the survey,
- closed down farms, farms with which the contact was not established during the survey performance.

For each stratum separately in each region, the size of the above groups, namely $n1_{wh}$, $n2_{wh}$, $n3_{wh}$, and $n4_{wh}$ is established, and then the likelihood function of surveyed and not surveyed among the farms with a determined status is established, that is:

$$(3) c_{wh} = \frac{n1_{wh} + n2_{wh}}{n_{wh} - n4_{wh}}$$

Then the number of the n_{awh} active farms in h -stratum of w -region is calculated for the drawn sample:

$$(4) n_{awh} = n1_{wh} + n2_{wh} + c_{wh} * n4_{wh}$$

On this basis, the R_{wh} correction factor is calculated for a given stratum:

$$(5) R_{wh} = \frac{n_{awh}}{n1_{wh}}$$

The purpose of this factor is to correct the $W1_{whi}$ weight in order to obtain final W_{whi} : weight:

$$(6) \quad W_{whi} = R_{wh} * W1_{whi}$$

The sum of X variable value for Poland is the sum of values obtained for particular regions, i.e.:

$$(7) \quad \hat{x} = \sum_w \hat{x}_w, \quad (w = 1, 2, \dots, 17)$$

Original weights resulting from sampling are corrected not only due to incompleteness of the survey but also due to the occurrence of so called unusual farms (outliers). This pertains to farms with high assigned weight (drawn with a high likelihood function) and, at the same time, with relatively high values for some of the analysed variables. In this case, the weight correction is to prevent significant overestimation of the value of the surveyed variable.

To estimate the precision of the estimation from survey of pig the formulas described in the section on sample survey of the livestock of cattle, sheep and poultry were used.

Table 3. The values of the relative standard error of selected variables for Poland – based on the results of a sample survey on the livestock of poultry and animal production as well as the results of a survey of pigs – conducted in December 2024

No. of the variable	Name of the variable	Relative standard error
1.	Milked cows	15.2
2.	Milked ewes	15.3
3.	Pigs total	0.6
4.	Sows total	0.8
5.	Hens	1.0
6.	Laying hens	0.3

Annex 5.8. LULUCF Land Transition Matrix

Table 5.8.A.1. Annual land use changes for the 1988-2005

LULUCF category	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FL (man.)																			
Remaining FL (man.)	kha	8656.01	8663.14	8674.71	8690.37	8702.59	8714.45	8714.35	8723.82	8741.11	8778.13	8808.94	8860.84	8876.42	8903.03	8915.21	8967.47	9030.44	9105.89
Converted to FL(unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	1.32	0.68	0.61	0.36	0.53	0.57	0.67	0.40	0.42	0.58	0.49	0.40	0.72	0.53	0.42	0.69	0.65	0.47
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unman. land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	8657.32	8663.82	8675.32	8690.72	8703.12	8715.02	8715.02	8724.22	8741.53	8778.71	8809.43	8861.25	8877.14	8903.56	8915.63	8968.16	9031.09	9106.37
Final area	kha	8663.82	8675.32	8690.72	8703.12	8715.02	8715.02	8724.22	8741.53	8778.71	8809.43	8861.25	8877.14	8903.56	8915.63	8968.16	9031.09	9106.37	9152.91
FL(unman.)																			
Remaining FL(unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL(man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unman. land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.1. Annual land use changes for the 1988-2005 (cont.)

LULUCF category	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CL																			
Remaining CL	kha	14705.18	14682.18	14658.41	14648.03	14624.13	14607.17	14581.06	14567.42	14536.31	14518.16	14446.69	14467.35	14435.14	14405.47	14345.31	14282.04	14331.26	14331.99
Converted to FL (managed)	kha	6.02	9.38	12.33	9.82	9.57	0.28	7.60	13.64	28.95	24.10	40.27	12.55	20.89	9.70	40.77	48.99	58.47	36.20
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	20.12	5.69	4.45	4.24	7.96	15.51	13.03	6.32	1.67	0.93	34.79	8.44	9.81	NO	17.63	35.89	5.67	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	7.66	7.33	5.94	5.22	6.58	7.69	6.37	1.42	1.21	0.98	1.32	1.72	1.50	1.88	1.77	1.88	2.24	2.78
Converted to OthL	kha	3.20	0.60	1.05	NO	NO	NO	NO	NO	NO	NO	NO	5.98	NO	25.62	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	14742.18	14705.18	14682.18	14667.31	14648.24	14630.65	14608.05	14588.80	14568.14	14544.17	14523.07	14496.04	14467.35	14442.66	14405.47	14368.79	14397.64	14370.97
Final area	kha	14705.18	14682.18	14667.31	14648.24	14630.65	14608.05	14588.80	14568.14	14544.17	14523.07	14496.04	14467.35	14442.66	14405.47	14368.79	14397.64	14370.97	14348.99
GL (managed)																			
Remaining GL (managed)	kha	4310.08	4317.52	4305.06	4297.67	4292.90	4291.37	4300.37	4306.19	4301.80	4298.48	4287.19	4308.30	4298.42	4287.29	4272.16	4260.53	4273.86	4262.09
Converted to FL (managed)	kha	1.80	2.80	3.68	2.94	2.86	0.30	2.27	4.07	8.65	7.20	12.03	3.75	6.24	2.90	12.18	14.63	17.46	10.81
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	8.90	NO	NO	NO	NO	NO	NO	NO	NO	NO	7.52	NO	NO	NO	NO	2.71
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (managed)	kha	1.41	5.03	1.57	2.45	0.97	1.61	0.03	3.15	2.07	0.20	0.92	4.30	3.57	1.05	2.95	14.62	5.09	1.75
Converted to WLs (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	2.41	4.86	3.99	6.45	5.18	7.59	4.21	NO	NO	NO	4.04	5.63	0.99	NO	NO	NO	NO	2.17
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	17.00	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	4315.70	4330.20	4323.20	4309.50	4301.91	4300.86	4306.88	4313.41	4312.51	4305.88	4304.18	4321.98	4316.74	4308.24	4287.29	4289.79	4296.42	4279.53
Final area	kha	4330.20	4323.20	4309.50	4301.91	4300.86	4306.88	4313.41	4312.51	4305.88	4304.18	4321.98	4316.74	4308.24	4287.29	4289.79	4296.42	4279.53	4262.09

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.1. Annual land use changes for the 1988-2005 (cont.)

LULUCF category	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2004
GL (unmanaged)																			
Remaining GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
WLs (managed)																			
Remaining WL (managed)	kha	1443.41	1444.79	1449.74	1451.29	1453.74	1454.68	1456.25	1455.81	1458.89	1459.37	1459.47	1459.66	1463.28	1462.57	1462.52	1464.63	1478.04	1481.87
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.39	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	0.01	0.03	0.08	0.02	0.01	0.03	0.04	0.47	0.07	0.20	0.10	0.74	0.68	1.05	1.09	0.85	1.21	1.27
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.24	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	1443.42	1444.82	1449.82	1451.31	1453.74	1454.71	1456.29	1456.28	1458.95	1460.96	1459.57	1460.40	1463.96	1466.85	1463.62	1465.48	1479.25	1483.14
Final area	kha	1444.82	1449.82	1451.31	1453.74	1454.71	1456.29	1456.28	1458.95	1460.96	1459.57	1460.40	1463.96	1466.85	1463.62	1465.48	1479.25	1483.14	1483.63

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.1. Annual land use changes for the 1988-2005 (cont.)

LULUCF category	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
WL (unmanaged)																			
Remaining WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL																			
Remaining SL	kha	1948.10	1959.50	1972.40	1983.02	1995.06	2007.36	2023.24	2034.53	2034.41	2032.71	2034.47	2040.41	2048.90	2028.08	2019.17	2006.87	1998.92	2003.02
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	12.36	15.58	11.37	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	0.00	2.413	3.39	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	28.64	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	1948.10	1959.50	1972.40	1983.02	1995.06	2007.36	2023.24	2034.54	2036.82	2036.10	2034.47	2040.41	2048.90	2056.72	2031.53	2022.45	2010.29	2003.02
Final area	kha	1959.50	1972.40	1983.02	1995.06	2007.36	2023.24	2034.54	2036.82	2036.10	2034.47	2040.41	2048.90	2056.72	2031.53	2022.45	2010.29	2003.02	2009.71

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.1. Annual land use changes for the 1988-2005 (cont.)

LULUCF category	Unit	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
OthL																			
Remaining OthL	kha	286.64	289.84	290.44	291.28	284.76	283.87	276.13	275.41	267.54	262.64	213.29	213.29	215.34	215.34	278.71	178.68	150.34	136.05
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	0.21	6.53	0.88	7.75	0.72	7.86	4.90	49.35	NO	NO	NO	11.12	100.03	28.34	14.29
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.94	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	286.64	289.84	290.44	291.49	291.28	284.76	283.87	276.13	275.41	267.54	262.64	213.29	219.28	215.34	289.83	278.71	178.68	150.34
Final area	kha	289.84	290.44	291.49	291.28	284.76	283.87	276.13	275.41	267.54	262.64	213.29	219.28	215.34	289.83	278.71	178.68	150.34	136.05
Total unmanaged land																			
Remaining Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.1. Annual land use changes for the 1988-2005 (cont.)

[illegible]

Table 5.8.A.2. Annual land use changes for the 2006-2024

LULUCF category	Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
FL (man.)																				
Remaining FL (man.)	kha	9152.32	9163.49	9223.49	9250.76	9275.23	9304.16	9328.68	9353.23	9368.63	9381.84	9381.53	9380.89	9425.23	9433.55	9438.77	9442.44	9449.16	9434.29	9434.45
Converted to FL(unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	0.59	0.60	0.62	0.64	0.55	0.60	0.49	0.50	0.77	0.74	13.64	1.09	0.50	0.53	0.35	0.43	0.95	29.77	0.48
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unman. land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	9152.91	9164.08	9224.11	9251.40	9275.78	9304.76	9329.18	9353.73	9369.40	9382.58	9395.17	9381.98	9425.73	9434.08	9439.12	9442.87	9450.11	9464.06	9434.93
Final area	kha	9164.08	9224.11	9251.40	9275.78	9304.76	9329.18	9353.73	9369.40	9382.58	9395.17	9381.98	9425.73	9434.08	9439.12	9442.87	9450.11	9464.06	9434.93	9471.61
FL(unman.)																				
Remaining FL(unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL(man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (man.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unman.)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unman. land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.2. Annual land use changes for the 2006-2024 (cont.)

LULUCF category	Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CL																				
Remaining CL	kha	14329.35	14278.75	14281.42	14261.48	14216.30	14182.92	14138.13	14103.69	14011.29	13998.72	13979.03	13941.50	13917.88	13884.34	13847.97	13816.06	13773.35	13762.73	13644.64
Converted to FL (managed)	kha	9.06	46.68	21.49	19.27	22.74	19.26	19.29	12.45	10.74	10.27	0.34	34.53	6.81	4.29	3.16	5.91	11.48	0.49	13.72
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	4.18	NO	10.20	12.25	11.46	7.92	6.7950	6.85	NO	NO	30.17	NO	25.40	26.23	30.41	18.49	14.30	0.47	84.91
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.94
Converted to WLs (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	6.40	3.92	3.44	2.06	10.99	6.20	18.7090	15.14	81.66	2.31	13.72	3.00	3.06	3.23	3.48	10.00	16.93	9.66	15.51
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	14348.99	14329.35	14316.56	14295.06	14261.48	14216.30	14182.92	14138.13	14103.69	14011.29	14023.26	13979.03	13953.15	13918.09	13885.01	13850.46	13816.06	13773.35	13762.73
Final area	kha	14329.35	14316.56	14295.06	14261.48	14216.30	14182.92	14138.13	14103.69	14011.29	14023.26	13979.03	13953.15	13918.09	13885.01	13850.46	13816.06	13773.35	13762.73	13710.33
GL (managed)																				
Remaining GL (managed)	kha	4234.58	4210.11	4182.43	4171.28	4167.52	4165.11	4162.78	4155.28	4153.20	4150.13	4159.35	4165.41	4148.37	4155.26	4156.52	4175.91	4198.46	4209.09	4122.55
Converted to FL (managed)	kha	2.71	13.94	6.42	5.76	6.79	5.75	5.7620	3.72	3.21	3.07	0.10	10.31	2.03	1.28	0.94	1.77	3.43	0.15	15.45
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	0.24	13.64	NO	NO	NO	NO	NO	NO	NO	NO	11.65	0.21	NO	NO	NO	NO	NO	63.50
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLs (managed)	kha	1.47	5.39	3.78	1.22	4.66	2.16	1.0330	3.13	NO	NO	1.62	2.38	0.18	0.10	1.93	NO	NO	NO	5.16
Converted to WLs (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	6.69	10.06	3.85	14.38	7.34	5.95	3.4560	1.13	5.72	NO	11.90	13.28	17.26	19.54	22.09	9.25	3.53	3.53	2.90
Converted to OthL	kha	16.64	NO	NO	NO	NO	NO	NO	6.32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	4262.09	4239.75	4210.11	4192.63	4186.32	4178.98	4173.03	4169.58	4162.12	4153.20	4172.97	4203.04	4168.05	4176.19	4181.49	4186.93	4205.42	4212.76	4209.56
Final area	kha	4239.75	4210.11	4192.63	4186.32	4178.98	4173.03	4169.575	4162.12	4153.20	4172.97	4203.04	4168.05	4176.19	4181.49	4186.93	4205.42	4212.76	4209.56	4208.42

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.2. Annual land use changes for the 2006-2024 (cont.)

LULUCF category	Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
GL (unmanaged)																				
Remaining GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLS (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WLS (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
WLS (managed)																				
Remaining WL (managed)	kha	1481.17	1481.04	1484.47	1484.24	1484.35	1487.96	1489.07	1489.06	1487.71	1487.71	1491.07	1492.69	1495.07	1495.25	1495.35	1486.26	1471.62	1470.46	1463.21
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	6.98
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	0.99	NO	NO	2.80	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	11.02	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	1.47	1.60	1.96	1.22	1.10	1.06	1.05	1.05	4.48	NO	NO	NO	NO	NO	NO	NO	14.64	1.16	0.26
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	1483.63	1482.64	1486.43	1488.25	1485.46	1489.02	1490.12	1490.11	1492.19	1487.71	1491.07	1492.69	1495.07	1495.25	1495.35	1497.28	1486.26	1471.62	1470.46
Final area	kha	1482.64	1486.43	1488.25	1485.46	1489.02	1490.12	1490.11	1492.19	1487.71	1491.07	1492.69	1495.07	1495.25	1495.35	1497.28	1486.26	1471.62	1470.46	1472.32

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.2. Annual land use changes for the 2006-2024 (cont.)

LULUCF category	Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
WL (unmanaged)																				
Remaining WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SL																				
Remaining SL	kha	2009.71	2024.86	2041.03	2060.04	2080.44	2104.30	2120.23	2145.62	2157.31	2199.20	2209.03	2248.29	2265.66	2286.47	2307.28	2335.70	2355.39	2380.41	2424.53
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	24.55	NO	NO	NO	NO	2.49	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	22.84	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.36	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	6.13	NO	NO	NO	NO	NO	NO	NO	NO	17.29	NO
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	2009.71	2024.86	2041.03	2060.04	2080.44	2104.30	2120.23	2145.62	2163.44	2249.94	2209.03	2248.29	2265.66	2286.47	2309.77	2335.70	2355.39	2397.70	2424.53
Final area	kha	2024.86	2041.03	2060.04	2080.44	2104.30	2120.23	2145.62	2163.44	2249.94	2209.03	2248.29	2265.66	2286.47	2309.77	2335.70	2355.39	2397.70	2424.53	2446.04

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.2. Annual land use changes for the 2006-2024 (cont.)

LULUCF category	Unit	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
OthL																				
Remaining OthL	kha	136.05	115.13	105.98	103.88	100.01	97.88	96.20	96.20	102.52	101.86	88.34	85.71	83.29	82.62	80.12	80.12	73.87	73.87	84.59
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.00
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	37.56	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.68	NO	NO	NO	NO	2.19
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	13.52	2.63	2.42	NO	NO	NO	NO	NO	0.97
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	9.14	2.11	3.87	2.13	1.68	NO	NO	6.78	NO	NO	NO	NO	2.49	NO	6.26	NO	2.36
Converted to Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area	kha	136.05	152.69	115.13	105.98	103.88	100.01	97.88	96.20	102.52	108.65	101.86	88.34	85.71	83.29	82.62	80.12	80.12	73.87	91.09
Final area	kha	152.69	115.13	105.98	103.88	100.01	97.88	96.20	102.52	108.65	101.86	88.34	85.71	83.29	82.62	80.12	80.12	73.87	91.16	84.59
Total unmanaged land																				
Remaining Total unmanaged land	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to FL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to CL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to GL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (managed)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to WL (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to SL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Converted to OthL	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Initial area (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Final area (unmanaged)	kha	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Acr.: man. - managed; FL - Forest Land; CL - Cropland; GL - Grassland; WL - Wetland; SL - Settlement; OthL - Other Land

Table 5.8.A.2. Annual land use changes for the 2006-2024 (cont.)

[illegible]

Annex 6. Common reporting tables

Common Reporting Tables are submitted as separate files together with National Inventory Document.